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Contraportada: Klara Torres Restrepo
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Contenido

Volumen 77: Suplemento 2, 2024

COPACO 2024-Segundo Congreso Internacional de Producción Animal Colombia

Decano 7

Director de Departamento 7

Comité Organizador 7

Comité de Apoyo 7

Equipo Logístico 8

Pares Evaluadores 9

Prefacio 11

COPACO-2024 -Un encuentro de la academia para la producción animal 11
Guillermo Vásquez Velásquez

Conferencias de Apertura 13

Urban and territorial sustainability: Integrating agricultural production in new ruralities
Sostenibilidad urbana y territorial: Integración de la producción agropecuaria en nuevas ruralidades 15
Carlos M Pérez Nanclares

Bioclimatic and animal production in Colombia: Currently and prospective situation
Bioclimática y producción pecuaria en Colombia: Situación actual y prospectiva 16
Jairo A Osorio Saraz

Integral vision of well-being from the perspective of solutions based on nature and territorial governance
Visión integral del bienestar desde la perspectiva de soluciones basadas en la naturaleza y la gobernanza territorial 17
Juan C de los Rios Cardona

Genomics as a tool for the conservation and use of zoo-genetic resources
La genómica como herramienta para la conservación y aprovechamiento de los recursos zoo-genéticos 18
Juan C Rincón Flórez

Conferencias Egresados 19

Experience in associative work and generation of value in the productive sector
Experiencia de trabajo asociativo y generación de valor en el sector productivo 21
Juan D Zuluaga López

Bees in beekeeping as generators of well-being on different scales
Las abejas en la apicultura como generadoras de bienestar en diferentes escalas 23
Andrea X Montilla Duque

Epigenetic modulators in the *in vitro* production of bovine embryos
Moduladores epigenéticos en la producción *in vitro* de embriones bovinos 24
Rodrigo Urrego Álvarez

Conferencias Intenacionales 25

Animal Welfare in Latin America from a productive approach and in comparison with North America and Europe: Current situation, projections and future from the opinion of researchers
Bienestar Animal en América Latina desde un enfoque productivo y en comparación con América del norte y Europa: Situación actual, proyecciones y futuro desde la opinión de investigadores 27
Juan Pablo Damián

Welfare in commercial poultry farming? past, current and future
¿Bienestar en la avicultura comercial? pasado, presente y futuro 28
Mateo Itza-Ortiz

Commercial egg production systems: Evolution and current situation in Brazil
Sistemas comerciales de producción de huevos: evolución y situación actual en Brasil 29
José Henrique Stringhini

Innovation in livestock production worldwide. The role of the Circular Economy and of Precision Livestock Farming 30
Inovação na produção animal a nível mundial. O papel da Economia Circular e da Zootecnia de Precisão
Vasco Fitas da Cruz

Sistemas agroalimetarios en el hambre cero 32
Juan Zuluaga

Sustainable protein sources for animal feed – insects and their products – the need for a United Kingdom framework 34
Stephen C Mansbridge, Vasil R Pirgozliev, Laura Vickers, Eric Siqueiros, David White, Karl Behrendt, Jane Eastham

Conferencias Nacionales 35

Collective intelligence for agri-food sustainability
Inteligencia colectiva para la sostenibilidad agroalimentaria 37
Martha R Valverde Luna, Juan S Pineda Arango

Animal Welfare´s contributions to Face the Global Challenges at 21st Century
Contribuciones de Bienestar Animal para Enfrentar los Desafíos Globales del Siglo XXI 40
Ricardo Mora Quintero

Chicharrón's Festival - Engine of Sustainable Development and Food Sovereignty in Antioquia
Festival del Chicharrón - Motor de Desarrollo Sostenible y Soberanía Alimentaria en Antioquia 41
Pedro J Madrid- Garcés, Tomás A Madrid-Garcés

Resúmenes

Resúmenes Módulo 1 43
Grandes Rumiantes

Resúmenes Módulo 2 83
Porcinos

Resúmenes Módulo 3 99
Equinos

Resúmenes Módulo 4 105
Avicultura

Resúmenes Módulo 5 123
Pequeños Rumiantes

Resúmenes Módulo 6 135
Piscicultura

Resúmenes Módulo 7 143
Especies Productivas no Tradicionales

Resúmenes Módulo 8 157
Zoocría

Resúmenes Módulo 9 161
Animales de Compañía

Índice de Autores 165

Segundo Congreso Internacional de Producción Animal Colombia - COPACO 2024

Decano

Guillermo Vásquez Velásquez	Decano Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín.	decagron_med@unal.edu.co

Director de Departamento

Albeiro López Herrera	Director del Departamento de Producción Animal. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín.	deproani_med@unal.edu.co

Comité Organizador

Sandra Clemencia Pardo Carrasco	Profesora Departamento de Producción Animal, Facultad de Ciencias Agrarias Universidad Nacional de Colombia sede Medellín. Áreas de experticia: Sistemas de producción acuícola, gestión ambiental de la acuicultura.	scpardoc@unal.edu.co
Verónica González Cadavid	Profesora Departamento de Producción Animal, Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. Áreas de experticia: Reproducción y producción con cerdos, bioclimática y producción pecuaria.	vgonzal@unal.edu.co
Giovanni Restrepo Betancur	Profesor Departamento de Producción Animal, Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. Áreas de experticia: Reproducción y biotecnología animal, criopreservación de gametos y embriones, producción *in vitro* de embriones.	grestre0@unal.edu.co
Jaime Eduardo Parra Suescún	Profesor Departamento de Producción Animal, Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. Área de experticia: Nutrición, salud y microbioma intestinal (monogástricos).	jeparrasu@unal.edu.co

Comité de Apoyo

David Alejandro Hernández Ricaurte	Estudiante del programa Profesional de Zootecnia, asistencia administrativa, apoyo en la operación y logística del congreso. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín.	dahernandezri@unal.edu.co
Óscar Eduardo Yepes Higuita	Estudiante del programa Profesional de Zootecnia, asistencia administrativa, apoyo en la operación y logística del congreso. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín.	oyepes@unal.edu.co
Sara Galeano Montoya	Estudiante del programa Profesional de Zootecnia, asistencia administrativa, apoyo en la operación y logística del congreso. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia.	sgaleanom@unal.edu.co

Equipo Logístico

Santiago Chica Arboleda	Gestor de Proyectos Vicedecanatura de Investigación y Extensión, Unidad de Gestión de Proyectos. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín.	schicaa@unal.edu.co
Miryam Ospina Ocampo	Diseño y Diagramación Revista Facultad Nacional de Agronomía Medellín - Facultad de Ciencias Agrarias, Universidad Nacional de Colombia sede Med	mospina@unal.edu.co

Pares Evaluadores

Albeiro López Herrera: Zootecnista. Médico Veterinario. Magíster en Ciencias. Doctor en Ciencias. Profesor Titular dedicación exclusiva. Director Departamento de Producción Animal, Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. alherrera@unal.edu.co

Ana Cristina Herrera: Zootecnista. Magíster en Biología. Doctora en Genética y Mejoramiento Animal. Postdoctoral Researcher en Solla S.A. anacristinah@gmail.com

Ángel María Giraldo Mejía: Zootecnista. Universidad Nacional de Colombia. Doctor en Ciencias, Universidade Federal de Minas Gerais. Profesor Asociado. Departamento de Producción Animal. Universidad Nacional de Colombia sede Medellín. agiraldom@unal.edu.co

Alexandra Úsuga Suárez: Médica Veterinaria y Zootecnista. Doctora en Biotecnología. Docente Asociada Facultad de Ciencias Agrarias. Escuela de Medicina Veterinaria. Universidad de Antioquia. alexandra.usuga@udea.edu.co

Carlos Abel Maya Ortega: Zootecnista . Magíster en Ciencias Agrarias, Nutrición y Alimentación Animal. Universidad Nacional de Colombia sede Medellín. camayao@unal.edu.co

Cristian Gutiérrez Vergara: Zootecnista. Magíster en Ciencias Agrarias. Doctor en Ciencias Agrarias. Consultor Técnico Comercial en Cerdos para Premex Colombia. ccgutier86@hotmail.com

Diana María Bolivar Vergara: Zootecnista, MSc, PhD. Profesora Asociada. Departamento de Producción Animal. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. dmboliva@unal.edu.co

Felipe Andrés Obando Vega: Ingeniero de Control. Universidad Nacional de Colombia. Magíster en Ingeniería de la Universidad de Antioquia. Doctor en Ciencias Agrarias Universidad Nacional de Colombia. Profesor de la Facultad de Ingeniería de la Universidad de Antioquia

Henry Cardona Cadavid: Zootecnista. Magíster en Ciencias Básicas Biomédicas. Doctor en Genética y Mejoramiento Genético, Universidad de Antioquia. Profesor Facultad de Ciencias Agrarias, Universidad de Antioquia. henry.cardona@udea.edu.co

Jaime Andrés Ángel Isaza: Médico Veterinario y Zootecnista. Magíster en Nutrición Animal, Universidad de Caldas. PhDc. Director de innovación Promitec. jangeli@unal.edu.co

Jorge Mario Cruz Amaya: Médico Veterinario, Universidad de Antioquia. Doctor en Ciencias Veterinarias, Universidad Complutense de Madrid. Docente Asociado. Departamento de Producción Animal. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. jmcrusa@unal.edu.co

Juan Camilo De Los Ríos Cardona: Ingeniero Forestal. MSc y PhD en Desarrollo Rural. Profesor Asistente. Departamento de Ciencias Agronómicas. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín. judelo@unal.edu.co

Juan Pablo Damián: Veterinario. Doctor en Medicina y Tecnología Veterinaria, Universidad de la República. Magister en Ciencias Biológicas, Universidad de la República. Doctorado (PhD) en el Programa de Posgrado de la Facultad de Veterinaria Universidad de la República. Profesor Agregado. Departamento de Biociencias Veterinarias. Facultad de Veterinaria. Universidad de la República, Montevideo 13000, Uruguay. Profesor Agregado. Núcleo de Bienestar Animal. Facultad de Veterinaria. Universidad de la República, Montevideo 13000, Uruguay. jpablodamian@gmail.com

Kelly Vanessa Zapata Carmona: Zootecnista. Magíster en Ciencias, Biotecnología. Estudiante de doctorado en

Biotecnología. Universidad Nacional de Colombia sede Medellín. kvzapatac@unal.edu.co

Tomás Antonio Madrid Garcés: Zootecnista. Magíster en Ciencias Agrarias, Universidad Nacional de Colombia. Especialista en Gerencia de la Universidad Pontificia Bolivariana. Doctor en Biotecnología. Universidad Nacional de Colombia. Decano Facultad de Ciencias Agrarias, Politécnico Colombiano Jaime Isaza Cadavid. tamadridg@unal.edu.co

Víctor Hugo Herrera Franco: Zootecnista. Magíster en Ciencias Agrarias. Doctor en Biotecnología, Universidad Nacional de Colombia sede Medellín, Departamento de Producción animal. Grupo Biodiversidad Genética y Molecular (BIOGEM). vhherrer@unal.edu.co

Mariano Eliecer Acosta Lobo: Biólogo. Magíster en Biotecnología. Doctor en Biotecnología. Docente de tiempo completo en la Institución Universitaria Visión de las Américas. Vinculado a la Facultad de Medicina Veterinaria y Zootecnia. Docente de cátedra en el Posgrado de la Facultad de Ciencias Agrarias de la Universidad de Antioquia. mariano.acosta@uam.edu.co

Mateo Itza Ortíz: Médico Veterinario y Zootecnista. Universidad Autónoma de Yucatán. Magíster en Ciencia Animal, Instituto Tecnológico de Conkal, Yucatán, México. Doctor en Ciencias de la Producción y de la Salud Animal. Universidad Nacional Autónoma de México. Miembro del Registro del Consejo Nacional de Ciencia y Tecnología de Evaluadores Acreditados (RCEA). mateo.itza@uacj.mx

Mónica Andrea Agudelo López: Zootecnista, Universidad Nacional de Colombia. Magíster en Agroindustria Rural, Desarrollo Territorial y Turismo Agroalimentario, Universidad Autónoma del Estado de México. Doctora en Problemas Económicos Agroindustriales, Universidad Autónoma de Chapingo. maagudel@unal.edu.co

Natalia Castrillón Mejía: Administradora Ambiental. Ingeniera Ambiental, Universidad Tecnológica de Pereira. Especialista en Administración y Gestión de Empresas, University of Wales, Institute, Cardiff (UWIC). Especialista en Manejo y Gestión del Agua, Universidad de Antioquia. Magíster en Administración y Gestión de Empresas, University of Wales, Institute, Cardiff (UWIC). Magíster en Medio Ambiente y Desarrollo, Universidad Nacional de Colombia sede Medellín. ncastrillon@alimentoscarnicos.com.co

Sandra Paola Rodriguez Gonzalez: Medica Veterinaria y Zootecnista. MS.c, Ph.D. Docente Universidad Pedagógica y Tecnológica de Colombia UPTC. Docente Universidad de la Salle. sprodriguezg@unal.edu.co

Valentina Montoya Urrea: Zootecnista. Magíster en Zootecnia con énfasis en Etología y Bienestar Animal. Docente catedrática de la Universidad Nacional de Colombia y la Universidad de Antioquia. vmontoyau@unal.edu.co

Viviana Torres Osorio: Ingeniera Biológica, Biología reproductiva, Universidad Nacional de Colombia. Magister en Ciencias. Biotecnología Reproductiva. PhD Biotecnología. Docente Asistente del Programa de Biología. Programa de Ingeniería Biomédica, Universidad CES. vtorreso@ces.edu.co

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PREFACIO

COPACO-2024

Un encuentro de la academia para la producción animal

No podríamos entender la civilización en todo su devenir histórico sin la presencia de los animales, realizada de tan distintas maneras y manifestaciones. La coevolución hombre – animal es cada vez más conocida y demostrada a partir de nuevos hallazgos arqueológicos y biológicos; y no es para más: desde el hombre pre-Neolítico cazador-recolector los animales acompañaron la trashumancia milenaria para explorar nuevos territorios, sin duda también de la misma manera que los cercanos y desaparecidos Neandertales.

Pero sería entonces a partir de la domesticación que las relaciones se establecieron de manera más permanente y segura: mejor que cazarlos, resultaba más exitosa la cría y el levante para la obtención de carne, pieles, leche huevos, así como también su utilización para la vigilancia, la carga y la tracción. Imaginarlo, es un viaje maravilloso a través de 10 mil años de relacionamientos logrados en los tres continentes África, Asia y América, en cientos de culturas y decenas de ecosistemas y ecotonos.

En las sociedades contemporáneas la presencia del animal reviste el primer orden de interés en por lo menos tres aspectos: la seguridad y soberanía alimentaria; la compañía, incluyendo la vigilancia; y la investigación médica. Cierto es que los animales como fuerza de trabajo ha perdido fuerza, aunque se mantiene en algunas culturas campesinas de varios países y culturas de la Tierra.

La proteína animal, así como la leche y sus derivados, los huevos, y las grasas y aceites, son base fundamental de la alimentación humana; en ello se invierten muchos esfuerzos de investigación a fin de mejorar las razas y variedades y, sobre todo, la productividad. Estando en el segundo nivel de la cadena trófica, los animales como heterótrofos dependen de los vegetales para su crecimiento y desarrollo, y este paso tiene un alto costo energético, por lo que la investigación en nutrición animal y en genética es fundamental.

Desde la cetrería usada en los aeropuertos para ahuyentar los animales peligrosos para la aviación; pasando por los perros usados en la inspección de drogas, explosivos, armamentos; y llegando hasta los animales de compañía, perros, gatos y equinos, entre otros, los animales generan muchas manifestaciones de seguridad, afecto, belleza artística y aliciente sicológico.

Cada vez se conoce de nuevos desarrollos en la investigación médica a partir de la genética animal, la secuenciación genómica, la experimentación y el uso de órganos de trasplante modificados o adaptados. Podríamos decir que estamos apenas en los albores de un campo científico inmenso que habrá de contribuir a la salud humana de muchas maneras.

Todas estas interacciones modernas del hombre con los animales tenían que plantearse, a diferencia a como se practicó por décadas, bajo un entorno de consideraciones éticas basadas en el bienestar animal, el buen uso y el manejo, en ese reconocimiento de que son, ante todo, seres sintientes que reclaman derechos de nosotros los humanos que somos, en últimas, sus congéneres coevolutivos en el planeta Tierra.

El II Congreso Internacional de Producción Animal Colombia, COPACO-2024, es la feliz oportunidad para reunir investigadores de Colombia y de otros países invitados para compartir tantos desarrollos investigativos, para conocer y re-conocer la comunidad científica reunida alrededor de temas tan importantes, y para proyectar innovaciones y desafíos que reclama la producción animal. Es por esto que la Facultad de Ciencias Agrarias en sus 110 años de fundación, siendo la más antigua del país en mantener ininterrumpidamente la docencia, la investigación y la extensión en ciencias Agrarias, se honra en ser epicentro de este destacado evento y de recibir de brazos abiertos a los investigadores, profesores y estudiantes, amigos todos de nuestros queridos animales.

Guillermo Vásquez Velásquez
Decano
Facultad de Ciencias Agrarias

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Urban and territorial sustainability: Integrating agricultural production in new ruralities

Sostenibilidad urbana y territorial: Integración de la producción agropecuaria en nuevas ruralidades

Carlos M Pérez Nanclares[1*]

ABSTRACT

The present study explores the interrelationship between the laws of thermodynamics, systems theory, and their application in the configuration of territorial, urban, and architectural spaces, considering current lifestyles. Understanding how these scientific principles can influence the design and functioning of our habitable environments is crucial to promoting sustainability and reducing the entropy generated by human activities. The laws of thermodynamics, particularly the conservation of energy and the increase of entropy, are essential for understanding how urban and territorial systems manage their energy resources. Systems theory offers an integrative perspective to analyze how the parts of a system interact and interrelate, with key concepts such as interdependence, feedback, and entropy being vital to understanding how cities and regions can function as balanced and sustainable systems. In this context, small-scale and sustainable animal production is analyzed as an essential actor in configuring the relationships between territories, using systems theory to define how cities efficiently supply themselves with resources. By integrating sustainable agricultural practices, dependence on external resources can be reduced, and resilient local economies can be fostered while preserving the environment. This approach aligns with the concept of "new ruralities," which redefines the relationships between rural and urban areas, promoting a more harmonious and functional integration. New ruralities involve a variation of norms and the economy that impacts land use in suburban areas or regions near contemporary urban centers. In this context, small-scale animal and agricultural production becomes a key component, allowing the development of green belts around cities, where food production can be more local, sustainable, and less dependent on long supply chains. Moreover, this approach facilitates the implementation of regenerative agricultural practices that improve soil health and increase biodiversity. The variation of urban and economic norms in these areas implies adopting policies that promote urban and peri-urban agriculture, as well as the implementation of infrastructure to support these activities, including the development of local markets, low-emission distribution systems, and the creation of incentives for local farmers and producers. Additionally, land use regulation must be flexible to allow a mix of residential, agricultural, and recreational uses, fostering multifunctional and resilient communities. From an economic perspective, new ruralities promote a development model that moves away from uncontrolled urbanization and sprawling urban expansion, favoring instead planned growth that integrates food production and environmental sustainability into territorial planning. This not only improves food security and local sovereignty but also contributes to reducing the carbon footprint and conserving natural resources. In terms of systems theory, this approach considers the interdependence of urban and rural systems, promoting positive feedback that reinforces the sustainability of both. The integration of animal and agricultural production near urban centers facilitates greater system homeostasis, where energy and material flows are more efficient and less wasteful. This results in a decrease in the total entropy of the system, achieving a more sustainable and resilient balance. In conclusion, the incorporation of sustainable and small-scale agricultural practices within the framework of new ruralities represents an effective strategy to foster urban and regional sustainability. By redefining the norms and economies that impact land use in suburban and peri-urban areas, an environment can be created where local food production not only meets the immediate needs of cities but also contributes to more balanced and sustainable long-term development.

Keywords:
Architectural spaces
Hermodynamics
Lifestyles
Systems theory
Territorial configuration

Palabras clave:
Espacios arquitectónicos
Hermodinámica
Estilos de vida
Teoría de sistemas
Configuración territorial

[1] Facultad de Arquitectura. Universidad Nacional de Colombia sede Medellín, Colombia. ORCID: 0000-0002-1320-2870.
*Corresponding author: cmperezn@unal.edu.co

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Bioclimatic and animal production in Colombia: Currently and prospective situation

Bioclimática y producción pecuaria en Colombia: Situación actual y prospectiva

Jairo A. Osorio Saraz[1]*

ABSTRACT

Colombia, is a country with 114 million hectares, and with a potential use of land in agricultural and animal production of more than 40 million hectares, of which today approximately 34 million are dedicated to livestock, nevertheless, according to UPRA only It has a potential vocation of 15 million hectares suitable for livestock farming and the rest hectares in poultry and pig's production, that's why It shows an inadequate use of the potential of the land. According to ICA, by 2023 the livestock population in the country was distributed in 620.807 properties with 29.642.539 animals, which represents an increase of 1.2% compared to 2022, pork production according to the number of animals was 9.658.204, and the bird's population was distributed in 473.961 properties with 215.217.692 animals. Those potential uses of the land have allowed to the livestock production in the country could tend to grow, especially as it has been happening in recent years, in poultry and pork production, in the function of either national or worldwide population, taking into account that by 2050, it is expected to have close to 10 billion inhabitants, which means that there will be a great demand for food, where animal protein there will be very important. In this way, livestock production in the country must have higher standards of efficiency in its production, greater sustainability, and introducing aspects such as animal welfare, beyond what the country has been making. Therefore, the objective of this work is to show the bioclimatic concept and It is application in Livestock Production, understanding this as the relationship between external and internal climatic and environmental variables inside of any animal facility, which allows the generation of a microclimate where the animals are housed, and It could help them to achieve the maximum performance productively. The Bioclimatic as a science has being applied in developed countries, and today technology and innovation based on Precision Livestock Farming – PLF systems are used, in order to have more sustainable production systems. The context of bioclimatic and its application in animal production in Colombia is not widely applied, that´s why it´s necessary to make major transformations in our production systems, starting with the production facilities and the use of new technologies, in order to take control and make decisions in real time over the microclimatic aerial environments, which presents great challenges for the present and future of the country.

Keywords:
Microclimatic aerial environments
New technologies
PLF systems
Production facilities
Sustainable production

Palabras clave:
Ambientes aéreos microclimáticos
Nuevas tecnologías
Sistemas PLF
Instalaciones de producción
Producción sotenible

[1]Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín, Colombia. ORCID: 0000-0002-4358-3600.
*Corresponding author: aosorio@unal.edu.co

Integral vision of well-being from the perspective of solutions based on nature and territorial governance

Visión integral del bienestar desde la perspectiva de soluciones basadas en la naturaleza y la gobernanza territorial

Juan C de los Rios Cardona[1]*

ABSTRACT

A three-dimensional analysis model is presented that proposes the concept of well-being as the articulating axis of the dimensions: a) animal production; b) human development and c) ecosystem health, a model that is applicable to the context of rural territories in countries like Colombia. It is discussed that the search for well-being in its comprehensive conception ends up being the ideal of every society, although its polysemic meaning makes it susceptible to interpretation and manipulation according to the interests placed by each individual or organization. It is also discussed that animal welfare should be conceived only in a context of human well-being and ecosystem well-being. Therefore, and based on different studies from Colombia, human development indicators (human development index, multidimensional poverty, land concentration, inequality, etc.) and ecosystem health indicators (deforestation, biodiversity, etc.) are presented, which show some positive advances, but unfortunately many of them negative in terms of improving the human and environmental dimensions of well-being, especially in Colombian rural territories. In this context, the objective of the presentation will be to present an intervention model based on the approaches of Nature-based Solutions (NbS) and territorial governance (GT) as an alternative to move towards better well-being, or at least, mitigate the negative impacts on human development and the health of ecosystems of the productivist model of intervention in rural territories that has predominated in Colombia. NBS are presented as solutions that are supported and inspired by nature, are cost-effectives, provide environmental, social and economic benefits and help create territorial resilience; Such solutions provide increasingly diverse characteristics and processes to territories through systemic interventions, efficient in the use of resources and locally adapted (European Commission, 2022). While GT is presented as a set of mechanisms, processes, relationships and institutions through which citizens and groups articulate their interests, exercise their rights and obligations, reconcile their differences in search of a common purpose (UNEP, 1997), it includes arrangements institutional and collective decision-making processes about the territory and its uses, which are characterized by the interaction and articulation of state and non-state actors (DNP, 2017). It is discussed that the integrated vision of the NbS and the GT requires overcoming the predominant perspectives that focus rural development towards sectorial and productivist visions, seeking a transition towards visions with a territorial focus, for which some public policy and intervention instruments will be presented. in the territories that promote this new conception of rural development.

Keywords:
Animal welfare
Ecosystem health
Human well-being
Sustainability

Palabras clave:
Bienestar animal
Salud de los ecosistemas
Bienestar humano
Sostenibilidad

[1]Facultad de Ciencias Agrarias. Departamento de Ciencias Agronómicas. Universidad Nacional de Colombia sede Medellín, Colombia.
*Corresponding author: judelo@unal.edu.co

Genomics as a tool for the conservation and use of zoo-genetic resources

La genómica como herramienta para la conservación y aprovechamiento de los recursos zoo-genéticos

Juan C Rincón Flórez[1*]

ABSTRACT

The genome refers to the totality of DNA present in an organism and contains the information necessary for the development and functioning of individuals, so understanding its composition, structure and function is a focus of current scientific research. The DNA preserves important signs of the evolutionary history of species. In particular, animal genomes have been shaped by different evolutionary pressures, some of which have occurred naturally in a changing environment, while others have been favored and influenced by anthropogenic processes. Domestication is a good example of these pressures and the use, selection and exploitation of animals leaves traces in their genomes. In the same way, environmental deterioration and the reduction of habitats generate changes in the genomes of domestic and wild species. These changes can be studied and this information can be used for conservation and utilization programs for domestic and wild species. With respect to domestic species, there are different locally adapted breeds that are in a critical state of conservation due to the massification and use of a few specialized breeds. These locally adapted resources are valuable and the genetic variants present in them are key in the future, especially in scenarios of accelerated climate change, which would generate extreme conditions and where locally adapted animals, due to their resilience and robustness, can offer alternatives for the production of animal protein. In addition, there are wild animal resources, which have been disappearing at an accelerated rate in recent decades and despite conservation efforts, these are still few considering the magnitude of the problem. In this aspect, one of the greatest difficulties for conservation is that the current status, diversity and the impact that their loss could have on the planet's ecosystems, affecting the ecosystem services they provide, is unknown. In this context, genomics offers a tool for the knowledge of the diversity and status of many domestic and wild animal genetic resources. For this, there are methodologies for identifying genomic variants, such as hybridization methods performed on genotyping chips, which require a priori knowledge of the genome of the species. On the other hand, there are methods based on genotyping by sequencing that can be applied to non-model species. Some of these methods are RADSeq, ddRADseq, NEXRAD, lcWGS and resequencing-WGS. From the genomic information of populations, different methods of population genomics, evolutionary, phytogeography and phylogenetics, landscape genomics and conservation are usually applied in order to identify diversity, gene flow, population structuring, identification of origin and traceability, search for adaptive genes or genes related to resistance or reproduction processes that may affect natural or wild populations. This information can also be used to guide informed reintroduction processes that reduce the risk of introducing exotic genes that may affect the performance of descendants. In addition, the identification of selection footprints in specific populations, the identification of inbreeding, loss of diversity, and studies that relate climatic conditions to genome footprints are becoming relevant in scientific research.

Keywords:
Climatic conditions
Diversity loss
Genome footprints
Inbreeding
Specific populations

Palabras clave:
Condiciones climáticas
Pérdida de diversidad
Huellas del genoma
Endogamia
Poblaciones específicas

[1]Facultad de Ciencias Agropecuarias. Universidad Nacional de Colombia sede Palmira, Colombia. ORCID: 0000-0002-6769-6407.
*Corresponding author: jcrincon@unal.edu.co

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Experience in associative work and generation of value in the productive sector

UNIVERSIDAD NACIONAL DE COLOMBIA

Experiencia de trabajo asociativo y generación de valor en el sector productivo

Juan D Zuluaga López[1]*

ABSTRACT

The rural sector in Colombia faces significant challenges in terms of strategic planning and productivity, which translate into high rates of multidimensional poverty. According to the DANE, only 17% of the productive population receives technical assistance, and more than 85% are small producers, indicating that planning tools at the national and departmental levels suffer from ineffective implementation and their applicability is insufficient to drive significant growth in the national GDP indicators, which barely exceed 7%.

It is important to highlight that in Colombia, there are few successful cases of associativity that achieve a prominent business level and fulfill the social purpose for which they were created. This is due to a lack of professionalism in the administrative management of resources and sound decision-making. It is crucial to understand that associations are businesses and, as such, must be managed to compete in the market and achieve sustainable annual growth, all in compliance with new government regulations, for which many associations are unprepared. Additionally, it is necessary to adapt to changes arising from tax reform, free trade agreements, and the commercial challenges of globalization dynamics.

In this context, cooperativism has emerged as a strategy to generate value and productivity in the rural sector, contributing to the efficiency of production costs for its members, technification, and access to public-private cooperation resources. In my presentation, I will focus on this latter part,drawing on my work experience in the solidarity sector (associations and cooperatives). Considering multiple factors that influence the success of the associative model, I will prioritize the most relevant ones.

The Colombian solidarity sector is fundamental and becomes an opportunity for the country's development, and it is in this context that territorial foresight with an agro-industrial focus gains great importance. In seeking to contribute professionally to the rural sector, the need arises to establish a differential cooperative model that has a significant impact on its development. The impact of this cooperative organization goes beyond improving the quality of life of its members, as it aims to meet the needs of the territories and community organizations by creating a useful and productive organization, facilitating the cohesion of community interests, thus strengthening governance systems, conflict resolution, and building trust to positively impact the action environment. These aspects, along with professional practices focused on administrative and economic systems, are fundamental to ensuring the sustainability of associative models. Additionally, special attention must be given to the transversal factors that ensure the viability of these models, such as marketing and setting fair prices. In summary, the solidarity sector plays a crucial role in rural development by

Keywords:
Multidimensional poverty rates
Planning tools
Rural sector in Colombia
Small producers
Strategic planning and productivity
Technical assistance

Palabras clave:
Índices de pobreza multidimensional
Herramientas de planificación
Sector rural en Colombia
Pequeños productores
Planificación estratégica y productividad
Asistencia técnica

[1]Cooporcicultores. Programa de Zootecnia. Universidad Nacional de Colombia sede Medellín, Colombia, ORCID 0009-0000-1352-7993.
*Corresponding author: juztproductividad@gmail.com

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promoting cooperation, sustainability, productive equity, and fair trade for the dignity of rural labor.
A key factor for the success of the cooperative model is its ability to articulate with public, private, and ONG entities, which becomes a distinctive competitive advantage. However, it is essential to recognize the crucial role of the human factor, management, and leadership in understanding the needs of communities or organizations. This involves knowledge in budget planning, action plans, and investment evaluation, to measure the economic impact and return on investments made in agricultural organizations. It is essential to understand that economic sustainability does not solely depend on management and project formulation with external resources. Therefore, strategies for autonomy must be generated and continuous internal strengthening processes carried out. Experience in the associative sector reveals the diversity of cooperative and associative models, and public policies encourage rural communities to opt for this system to organize themselves. However, this model cannot function in isolation; professional leadership is required that understands, from a technical, administrative, and financial perspective. In a country with multiple needs in rural areas, such as generational succession problems, access road limitations, production costs, and labor availability, it is crucial that agricultural professionals recognize the opportunity to participate in administrative, financial activities, and project formulation. Rural entrepreneurship led by communities, which represent the majority, not only offers professional growth opportunities but also highlights the low economic valuation of professionals in this field. It is often perceived that the best professional scenario is found in the commercial activities of large companies, without considering that the Colombian rural sector possesses a great opportunity from the global food demand and conservation of productive activities. It is recognized that the Colombian productive sector is in a stage of evolution towards technification and specialization. Therefore, it requires interdisciplinary professionals accompanied by associative models to jointly enhance the sector's opportunities.

Bees in beekeeping as generators of well-being on different scales

Las abejas en la apicultura como generadoras de bienestar en diferentes escalas

Andrea X Montilla Duque[1]*

ABSTRACT

Within the different biological groups of pollinators, bees with between 25,000 and 30,000 species are effective agents recognized for their important work in ecosystem services, conservation of diversity, preservation, function and maintenance of ecosystems, production of food and inputs. for various agroindustrial and economic activities worldwide of great importance for the survival of humans and other species. Beekeeping, as an agricultural activity with Africanized bees (*Apis mellifera*), is considered sustainable from its management to its services and products, generating ecosystem, environmental, social, human and cultural well-being. The products derived from this activity represent an effective means of generating income and direct activities for producers that can also be scaled up to transformation processes such as agro-industrial and cosmetics. This is how Ápix, a Colombian beekeeping company and the transformation of hive products into natural cosmetics, works from primary production to their industrialization, generating well-being for those who are part of it and those who benefit. As a result of these processes, from beekeeping and the production chains derived from it, the positive impacts on ecosystem processes, food production and inputs for different industries, social, human, environmental and economic well-being are recognized

Keywords:
Beehive products
Colombian beekeeping company
Ecosystem processes
Natural cosmetics

Palabras clave:
Productos de colmena
Empresa apícola colombiana
Procesos ecosistémicos
Cosméticos naturales

[1]Representante de la empresa Ápix, Medellín, Colombia. Egresada del programa de Zootecnia. Facultad de Ciencias Agrarias. Universidad Nacional de Colombia sede Medellín, Colombia.
*Corresponding autor: amontilladuque@gmail.com; apixempresa@gmail.com

Epigenetic modulators in the *in vitro* production of bovine embryos

Moduladores epigenéticos en la producción *in vitro* de embriones bovinos

Rodrigo Urrego Álvarez[1]*

ABSTRACT

Despite the many improvements *in vitro* production of bovine embryos (IVPE), embryos obtained in vitro differ from those obtained *in vivo*. Differences have been observed at the level of morphology, developmental capacity, freezing survival, metabolic parameters, as well as gene expression profile and changes in methylation patterns. It has been shown that assisted reproduction technologies can generate epigenetic alterations and changes in gene expression in oocytes and embryos, which can generate altered phenotypes in cattle. It is therefore necessary to introduce molecules into culture media that act as epigenetic modulators to mitigate aberrant changes in DNA methylation and gene expression, in order to produce a greater quantity of embryos and of better quality, from bovine females of high genetic merit. There are reports that the use of an epigenetic modulator and antioxidant such as resveratrol in the *in vitro* maturation of porcine, bovine and goat oocytes increases the concentration of reduced glutathione within the oocyte, decreases the production of reactive oxygen spices (ROS) and increases the rate of blastocysts. In addition, our work with resveratrol has shown that during *in vitro* culture of embryos has had a positive effect on embryonic development and an increased in cryo-tolerance of blastocysts, reflecting both a modulating capacity in the epigenetics of cells, and antioxidant in the processes of culture and vitrification of bovine oocytes and embryos. On the other hand, one molecule that has attracted attention in aging research is NMN (nicotinamide mononucleotide), a direct precursor of NAD+, which can efficiently become NAD+ once inside the cell. Decreased intracellular levels of NAD+ have been linked to aging and cell dysfunction, and it has been proposed that supplementation with NAD+ precursors such as NMN could offer beneficial effects on cellular health and longevity. In our work we have found a beneficial effect of supplementation with NMN in the medium of maturation, enhancing cleavage rates and embryonic development. In conclusion, the bovine IVPE is a biotechnology that is used commercially widely throughout the world; however, cultivation media are still susceptible to improvements, epigenetic modulators such as resveratrol and NMN are alternatives that by improving the energy status and antioxidant capacity in cells can lead to improvements in embryonic development rates and mitigate the difference in embryo *in vivo vs in vitro*.

Keywords:
Embryonic development
In vivo
In vitro
IVPE biotechnology
NMN
Resveratrol

Palabras clave:
Desarrollo embrionario
In vivo
In vitro
Biotecnología IVPE
NMN
Resveratrol

[1]Facultad de Medicina Veterinaria y Zootecnia. Universidad CES, Medellín, Colombia, ORCID 0000-0001-5716-5832
*Corresponding author: rurrego@ces.edu.co

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Animal Welfare in Latin America from a productive approach and in comparison with North America and Europe: Current situation, projections and future from the opinion of researchers

Bienestar Animal en América Latina desde un enfoque productivo y en comparación con América del norte y Europa: Situación actual, proyecciones y futuro desde la opinión de investigadores

Juan Pablo Damián[1,2**]

ABSTRACT

For more than three decades, animal welfare in production species has been a topic of great concern for society as a whole, as well as for academia. Latin America has been and continues to be a supplier of raw materials from animals, highlighting the production mainly of meat, milk and eggs, thus contributing to the nutrition of the planet. Based on the great variability that exists in productive species, productive systems, environments and production climates, it is really very ambitious to comment in a few words on how Latin America is in relation to the animal welfare of productive species from the current situation, its comparison with United States and Canada and other continents such as Europe, as well as the projections and future of the sector. In this sense, the objective of this work is to analyse and discuss the opinion of Latin American researchers based on a survey. Based on their responses, the researchers reported on average an intermediate valuation of animal welfare in their country, and very close and without significant differences with respect to the valuation in Latin America. However, the valuation of animal welfare in your country and in Latin America was significantly lower than that of the USA and Canada, and this in turn lower than that of Europe. In addition, 10 questions were asked for the researchers to consider whether certain topics represent a priority and what priority they assign to the productive sector in relation to animal welfare in Latin America for the next 10 years. All topics asked had a medium to high priority for the researchers. However, the priority assessment varied depending on the topic consulted, with the lowest priority being the use of technologies (for example, activity sensors, temperature, heart rate) and the highest priority being the quantity and quality of water and welfare of farmers and animal caretakers. In conclusion, from the perspective of researchers, the situation and valuation of animal welfare of productive species in Latin America is lower than that of the USA and Canada, and this in turn, lower than that of Europe. Among future priorities, although there is great variability, the researchers highlighted the role played by the quantity and quality of water and welfare of farmers and animal caretakers. Latin America faces a significant challenge in improving animal welfare, while balancing production conditions for both animals and farmers, and meeting the demands of the international market, all amidst environmental challenges posed by climate change and global warming. This must be done while safeguarding the sustainability of the systems as a whole, under the concept of 'One Health", "One Welfare".

Keywords:
Climate change
Environmental challenges
Global warming
International market
One health"
"One well-being"

Palabras clave:
Cambio climático
Desafíos ambientales
Calentamiento global
Mercado internacional
"Una salud"
"Un bienestar"

[1]Departamento de Biociencias Veterinarias. Facultad de Veterinaria. Universidad de la República. Montevideo, Uruguay.
[2]Núcleo de Bienestar Animal. Facultad de Veterinaria. Universidad de la República. Montevideo, Uruguay, ORCID 0000-0001-8042-5743.
Corresponding author: jpablodamian@gmail.com

Welfare in commercial poultry farming? past, current and future

¿Bienestar en la avicultura comercial? pasado, presente y futuro

Mateo Itza-Ortiz[1]*

ABSTRACT

The term Poultry is modern, we can say that the feed of products such as eggs and poultry meat has been around since the Neolithic era. The current domestic chickens have their origin from the Bankiva rooster and hen (*Gallus gallus bankiva*) is a subspecies of *Gallus gallus*, the wild Asian ancestor of the domestic rooster (*Gallus gallus domesticus*). Which arrived in Spain through the Silk Road trade, and on Columbus's second voyage (1493) to the American continent. In 1923, the poultry industry began with a 20-year-old woman, Cecile Lang Steele. She raised 20 to 30 dual-purpose birds and mistakenly received 500 chicks instead of the 50 she had ordered, thus beginning the poultry industry. In 1930, the poultry population census showed that the total number of birds in 35 countries was 1,620 million, of which 90%, that is, 1,458 million, were chickens. The United States Government, at the end of World War II, in 1946, created the "Chicken o Tomorrow Contest", which completely changed the poultry industry worldwide. In the 20th century, a great global demand for food products began, there are 23,000 million of chickens on the planet; that is, more than three times the human population; Hence many scientists say that we are living on the "planet of chickens" and that these same chickens serve to feed the planet's population. Currently (2023), almost 60,000 million of chickens are fattened per year and about 4,500 million of hens lay more than 300 million dozen eggs per day. The fundamental question of animal welfare is whether it is related to production because production is inherently related to the amount of product produced (meat or egg) and is related to the productivity and profitability of the company. And indeed, a healthy and uncomplicated bird is more productive, therefore, no producer should compromise the well-being of his flock. Animal welfare, and particularly in the poultry, is a complex issue with multiple scientific, ethical, economic, cultural, social, religious, and political dimensions. This is an issue that arouses growing interest in civil society and constitutes one of the priorities of the World Organization for Animal Health (WOAH); However, consumers value the welfare of poultry, so producers who ensure the welfare of their flocks may have better market access. Food security must guarantee food for the planet and poultry production is essential, producing meat and eggs in free-range environments is more expensive per square meter compared to a cage, and the consumer will have to pay the difference in prices. But where this context really takes us, 100% of the cages can be eliminated or there will be changes in their designs without ceasing to be cages.

Keywords:
Cages
Food safety
Free environments
Meat and egg production
Poultry production

Palabras clave:
Jaulas
Seguridad alimentaria
Entornos libres
Producir carne y huevos
Producción de aves de corral

[1]Departamento de Ciencias Veterinarias. Universidad Autónoma de Ciudad Juárez, Chihuahua, México, ORCID 0000-0003-0313-586X.
*Corresponding author: mateo.itza@uacj.mx

Commercial egg production systems: Evolution and current situation in Brazil

Sistemas comerciales de producción de huevos: evolución y situación actual en Brasil

José H Stringhini[1]*

ABSTRACT

The commercial egg laying sector was one of the most evolved in the world, and consequently in Brazil. The country today is the seventh egg producer in the world and has modified its production pattern mainly regarding the production systems. Chronologically, four periods of egg production can be characterized (Windhorst, 2017): 1. first steps in intensive breeding (before 1930); 2. beginning of modern production (1930–1960); 3. spread of intensive egg production (1960-2000); 4. Trends in animal welfare and sustainability (2000-present). It is possible to verify the use of different forms of hosting. In the cage system, conventional cages, enriched or enrichable collective cages can be used. In the aviary system, nests or mixed vertical or horizontal systems can be used. Regarding systems with access to external areas, Free-range systems, aviaries with solariums or paddocks can be observed. In these last systems, organic production systems can be characterized, if dietary standards and use of medicines are met. In Brazil, cage production systems are still the vast majority, and the Instituto Ovos Brasil estimated that only 2% of the total eggs produced in the country come from non-cage systems. These systems require modern installations, but EMBRAPA points out some important trends in Brazilian laying poultry farming: 1. trend towards automation of the laying system; 2. automatic egg collection; 3. automatic feeding; 4. monitoring of environmental conditions inside the warehouses; 4. Alternative or conventional cages; 5. High housing densities of laying hens. Therefore, it is important to discuss not only the production systems, but also the quality of the eggs produced in this system. Consumers have become increasingly interested in seeking more sustainable alternatives that comply with established criteria for maintaining animal welfare. According to the Brazilian Animal Protein Association (ABPA), Brazil jumped from *per capita* consumption of 168 eggs in 2013 and reaching 257 eggs in 2021, being one of the most consumed foods during the pandemics, maintaining slightly lower values, of 242 eggs per consumer in 2023. This shows the importance of carefully evaluating the quality of eggs offered to consumers and the means of connecting production systems with consumers' desires. Some commercial establishments in Brazil, as well as in different countries around the world, have prioritized companies that are concerned with production criteria and the physical and sensorial characteristics of eggs, including shell and yolk colors. However, costs have been a major challenge in Brazil, since in different systems, both equipment costs and production density, especially the number of birds per unit area. Another major Brazilian challenge is the exportation of eggs, as international demand for this food has increased in recent years, and Brazil has great potential to meet these demands. However, according to ABPA, only 1% of Brazil's total production was exported in 2023, but the amount sent to other countries practically doubled compared to 2022. Therefore, discussing these systems in Brazil and around the world becomes important to guide the next steps in the evolution of egg production and quality in Brazil and around the world.

Keywords:
Animal welfare
Intensive farming
Layers
Modern production
Sustainability

Palabras clave:
Bienestar animal
Cría intensiva
Ponedoras
Producción moderna
Sostenibilidad

[1]Departamento de Zootecnia. Escola de Veterinária e Zootecnia. Universidade Federal de Goiás, Campus Samambaia, Goiânia, 74690-900, Brasil, ORCID 0000-0002-3710-6963.
*Corresponding author: henrique@ufg.br

Innovation in livestock production worldwide. The role of the Circular Economy and of Precision Livestock Farming

Inovação na produção animal a nível mundial. O papel da Economia Circular e da Zootecnia de Precisão

Vasco Fitas da Cruz[1]*

Keywords:
Efficiency
Future
Livestock
News
Projects
Sustainability

ABSTRACT

The consumption of animal protein is, at the moment, one of the aspects that most concerns public opinion, which influences political power, leading to the production of legislation in many regions of the world, with Europe at the forefront, almost daily, whose main objective is to regulate animal production, imposing a series of restrictions on its development. This legislation is based on three main areas of action: Public Health and Food Safety, Environmental Protection and Animal Welfare. However, other aspects such as the resilience of productive systems to climate change (either through the adaptation of animals or through the adaptation of their inherent systems and infrastructures) and the economy should not be ignored (Profitability) of the systems, when we intend to have a sustainable animal production taking into account the three pillars of sustainability: environmental, economic and social. Currently there are two technical-scientific areas, innovative, that allow us to continue producing animals in a sustainable way. They are the Circular Economy and the Precision Zootechnics. The Circular Economy moves away from the concept of Linear Economy. In the Linear Economy raw materials are extracted, transformed and used and then removed, leading to the depletion of the planet's natural resources. Por otro lado, la Economía Circular se centra en preservar y valorar el capital natural y minimizar el desperdicio centrándose en "cerrar el ciclo" en toda la cadena de valor (desde la etapa inicial hasta la etapa final). Este enfoque innovador también abre excelentes perspectivas para las llamadas simbiosis industriales, es decir, cuando dos cadenas de valor trabajan en simbiosis, aprovechando una lo que la otra quiere eliminar. On the other hand, the Circular Economy focuses on preserving and valuing natural capital and minimizing waste by focusing on "closing the cycle" across the entire value chain (from the initial stage to the final stage). This innovative approach also opens up excellent prospects for so-called industrial symbiosis, that is, when two value chains work in symbiosis, taking advantage of what the other wants to eliminate. The main objective of the Circular Economy is to improve the efficiency of production systems. It adopts two basic principles: "do more with less" and "waste are resources". Precision Husbandry, internationally known as Precision Livestock Farming (PLF), is understood, in a very general and integral way, as the application of technology and engineering processes in the management of animal production. More precisely, Precision Zootechnics can be defined as the management of animal production that is based on the principles and technology of Process Engineering, being the main means through which the use of 'intelligent' sensors will occur. Based on automatic and continuous monitoring of animals and related physical processes, precision husbandry treats animal production as a set of interconnected processes, where animals are continuously monitored, as well as all processes involved in their handling, in an environment in which decisions are made. and control is performed 24 hours a day. Today, the use of integrated solutions is the innovative path to sustainability.

[1]Departamento de Engenharia Rural. Instituto Mediterrânico para a Agricultura, Ambiente e Desenvolvimento-MED. Universidade de Évora, Portugal, https://orcid.org/0000-0002-2711-4492.
*Corresponding author: vfc@uevora.pt

The adoption of integrated solutions of Circular Economy and Precision Zootechnics allows to respond to the following concerns related to animal production: Consumers demanding the quality of food products and animal welfare; increasingly stringent environmental and animal welfare legislation and regulations; environmental sustainability and the adoption of productive practices that reduce the ecological footprint combined with the constant need to rationalize costs and increase efficiency in the use of productive factors and value chains. In this way, it is possible to identify a set of needs and opportunities to address these concerns, which include: The potential of Precision Zootechnics to improve animal welfare and improve production results, the difficulties faced by the Precision Zootechnics in analysing, in a simple way, the complex interactions between the animal and the environment, the need to adopt new ways of acquiring environmental information and monitoring the behaviour and health of animals, that is, those who can operate in real time (Real Time), the opportunity offered by Artificial Intelligence in manipulating huge volumes of data, by using so-called BigData systems. The agri-food sector, which includes animal production, is perhaps the most capable of adopting Circular Economy practices, with special emphasis on establishing industrial symbiosis. Waste management must be carried out according to a hierarchy (the 3 Rs) that begins with the use of good practices that prevent or lead to a reduction in their production, through reuse and recycling, avoiding as much as possible their disposal. Therefore, the recovery of waste, based on recovery processes, is the way forward for proper management. In the European Union, in accordance with the European Circular Economy Plan, the forms of recovery (agronomic, organic or biotechnological and energy) of the by-products, meaning by-products the recovered waste, follow a hierarchy where agronomic valuation should be privileged and energy recovery should be avoided (processes such as incineration or pyrolysis involving a high level of greenhouse gas emissions). As regards animal production, the most representative examples of the agronomic recovery of livestock effluents (slurry and manure) are their application, directly or in the form of compost, to soils, since this practice improves chemical properties (increased organic matter) of the soil and, in the case of compost application, its physical properties (texture) and water retention capacity can also be improved. As for organic or biotechnological valorization, the best known way to do this is the production of biogas (methane plus carbon dioxide) by integrating slurry into anaerobic digestion processes (biomethanization). Today too, the processes for extracting valuable biochemical elements from the blood, bones, fat and intestines of animals are a reality. It is also a reality to obtain animal protein provided by insect larvae fed in compost piles (vermicompost). The future of animal production depends on precision zootechnics. The scope of this new science is quite broad. You can focus on the analysis of the production system as a whole where the focus could be on grazing systems (use of virtual fencing, for example)integrated management of the entire production system through software specifically developed for this purpose (intelligent platforms for monitoring the performance of poultry facilities, for example) or analysis of the operation of installations and equipment and the automation systems connected to them, such as the use of mechanical milking robots. Another focus will be the analysis of the animal itself, based on the principle of "treating differently what is different". In this case, there are solutions that allow us to focus on an individual animal (dairy cow or breeding sow) or on the handling of group animals (meat chickens or pig feeders). The GOEfluentes - Livestock Effluents project: strategic approach for the agronomic/ energy valuation of the flows generated in livestock activity, coordinated by the National Zootechnical Station with the participation of the University of Évora, continued by the LivingLab project - Effluents and Co-products the livestock activity (PRR-CO5-i03-I-000218) and the AWARTECH project - Real-time adjustment of the environmental conditions of accommodation taking into account animal welfare, coordinated by the University of Évora, show excellent examples of innovative and inclusive practices. based on best available techniques, likely to be used in future animal production systems.

Palabras clave:
Eficiencia
Futuro
Ganadería
Novedad
Proyectos
Sostenibilidad

Sistemas agroalimetarios en el hambre cero

Juan Zuluaga[1]

El concepto de sistema agroalimentario territorial, se presenta como una apuesta teórica y práctica para integrar elementos que se transfieren, se mezclan y se transponen en diferentes áreas, los cuales conforman un sistema de actividades cuyo objetivo común es proporcionar los alimentos que una determinada sociedad demanda, estas acciones se desarrollan en espacios sociales marcados por condiciones ambientales, económicas y políticas. De esta manera, se conforman espontáneamente encadenamientos y redes entre diferentes actores, con diferente funcionalidad, estableciendo relaciones de cooperación y competencia[2], que a su vez se encuentran inmersas en las dinámicas sociales que otorgan particularidades a cada territorio.

Al relacionar la anterior conceptualización, con el objetivo de la seguridad alimentaria trabajado por FAO, el cual tiene como epicentro poder garantizar que todas las personas tengan, en todo momento, acceso físico y económico a los alimentos básicos que necesitan[3]. Emerge una urgencia manifiesta, especialmente en los países latinoamericanos, donde los niveles de pobreza desbordan lo admitido por una sociedad justa e incluyente, de consolidar un sistema agroalimentario que tenga como base elementos de liderazgo gubernamental en los procesos de producción, circulación y comercialización de bienes alimentarios, es decir, política pública para el abastecimiento, que garantice el acceso y disponibilidad y reconozca factores ambientales y culturales, sin que esto implique intervenir el mercado de forma directa, ni crear mecanismo de subvención que generen dependencias insostenibles con el Estado.

Inicialmente se debe comprender el territorio como un espacio de relaciones sociales, producto de una red construida y atada a una acción colectiva, generando lazos de solidaridad y conflicto entre las personas, las instituciones y el medio ambiente. Consecuencia de lo anterior, el territorio es valorizado de acuerdo a su capacidad de soporte de la "materialidad", es decir, de las objetos físicos y de las actividades productivas, dentro de las que se encuentran inmersas la producción, circulación, comercialización y consumo de bienes alimentarios, así como de aquellas dimensiones "inmateriales" vinculadas al desarrollo de una "cultura propia".

Una visión de ciudad región permite reconocer necesidades, sin que estas estén ponderadas necesariamente por el tamaño de la población, asimismo, se debe considerar que solo será posible la constitución de un sistema resiliente y sustentable, que de valor a los servicios ecosistémicos, si las relaciones establecidas entre territorios, son de tipo simbiótico, es decir, que estas se encuentren basadas en condiciones de justicia espacial, social y económica. En consecuencia, se deben iniciar procesos que consoliden una economía solidaria que sirva de base para el sistema agroalimentario y que valore la naturaleza como sujeto activo y no como un objeto pasivo, reconociéndole derechos al interior del sistema de relaciones sociales, lo anterior se podrá alcanzar construyendo redes de producción y consumo mediadas por la acción estatal a través de planes, programas y proyectos integrados a una visión amplia de la seguridad alimentaria y, a su

[1]Coordinador Territorial FAO Naciones Unidas.
Corresponding author: juzulu79@gmail.com

vez, sean el resultado de mecanismos de dialogo entre instituciones y sociedad.

Es importante entonces, la reivindicación del derecho a la alimentación, por medio del cual se garantice, a través de planes, programas y proyectos, agrupados por medio de una política pública amplia y, a su vez compacta, que visibilice las acciones necesarias para garantizar la disponibilidad y acceso de alimentos saludables para toda la sociedad, sin olvidar que la educación alimentaria permite darle sostenibilidad al sistema. Por tanto, se debe entender que la gobernabilidad generada en todas las escalas, debe garantizar unicidad técnica y brindar una base jurídica, que permita a las instituciones trazar objetivos comunes y no individuales.

Por otro lado, el fortalecimiento de la institucionalidad rural, es fundamental para garantizar que al interior del sistema agroalimentario se generen relaciones de equidad que le permitan ser sustentable y sostenible, para lograr lo anterior se deben tener en cuenta, entre otras cosas: factores ambientales que le otorguen a la naturaleza su verdadero valor, más allá de ser simplemente una fuente de recursos, como ya fue expresado en líneas anteriores, además es fundamental que la formulación de políticas rurales, dejen de lado la lógica asistencialista y garanticen de manera continua, el acompañamiento técnico para lograr una producción basada en las Buenas Prácticas Agrícolas, para lo cual es necesario superar la visión netamente productivista y darle un valor preponderante a los procesos de transformación y comerciales, integrando de forma directa al consumidor a la cadena de valor, es decir generando un consumo responsable que valore social y económicamente los esfuerzos de cada uno de los actores del sistema, especialmente de los pequeños productores.

Por consiguiente deben valorarse los territorios más allá de su funcionalidad al interior del sistema agroalimentario, es decir no se deben reconocer como lugares geográficos aislados, los cuales se encuentran habitados por productores y consumidores de alimentos, se deben reconocer los lazos existentes y pocas veces percibidos, de forma tal que la política pública conduzca a acciones que superen la visión localizada de la intervención y logren articularse de forma más contundente, permitiendo de cierta manera dinamizar y regular las fuerzas del mercado que se encuentran sometidas a la posición hegemónica de los actores que se encargan de la logística y la comercialización de alimentos.

En síntesis, la visión de sistemas agroalimentarios territoriales debe facilitar la integración, organizar la intervención y promover la inclusión, adicionalmente permitir una observación al sistema, ubicando puntos débiles que lleven a intervenciones directas, generando claridad sobre los actores que participan, posibilitando un mapeo espacial y funcional, para entender los cambios y determinar sus efectos por medio de la ponderación y evaluación de eventos al interior de los territorios, todo lo anterior se traduce en la posibilidad de tener una herramienta territorial para la compresión de una estructura social que se encuentra influenciada por las relaciones generadas en la necesidad de tener acceso y disponibilidad de alimentos para lograr hambre cero.

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Sustainable protein sources for animal feed – insects and their products – the need for a United Kingdom framework

Stephen C Mansbridge[1]*, Vasil R Pirgozliev[2], Laura Vickers[3], Eric Siqueiros[4], David White[5], Karl Behrendt[6] and Jane Eastham[7]

ABSTRACT

Keywords:
Alternative protein
animal nutrition
Black Solider Fly larvae
Net zero
Pig production
Poultry production

Introduction: Sustainable protein sources can contribute to achieving net zero carbon and global warming mitigation in pig and poultry production. In the United Kingdom (UK), soybean (*Glycine max*) meal is the main protein source used in non-ruminant livestock feed, however, due to the UK climate being adverse for soybean production, soya is almost exclusively imported. Particularly where this imported soya is associated with land use change then its contribution to carbon calculation values and other sustainability metrics is unfavourable. Alternative protein sources to soya, including insects, are therefore of great interest to the UK animal feed industry. **Insects as animal feed:** At present (2024) it is only legal in the UK to feed live insects and insect fat to pig and poultry livestock, resulting in limited applications and quantities available and produced for the UK market. Live larvae can be fed to pigs and poultry *ad libitum* or in small amounts (<10% of daily feed intake) for enrichment or supplementary feeding without dietary reformulation, however, care must be taken to ensure the overall diet fully meets the animals' nutritional requirements, whilst being considerate to the environment (e.g. not excessive in protein or energy). In addition, the production standards and feedstock used for the rearing of insects for animal feed are controlled by UK regulations and retained EU legislation, reducing feed material available for insect feedstock. These restrictions limit access to insect meal (processed animal protein), and constrain the development of the insect animal feed industry within the UK to using greater inclusion levels (>10% of daily feed intake) in formulated pig and poultry diets. It is therefore important that feed business operators are supported to understand the opportunities and requirements to produce safe insect products for the UK market. **Conclusion:** Informed workflows and a modular insect farming approach that is configurable to produce animal feed grade live larvae and processed insect products (when the UK regulations permit) should be developed to support the UK market for insects and insect products as alternatives to soybean meal for non-ruminant livestock.

[1]Harper Adams University, Shropshire, TF10 8NB, United Kingdom; [1]ORCID 0000-0003-4246-9782, [2]ORCID 0000-0002-4213-7609, [3]ORCID 0000-0002-7709-6712, [4]ORCID 0000-0002-0053-2686, [5]ORCID 0000-0001-5282-1247, [6]ORCID 0000-0003-2905-4996, [7]ORCID 0000-0003-2021-5589
*Corresponding author: smansbridge@harper-adams.ac.uk

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Collective intelligence for agri-food sustainability

Inteligencia colectiva para la sostenibilidad agroalimentaria

Martha R Valverde Luna[1]*, Juan S Pineda Arango[1]

ABSTRACT

In the agri-food sector, inefficient data management between organizations and producers creates a disconnect that negatively impacts the efficiency and sustainability of the supply chain. This disconnect compromises operations, limits analytical capacity for strategic decision-making, and deteriorates the quality of service to the producer. In response to these challenges, In-Ova Inteligencia Colectiva has designed a digital ecosystem that revolutionizes data management in agriculture, optimizing real-time data collection and analysis, automating report generation, and improving direct communication with producers through advanced tools like WhatsApp. This system not only enhances collaboration and mutual learning among stakeholders but also drives sector sustainability. A notable success case is our collaboration with the Girardota municipality. Through collective intelligence, we have identified and closed critical gaps with over 1,500 rural families, attracting strategic partners to address these gaps and significantly improving their access to technical, financial, commercial, and environmental services. For instance, we implemented short marketing circuits, connecting 1,500 producers with 250 local stores, a highly effective model recognized by the FAO, which optimizes profits and contributes to reducing the carbon footprint. Additionally, data management inspired the development of initiatives such as the coffee laboratory and the chicharrón festival, two essential chains for the regional economy. In terms of environmental gaps, through the use of environmental mapping and satellite data, we have managed the location of producers in relation to protected areas, preventing practices that could harm natural reserves. We also identified producers without septic tanks on a satellite map and their negative impact on rivers, which supported environmental programs for these families. Our work with Alpina also illustrates how advanced technology can transform the agri-food industry. We developed machine learning algorithms to predict the impact of climate change on milk production, optimizing purchases and preparing the company for market fluctuations with 98.5% accuracy. The recent project with the Colombian Agricultural Institute (ICA) demonstrates additional transformative potential. We digitized field processes, improving operational efficiency by 40%, which will be scaled to 4,000 professionals with over 1,500 field processes. Additionally, the producer experience will be optimized through WhatsApp with Chat GPT 4.0, handling up to 2 million PQRS, and allowing for real-time notifications of officially controlled diseases. These collective efforts, aligned with Sustainable Development Goal #17—Partnerships for the Goals—demonstrate that strategic collaboration can catalyze significant and lasting change. In-Ova's focus on collective intelligence not only transforms the agri-food landscape but also prepares the sector for a more productive and sustainable future, showcasing that technology and cooperation can reshape the agri-food landscape towards a more sustainable and productive future.

Keywords:
Agri-food landscape
Collective intelligence
Strategic collaboration
Sustainable and productive development

Palabras clave:
Paisaje agroalimentario
Inteligencia colectiva
Colaboración estratégica
Desarrollo sostenible y productivo

[1]In-Ova SAS, Colombia. ORCID: 0009-0004-8837-7730; 0009-0002-1424-560X
*Corresponding author: copaco_med@unal.edu.co

Animal Welfare´s contributions to Face the Global Challenges at 21st Century

Contribuciones de Bienestar Animal para Enfrentar los Desafíos Globales del Siglo XXI

Ricardo Mora Quintero[1]*

ABSTRACT

Keywords:
Agricultural frontier
Animal feed
Animal welfare
Biodiversity loss
Public health
Sustainable future

The 21st century has been characterized by the emergence of complex phenomena that have questioned the way humanity has managed agricultural and livestock production systems, this being the result of centuries of development of agro-industrial production techniques that seek to satisfy the growing demands of nutrients, particularly protein and derivatives of products and by-products of animal origin.

In recent years, meat production and demand has grown significantly; by 2018, meat production was 470% higher than 50 years ago, having increased from 70 million tons annually to more than 330 million tons achieving this through farming industrialization. A good example of one of the areas with the greatest growth is fish farming, which grew rapidly during this period, multiplying by 50, which means that it went from 2 million tons to more than 100 million tons per year [1]. The industrialization of animal production has surpassed demographic growth: the world population doubled, in the same mentioned period.

By reviewing the figures related to animal protein global average consumption, it is evident that per capita meat consumption has doubled in the last 30 years [2]. For those high-income countries, meat consumption for 2019 was: (USA: 101Kg, Australia: 90 kg, Israel 90 kg, New Zealand: 75 kg, Canada: 70 kg and United Kingdom 61.5 kg) [3].

For the countries of the region, Argentina (88 kg), Chile (81 kg), Brazil (79 kg) stand out, and in countries like Peru there is a substantial increase in meat consumption, close to 2 kg/capita/year. In the case of the most populated country in the world, China, total annual consumption is almost a third of the world's meat, representing a third of the growth in the last 20 years, with a per capita meat consumption of 46 kg.

Palabras clave:
Frontera agrícola
Alimentación animal
Bienestar animal
Pérdida de biodiversidad
Salud pública
Futuro sostenible

According to BBFAW statistics, by 2023 a total of 92 billion land animals were produced to obtain animal protein, this represents a significant increase compared to the estimated figure for 2021 of a total of approximately 80 billion land animals; composed for 69 billion chickens; 1.5 billion pigs; 656 million turkeys; 574 million sheep; 479 million goats; and 302 million cattle [4]. In addition, a large increase in the number of fish from fish farming is notable, since by 2021 the global fish consumption was around 80 million tons of fish coming from technical fish production systems [5]

[1]International Farming Team World Animal Protection, Colombia.
*Corresponding author: rmoraquinteros@gmail.com

and according to the BBFAW for 2023 the estimated number of fish from fish production systems is 124 billion animals.

This industrialized animal production entails great global challenges, such as the search for sufficient food to meet the requirements of animal diets. The use of soy, corn, and sorghum as the main dietary components used for poultry and pig farming stands out.

The increase in consumption has led the planet to uncontrolled animal production, which is currently affecting the environment, associating soy crops (for example: with forest fires, deforestation and impact on the most fragile biomes necessary for the subsistence of our planet, such as the Amazon region, and Cerrado in Brazil).

Improvements in animal welfare pose a solution as they promote more sustainable animal production, focused on the quality of the final product and offering the consumer alternatives that allow reducing the impact on the environment, as the case of silvopastoral and agroforestry systems, which have promoted efficient solutions; which accompanied by more conscious and responsible consumption, manage to give signs of a more promising future for people, animals and the planet.

Another solution that animal welfare offers as a tool to face the great challenges of the 21st century, is its predominant role as a factor in the fight against antimicrobial resistance (AMR). In most Latin American countries, the use of antibiotics as growth promoters in intensive animal production systems is allowed, where the systemic and prophylactic use of antibiotics is allowed, which generates great challenges to keep the possibility of creating low resistance to antimicrobials and contaminate with AMR sources of water, soil, subsoil, crops and in general food from production systems with traceability failures or that may be associated with cross contamination.

Currently, it is estimated that 73% of all antibiotics available in the world are used in intensive production systems [6], and that this value will continue to increase as the demand for “cheap” animal protein increases, low- and middle-income countries to which intensive production has been migrating, given its potential for expansion and lack of regulations on the matter.

In 2010, the five countries with the highest proportion of global antimicrobial consumption regarding animal production were: China (23%), USA (13%), Brazil (9%), India (3%) and Germany (3%), all of them countries associated with the highest concentrations of intensive animal production systems.

As low- and middle-income countries are expected to shift to more industrial livestock systems, the total use of antibiotics in animal production is expected to increase by 11.5% between 2017 and 2030, rising from a total of more than 93,000 tons to more than 104,000 tons [7].

By improving animal welfare conditions in these production systems, for example, replacing individual gestation crates in swine production by group gestation systems, or increasing forage-based feeding and giving more space to animals that are at overcrowded conditions or extreme confinement in barren environments; the general level of mental and physical health of animals can be improved, requiring treatments with the use of antibiotics only for those animals that are sick and keeping the vast majority of the population in better conditions of health and welfare.

Finally, the response of investors and consumers (in specific markets) to the challenges related to improving animal welfare conditions is generating pressure for the food-related services industry such as supermarket chains, restaurants, hotels, casinos, among others, to have serious commitments in animal welfare, leading producers, packers and marketers to establish better animal production and welfare policies and practices in line with the current reality to guarantee the improvement of animal welfare standards. As a proof of this trend, the development of reports such as the Business Benchmark for Farm Animal Welfare [8] (BBFAW), a tool that allows investors and consumers since 2012 to get first-hand information about what are the progress in animal welfare policies and practices of the main food industry players (farming, and marketing of animal origin food) in terms of those that publicly mention their progress on addressing animal welfare´s issues and compare it with concrete evidence in this regard. The report maintains that for 95% of the companies presented, animal welfare is a sensitive issue for business and 25% of companies have recognized that there is a need to reduce dependence on animal products.

In conclusion, in the face of the great challenges of the 21st century such as deforestation and damage to ecosystems for crops used for animal feed, the loss of biodiversity in areas of expansion of the agricultural border, threats to public health due to of resistance to antimicrobials and the appearance of other diseases and viruses that originate in animals and that may be zoonotic in nature, animal welfare represents a solution for the improvement of animal production techniques and is being recognized by consumers, investors and the food industry (associated with animal products) as a key piece that allows a more sustainable future for our planet, people and animals.

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Chicharrón's Festival - Engine of Sustainable Development and Food Sovereignty in Antioquia

Festival del Chicharrón - Motor de Desarrollo Sostenible y Soberanía Alimentaria en Antioquia

Pedro J Madrid-Garcés[1]*, Tomás A Madrid-Garcés[1]*

Keywords:
Culinary heritage
Cultural valorization
Economic growth
Environmental sustainability
Pork belly

ABSTRACT

The Festival del Chicharrón in Antioquia is a registered trademark that represents an important celebration that goes beyond the simple tasting of a traditional dish. This event has become a key element for economic development and the promotion of food sovereignty in the region, addressing both the valorization of local products and the integration of various links in the pork production chain. By fostering short marketing circuits, the festival ensures that economic benefits remain within the community, supporting small and medium-sized producers and facilitating access to fair and sustainable markets.

The Festival del Chicharrón not only stands out for its contribution to the local economy, but also for its impact on cultural preservation and social integration in Antioquia. It acts as a platform that unites culinary tradition with gastronomic innovation, encouraging restaurants and consumers to opt for local and sustainable raw materials. This initiative not only competes with globalized foods that use imported ingredients but also promotes conscious and responsible consumption.

Furthermore, the Festival del Chicharrón serves as a vehicle for educating about sustainable food consumption and production practices. By promoting the circular economy and reducing the carbon footprint through proximity circuits, it not only improves food security but also strengthens cultural identity and promotes social cohesion. This event allows the people of Antioquia to reflect on their role in the consumption chain and make decisions that benefit both the environment and the local economy.

Palabras clave:
Herencia culinaria
Valorización cultural
Crecimiento económico
Sostenibilidad ambiental
Chicharrón

In summary, the Festival del Chicharrón in Antioquia is more than a festivity; it is a strategic initiative that integrates economic development, environmental sustainability, and cultural valorization. It represents a model of how traditions can be adapted to promote a more prosperous and sustainable future, demonstrating that culture and gastronomy can be pillars of comprehensive and lasting development in the region.

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Humanas y Económicas, Colombia, ORCID 0000-0002-3848-2880, 0000-0002-4191-2343
*Corresponding author: pjmadridg@unal.edu.co, tamadridg@unal.edu.co

RESUMENES

MÓDULO 1

GRANDES RUMIANTES

EXTENSIÓN RURAL

Knowledge and use of the totumo tree (*Crescentia cujete*) in rural communities of the Colombian Caribbean

Conocimiento y uso del árbol del totumo (*Crescentia cujete*) en comunidades rurales del Caribe colombiano

Luz M Botero Arango[1]*, René M Patiño Pardo[1] and Sergio Montoya Botero[1]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0000-0002-4540-7352, ORCID 0000-0001-6137-6384, ORCID 0009-0008-7087-4308.
*Corresponding author: lbotero15@gmail.com

Introduction: The different parts of *Crescentia cujete* tree have received, among members of rural communities in the Caribbean region, different uses over time. **Justification:** *C. cujete* can also be considered as forage, widespread in the region, and with important cultural roots. **Objective:** To investigate the knowledge of people of different genders and ages about the use they give to the *C. cujete* tree in localities in the Caribbean region to evaluate the current state of the relationship with the plant. **Methods:** The study was carried out in Magdalena, Sucre, César and Bolívar, applying 48 surveys with 21 questions, to people of rural origin of different gender and age (8 to 68 years). The use of the parts of the tree, phenological and planting aspects, species, pollination, fruit shapes, management in pastures, animal feeding, pests or diseases, and experiences associated with folklore were investigated. From the matrix, frequency tables were constructed, and the results were enriched with the stories expressed. **Results and Discussion:** Uses were emphasized (>20%) such as: making playpens or utensils, shade for people and animals, food for animals and medicine; and others as shelter for birds, wood, and firewood (7–10%). No one recognized the bat as a pollinator. They identify herbivores and man in propagation. The phenological aspects associated with the flower are not recognized, but others related to the development of the plant are. The use of the fruit is more recognized (>50%). For many (58%), today there are more *C. cujete* trees than before, especially in the pastures (39%) and, although one variety is recognized (38%), up to four are recorded. For the majority (68.8%) no pest attacks it. The artisanal use is well known to everyone, even that associated with songs. Men have greater knowledge on the subject than women and boys than girls, with the response "don't know" standing out among the youngest. **Conclusion:** Although the relationship of the rural population with *C. cujete* is recognized, knowledge or knowledge about its use has been lost as a consequence of generational changes.

Keywords: Biodiversity, livestock, society
Palabras clave: Biodiversidad, ganadería, sociedad

Experiences of sustainable use of coffee by-products for livestock farming in Santander

Experiencias de aprovechamiento sostenible de subproductos de café para la ganadería en Santander

Juan L Cardona Iglesias[1*], Tatiana C Avilés Vargas[1], Juan R Zambrano Ortiz[1] and Álvaro M Cadena Pastrana[1]

[1]Corporación Colombiana de Investigación Agropecuaria (Agrosavia), Colombia, ORCID 0000-0001-5225-8108, ORCID 0009-0002-6989-8325, ORCID 0003-3748-6211, ORCID 000-0003-3836-5171.
*Corresponding author: jlcardona@agrosavia.co

Introduction: Colombia is the third coffee producer in the world with around 96% of small producers. In the traditional post-harvest process, about 5% of the fresh fruit is used and 95% is waste that causes different socio-environmental conflicts. For this reason, different alternatives have currently been generated, one of which is animal feeding with by-products to contribute to the circular economy and sustainable livestock farming in the territories, where various processes of knowledge and technology transfer in this regard have been generated. **Objective:** Systematize the experience of the ASOCOGAN association, and rural young people from agricultural schools in the province of Comunera, Santander, in the sustainable use of coffee by-products for livestock feeding, to recognize lessons learned regarding the processes of knowledge and technology transfer. **Methods:** The systematization addresses the moments of retrospection and recognition of the use of coffee by-products in the territory, identification of socio-environmental conflicts, participatory spaces for use, experiences on producer farms and design of routes for the valorization of coffee by-products, through semi-structured interviews, focus groups and process evaluation and feedback workshops. **Results and Discussion:** A low adoption of technologies for the use of by-products was evident due to the low level of access to information about these alternatives, and a perception of producers of different socio-environmental conflicts generated by coffee, especially in supply and quality, of the water resource, and a low motivation of the young people to continue in their territory. Likewise, the process of transferring knowledge and technologies through already consolidated community organizations and the peasant-to-farmer method on producer farms led to the strengthening of 35 small producers of ASOCOGAN, and the creation of a research hotbed with rural youth. which suggests the importance of social capital

as a basis for technological innovation. **Conclusion:** These technologies can contribute to improving the perception of the ecosystem services of agroecosystems and life strategies in the territories by rural youth, through social innovation.

Keywords: Appropriation of social knowledge, circular economy, sustainable livestock farming, innovation, rural youth
Palabras clave: Apropiación social de conocimiento, economía circular, ganadería sostenible, innovación, jóvenes rurales

Productive performance of Angus steers under rotational grazing with energy supplementation in the high tropics

Desempeño productivo de novillos Angus bajo pastoreo rotacional con suplementación energética en el trópico alto

Claudia del P Herrera Farfán[1], Liranis L Flórez Botello[2] and José M Barbosa Gelvez[3*]

[1]SISPROPEC-CIBA, Colombia. [2-3]Centro de Biotecnología Agropecuaria, SENA-Cundinamarca, SISPROPEC-CIBA, Colombia. [3]Centro de Biotecnología Agropecuaria, SENA-Cundinamarca, ORCID 0001-9995-9876.
*Corresponding author: cpherreraf@sena.edu.co

Introduction: Cattle farming depends mainly on the fodder supply that is affected by climatic factors in bioavailability and quality affecting productive efficiency. **Justification:** The Western Savannah Province of Cundinamarca, due to its geographical and climatic position, has optimal conditions for the production of different beef breeds of high productive performance in pastoral systems, whose grass best adapted is the Kikuyo. To achieve daily weight gains (GDP) greater than 0.5 kg/day, livestock specializing in meat requires daily additional energy consumption. **Objective:** To evaluate the productive behavior of beef steers, in pastoral system with energy supplementation in the high tropics. **Methods:** The study was conducted from November 2022 to December 2023, in the Corsica farm, Hondura Chingafrio village of the municipality of El Rosal, Cundinamarca, dedicated to beef production. 40 steers of two genetic groups were used: Angus x Simmental (AxS) and Angus x Brahman (AxB) with 8 months (0.63) of initial age, with average weight of 237.75 kg (16.83 kg), fed in a rotational system based on Kikuyo (*Pennisetum clandestinum*), supplemented with balanced energy (Palm kernel 60%, Corn 30% and Glycerol 10%) at a ration of 0.5 kg/day. The animals were weighed every 45 days. The prairies had 65 days of recovery and 4 days of occupation, fertilized with porquinaza. Monthly digital capacities and bromatology were obtained, with aerial images captured by Mavic mini DJI2 drone and processed by specialized software. **Results and Discussion:** The forage base was characterized by high protein content in the pre-pastoreo (PC 19.4%) and low content of soluble sugars (ENl 1.91 MCal/kg of MS). The time to reach the benefit weight of 510.5 kg (16.18 kg) standing was 390 days. The highest GDP was observed in animals of the AxB lineage (*P*=0.001) with 740 g/animal/day. AxS GDP corresponded to 608 g/animal/day. **Conclusion:** Supplementation of grazing steers increases GDP and meat production (kg/ha) suggesting that fattening steers in the high tropics is a valid and efficient alternative.

Keywords: Cattle, supplementation, highland tropics
Palabras clave: Bovino, suplementación, trópico alto

Implementation of good livestock practices for competitive milk production of small farmers associated with COLATTE

Implementación de buenas prácticas ganaderas para la producción competitiva de leche de pequeños ganaderos asociados a COLATTE

Claudia del P Herrera Farfán[1], Paula A Vargas Martínez[2] and Juan J Mazo Londoño[3*]

[1]SISPROPEC-CIBA, Colombia.[2-3]Centro de Biotecnología Agropecuaria, SENA-Cundinamarca, SISPROPEC-CIBA, Colombia. [3]Centro de Biotecnología Agropecuaria, SENA-Cundinamarca, ORCID 0001-9995-9876.
*Corresponding author: cpherreraf@sena.edu.co

Introduction: The quality and safety of milk are the most important factors to ensure the competitiveness of cattle farming in any region. Justification: The rural extension project with young implementers of Good Livestock Practices (BPG), allowed to interconnect the SENA training, with the guild (FEDEGAN) and farmers focused on dairy production (Agricultural Cooperative of Tenjo, COLATTE) for the adoption of the regulations in accordance with the guidelines of Safety and GMP contained in Resolution 2341 of 2007 and in accordance with Resolution 68167 of the ICA of May 20, 2020, for the certification of small and medium cooperative livestock producers. **Objective:** Implement and certify in BPG before the ICA to farms of small milk producers associated COLATTE promoting resource efficiency and agricultural development. **Methods:** The work was carried out with 7 trainees implementing BPG from the technologist in livestock production who advanced their production stage and cooperating producers from COLATTE in the municipality of Tenjo during the period of October 2023 and March 2024. A technical committee was organized to construct basic procedures manuals and accompanying schedules for 63 sites that adopted GBPs. In the first diagnostic visit, Form 3-852 was applied to determine the degree of compliance with the criteria Fundamental (F), Major (My) and Minor (Mn). A contingency plan was drawn up in order to increase compliance by scheduling follow-up and monitoring visits to the 42 priority sites to reach the minimum requirements: (F) 100%, (My) 85% and (Mn) 60%. BPG audit was requested from the ICA certifying

body. **Results and Discussion:** 3 audit sessions were held: 2 in December and 1 in March for certification of BPG to 30 livestock farms. 28 sites obtained certification with average compliance for the fundamental criteria of 100%, higher 89% and lower 69%. **Conclusion:** The association group manages to certify in BPG 28 farms of small producers, constituting as a reference in sustainable livestock production at regional and national level.

Keywords: Animal welfare, health, safety, traceability
Palabras clave: Bienestar animal, sanidad, inocuidad, trazabilidad

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Effect of aeronautical noise on productivity and health in dairy farms in Funza, Colombia

Efecto del ruido aeronáutico sobre la productividad y sanidad en fincas lecheras de Funza, Colombia

Diana C Mogollón Vergara[1], Román D Castañeda[2], Jairo A Pardo[2], Andrés Mejía[1], Olga Barreto[1] and Saira Romero[2]

[1]Universidad Cooperativa de Colombia. Departamento de Ciencia Animal, Colombia. [2]Universidad del Tolima. Departamento de Ciencia Animal, Colombia, ORCID 0000-0003-2968-3397.
*Corresponding author: diana.mogollonv@campusucc.edu.co

Introduction: An evaluation was conducted to measure the impact of noise from air operations at El Dorado International Airport on the productivity and health of dairy cattle in the municipality of Funza, Colombia. This experimental study sought to determine if aircraft noise significantly affected milk production, considering various factors such as health and animal welfare. **Justification:** The evaluation conducted arises from the need to understand how this factor can influence key aspects of dairy production. Given the importance of the livestock industry in the region and the proximity of the airport, it is crucial to understand if aircraft noise significantly affects productive, sanitary, and welfare variables of cattle. **Objective:** To evaluate the effect of aeronautical noise on productivity and sanitary condition in dairy herds in the municipality of Funza. **Methods:** The study was conducted in the rural area of the International Airport, in the municipality of Funza, at an altitude of 2,548 meters above sea level. There were 18 stratified dairy farms in 3 groups according to exposure levels (n=6 farms per group): Low (0%-33.3%), Medium (33.3%-66.6%), and High (66.6% -100%), corresponding to low, medium, and high levels of noise exposure, respectively. The evaluated variables were: acoustic measurement, blood count, milk production, and somatic cell count for 5 months. The treatments evaluated were the exposure levels; data were analyzed using ANOVA. **Results and Discussion:** Higher grazing noise (dB) was observed in the medium and high treatments (68.47 dB - 69.20 dB). Meanwhile, the noise recorded in the milking facilities was higher in the medium treatment (78.67 dB). Milk production was higher in the ranges classified as high and low exposure levels (17.09 L and 15.7 L), respectively, unlike the medium level where the recorded production was lower (10.30 L).The variables red blood cells, hemoglobin, hematocrit, and platelet variables showed no differences between treatments; the total protein variable showed statistical differences between medium and low treatments. Likewise, the somatic cell content was not affected by noise exposure. **Conclusion:** It is concluded that exposure to noise during milking may lead to a decrease in milk production; however, it was evidenced that it does not directly affect the health of the cattle, considering the sanitary variables evaluated in the dairy herds.

Keywords: Aircraft, dairy production, healthcare, welfare, dairy
Palabras clave: Aeronaves, producción láctea, sanidad, bienestar, lechera.

Measuring respiratory activity in grazing cattle with an electronic spirometry mask

Medición de la actividad respiratoria en bovinos pastoreando con una máscara espirométrica electrónica

Ligia J Jaimes Cruz[1], Sebastián Castrillón Mojica[2], Brandon S Bustamante Castañeda[2], Maira A Mejía Sánchez[2] and Héctor J Correa Cardona[2]*

[1]Institución Universitaria Visión de las Américas sede Medellín, ORCID: 0000-0002-3327-0360. [2]Universidad Nacional de Colombia sede Medellín, ORCID 0009-0001-0138-0469, ORCID 0009-0004-6690-3736, ORCID 0000-0002-7371-4640.
*Corresponding author: hjcorreac@unal.edu.co

Introduction: Measuring respiratory activity in grazing cattle enables the assessment of their adaptability to climatic conditions, energy expenditure, and overall health status (Proyecto HERMES 57857). **Justification:** Currently, there is a lack of equipment available for measuring respiratory activity in grazing cattle. **Objective:** To determine the respiratory frequency and exhaled air volume in cattle under grazing conditions. **Methods**: Electronic spirometry masks (ESMs) equipped with 1 ½" flowmeters were fitted on four lactating cows grazing kikuyu grass pastures (*Cenchrus clandestinus*) for at least two consecutive hours. The flowmeters measured the total volume of exhaled air (L/min), while a switch determined exhalations and inhalations and their duration in milliseconds (ms). The flowmeters were calibrated with known air volumes within the expected range for each exhalation (4.0 to 6.0 L/exhalation). Data were stored in a MicroSD memory card in an Excel file and analyzed using an algorithm to identify exhalations from inhalations and calculate the average duration. **Results and Discussion:** The animals readily adapted to the masks without showing signs of stress or discomfort. On average, the cows exhibited 36.3±7.53 exhalations/min with a duration of 827.0±141 ms/exhalation and an exhaled air volume of 172.8±85.9 L/min. **Conclusion:** The ESM is a portable device that allows for the measurement of respiratory activity in grazing cattle without affecting their behavior.

Keywords: Arduino, dairy cows, exhalations, inhalations
Palabras clave: Arduino, vacas lecheras, exhalaciones, inhalaciones

Relationship between fat mobilization and productive efficiency in Zebu cows during lactation

Relación entre movilización de grasa y eficiencia productiva en vacas Cebú durante la lactancia

Juan C Velásquez Mosquera[1]*, Jorge Triana Valenzuela[1], Mayerling Sanabria Buitrago[1] and Joao Alvarado Rincón[2]

[1]Universidad La Salle. Bogotá, Colombia, ORCID 0000-0003-4066-5376, ORCID 0000-0001-5403-1636, ORCID 0000-0002-7696-3245. [2]Universidad La Salle Yopal. Facultad Ciencias Agropecuarias, Colombia, ORCID 0000-0002-1413-5120.
*Corresponding author: jcvelasquez@unisalle.edu.co

Introduction: Evaluating the mobilization of body reserves in zebu cows suggests great challenges in herd management, especially in first-calf cows. Introduction. The body condition score is the most used method to evaluate fat reserves in lactating zebu cows. Recently, alternative methods have been proposed, such as body mass index and thoracic-hump perimeter, which estimate the amount of subcutaneous fat in specific anatomical areas. of the cows. **Objective:** To evaluate the mobilization of subcutaneous fat in zebu cows using three estimation methods and to know its relationship with productive efficiency during the calving-weaning productive cycle. **Methods:** A group of first-calf zebu heifers (n=12) of contemporary age that calved the same month-time of the year in a cow-calf herd in Yopal were fixed time artificial insemination, then evaluated at the beginning and end of the productive cycle (calving - weaning): the body condition score (BCS scale 1-9), the heart girth around the hump (HGH) with a tape measure and the body mass index (BMI) based on weight, body length and hip height. The cows were weighed at calving (WCC), at weaning (WCW) and the calves were weighed at birth (BW) and at weaning (WW 240 days), the productive efficiency index was calculated: weight of the weaned calf divided by weight of the cow weaned (WW-WCW). **Results and Discussion:** The WCC and WCW were on average 434±39 kg and 408±49 kg, respectively. Calf BW and WW were 38±3.1 kg and 247±17 kg, respectively. The BCS at calving and BCS at weaning were 5.33±0.65 and 5.08±0.59, respectively. The HGH at calving and HGH at weaning was 197±7.27 cm and 191±9.77 cm, the BMI at calving and weaning was 22±0.0 kg/cm and 21±0.0 kg/cm, respectively. The average WW-WCW efficiency index was 61±7.8%. There were inverse relationships between the variations in calving-weaning fat reserves with the WW-WCW index in the cows, being the correlation coefficients BMI (-0.71, $p<0.01$), HGH (-0.63, $p<0.005$), and BCS (-0.45, $p< 0.13$), respectively. **Conclusion:** The mobilization of body reserves in lactating cows estimated by the three methods had inverse relationships with the WW-WCW efficiency index.

Keywords: Body condition score, *Bos indicus*, herd, weaning weight

Palabras clave: Condición corporal, *Bos indicus*, rebaño, peso al destete

Flight distance and grazing behaviour of Holstein cows under a conventional milking system

Distancia de fuga y comportamiento en pastoreo de vacas Holstein en un sistema de ordeño convencional

Jéssica T Morales Piñeyrúa[1]* and Juan P Damián Cabrera[2]

[1]Instituto Nacional de Investigación Agropecuaria sede La Estanzuela. Programa Nacional de Producción de Leche, Uruguay, ORCID 0000-0003-0800-9731, [2]Universidad de la República. Facultad de Veterinaria, Departamento de Biociencias Veterinaria, Uruguay, ORCID 0000-0001-8042-5743.
*Corresponding author: jmorales@inia.org.uy

Introduction: Flight distance (FD) is a temperament test associate to lying time of dairy cows in early lactation and under a conventional millking system. **Objective**: To determine the relationship between FD test of Holstein cows in late lactation and grazing behavior under conventional milking system. **Methods:** The study was conducted at the dairy research station of INIA La Estanzuela (Colonia, Uruguay) where 59 Holstein cows (23 primiparous and 36 multiparous) were classified as 'calm' ($\leq$2.3 m, n=20) or 'reactive' ($\geq$3.4 m, n=20). based on FD mean (distance that cows allowed a nonfamiliar person to approach, m) at 40, 70, and 170 days in milk at parlor system. The behaviors 'standing', 'lying', 'grazing', 'ruminating' and 'inactivity were record by scan method each 10 minutes (12 hours/day) during 10 days. Daily frequencies of behaviors were expressed as percentage, and its relation to cow´s FD were analyzed by generalized linear mixed for longitudinal data. **Results and Discussion**: There was a significant interaction between FD and parity in 'grazing' behavior. Primiparous cows classified as 'reactive' (61.7±0.5%) grazing less frequently that 'calm' (64.4±0.8%) ($P=0.001$). However, these differences were not observed in multiparous cows. The daily frequencies of 'standing', 'lying', 'ruminating' and 'inactivity' were not different between 'reactive' and 'calm' cows. On contrary ours results, it is reported that FD of cross-bred cows (Friesian × Jersey) under pasture conventional system was useful in predicting lying time but not grazing or ruminating. The different days in milk of cows could be the reason of the differences between studies. **Conclusion:** The reactivity of Holstein cows to FD test influenced the 'grazing' but it had not affect 'standing', 'lying', 'ruminating' and 'inactivity' behaviors. However, this difference on 'grazing' between 'reactive' and 'calm' was evident only in primiparous cows.

Keywords: Ethology, lying, personality, rumination, welfare
Palabras clave: Etología, echado, personalidad, rumia, bienestar

GENÉTICA Y MEJORAMIENTO

Genetic variation in caseins and β-lactoglobulins in Hartón del Valle and Lucerna breeds

Variación genética en las Caseínas y la β-Lactoglobulina en las razas Hartón del Valle y Lucerna

Darwin Y Hernández Herrera[1]*, Luis G González Herrera[2] and Juan C Rincón Flórez[1]

[1]Universidad Nacional de Colombia sede Palmira. Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0002-1758-604X, ORCID 0000-0002-6769-6407. [2]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0001-7156-9753.
*Corresponding author: dyhernandezh@unal.edu.co

Introduction: The Hartón del Valle (HV) and Lucerna (LC) breeds represent a genetic resource adapted to the Colombian tropics. Knowledge of genetic variation related to productivity, nutritional quality and technological performance of milk in these breeds is limited. **Objective**: To determine the variation in *CSN1S1*, *CSN2*, *CSN1S2*, *CSN3* and *BLG* genes in HV and LUC breeds. **Methods:** DNA was extracted from 94 LUC and 10 HV animals and genotyped using the GGP™ Bovine 150 K chip. This platform contains four SNPs in the *CSN1S1* gene, 14 in the *CSN2* gene, two in the *CSN1S2* gene, 12 in the *CSN3* gene and 11 in the *LGB* gene. These SNPs were used to reconstruct the haplotypes and protein variants of the caseins α*S1-CN*, β-*CN*, α*S2-CN* and κ-*CN*; and beta-lactoglobulin (β-*LG*). **Results and Discussion:** Only **B* (0.88 in LC and 0.65 in HV) and **C* alleles of the *CSN1S1* gene were found in both breeds. In the *CSN2* gene, the **A*^{1} (0.31) and **A*^{2} (0.67) alleles were the most frequent in the LC; in the HV breed these alleles showed values of 0.30 and 0.70, respectively. The **B* and **F* alleles of this gene showed a low frequency in LC and were not found in HV. The **A* allele of the *CSN1S2* gene was fixed in both breeds. Six alleles were found in the *CSN3* gene, the most frequent being **A*=0.82 and **B*=11 in the LC breed, and the alleles **A*=0.55 and **I*=0.25 in the HV breed. In the BLG gene, the **B* allele was the most frequent (0.59 in LC and 0.650 in HV), followed by the **A* allele (0.39 in LC and 0.35 in HV), the **D*, **H*, **G* and **I* alleles were found only in the LC breed with a frequency of 0.005. **Conclusion**: Haplotype reconstruction revealed linkage with r^2 greater than 0.5 between some markers of the same gene, but not between genes.

Keywords: Milk quality, genetic polymorphism, milk proteins, milk A2
Palabras clave: Calidad de Leche, polimorfismo genético, proteínas lácteas, leche A2

Weight ratio between Brahman cows and their calves and its effect on reproduction in Cotové

Relación de peso entre vacas Brahman y sus crías y su efecto sobre la reproducción en Cotové

Edimer D Jaramillo[1], **Diana M Bolívar Vergara**[2]* and Luis G González Herrera[2]

[1]Grupo de investigación Nutrisolla, ORCID 0000-0001-9220-9984. [2]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.
*Corresponding author: dmboliva@unal.edu.co

Introduction: The weight relationship between the cow and its calf during lactation can explain the reproductive performance of cows. **Objective:** To determine the effect of the weight ratio between Brahman cows and their calves on reproductive parameters in the Cotové herd. **Methods:** Monthly weight information was collected from red Brahman cattle in the Cotové herd at the National University of Colombia, Medellín campus (Santa Fe de Antioquia). Information from 58 first calvings occurring between 2010 and 2023 was analyzed. Using R Project software, weights of cows and their calves were organized to coincide with weighing dates; records of age at first calving (AFC) and first calving interval (FCI) were also kept. Two approaches were undertaken: 1) Calculation of the mean differences between cow and calf weights during 10 weighings (DIFF) and their correlation with AFC and FCI. 2) Using a mixed linear model that considered cow weight as a function of the covariates cow age and calf weight (modeled with a second-order polynomial); fixed effects of calf sex, calving year, and calving season were also included in this model. Random regression coefficients of the model (b0, b1, and b2) were correlated with AFC and FCI. **Results and Discussion:** AFC ranged from 28.10 to 57.13 months. FCI ranged from 315 to 845 days. Pearson correlation between DIFF and AFC and FCI was 0.09 (95% CI -0.04;0.21) and -0.25 (95% CI -0.39;-0.10). Pearson correlations between b0, b1, and b2 with FCI were -0.29 (95% CI -0.50;-0.05), -0.19 (95% CI -0.52;-0.06), and -0.19 (95% CI -0.42;0.06), and with AFC were 0.40 (95% CI 0.17;0.58), -0.40 (95% CI -0.59;-0.17), and 0.10 (95% CI -0.15;0.34). **Conclusion:** The mixed model successfully identified a relationship between maternal weight fluctuation and reproductive variables. Further analyses should be conducted to better understand the influence of cow weight variability during lactation on reproductive parameters.

Keywords: Growth curves, mixed model, Pearson correlation, polynomials, weight difference
Palabras clave: Curvas de crecimiento, modelo mixto, correlación de Pearson, polinomios, diferencia de peso

Multiple Correspondence Analysis for the number of perturbations in first lactations of Lucerne cows

Análisis de correspondencia múltiple para número de perturbaciones de primeras lactancias de vacas Lucerna

Luis G González Herrera[1]*, Oscar E Yepes Higuita[1], Juan C Ramírez Herrera[2] and Juan C Rincón Flórez[1]

[1]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0000-0001-7156-9753, ORCID 0009-0002-3166-5518, ORCID 0000-0002-6769-6407. [2]Universidad de Antioquía, Colombia, ORCID 0000-0003-2703-6145.
*Corresponding author: luggonzalezhe@unal.edu.co

Introduction: Lactation perturbation is defined as the period between an initial decrease in test day milk yield (TDMY) and its subsequent recovery, as this decrease is understood as a drop in TDMY that is not due to normal physiological processes. The number of perturbations (NP) during lactation generates negative impacts on milk production systems. Identifying factors associated with higher NP is crucial for designing strategies aimed at improving milk yield. **Objective:** To identify factors affecting the number of perturbations in Lucerna cow lactation, using multiple correspondence analysis. **Methods:** TDMY of 2493 first lactations of Lucerna cows were analyzed. The Wood model was used to estimate lactation curve parameters (a, b, and c). In multiple correspondence analysis (MCA), quantitative variables were categorized: initial production (a) and milk yield drop rate (PL), cow age at calving, and lactation duration categorized as low (less than 1 standard deviation), medium (between -1 and 1 standard deviation), and high (greater than 1 standard deviation), according to the distribution of each variable. The factors Farm (F), calving season (CS), and calving year (CY) categorized into two groups (calvings before (A) and after (B) CY 2000, marking before and after the establishment of agro-silvopastoral systems), were also included in the analyses. The FactoMineR and ca packages from the R Project were used to generate the perceptual map and residual analyses. **Results and Discussion:** The first two principal components explained 71.4% of the total variability. In the perceptual map, it was possible to observe that factor BY, farm A, and older ages were the factors most associated with a higher presentation of NP ($p < 0.05$). Year A, farm B, and younger ages are more associated with a lower presentation of NP ($p < 0.05$). **Conclusion:** Lucerna breed producers should pay attention to cows calving on farm A, at older ages, and under conditions similar to those presented after 2000, seeking to reduce the occurrence of NP.

Keywords: Milk production on control day, multivariate analysis, native cattle, residual analysis
Palabras clave: Producción de leche en el día de control, análisis multivariado, ganado criollo, análisis de residuos

Correlated Responses in economically important traits in Brahman when selecting by regression coefficient

Respuestas correlacionadas con características de importancia económica en Brahman al seleccionar por coeficiente de regresión

Cristina Álvarez Munera[1]*, Diana M Bolívar Vergara[1], and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias, Colombia, ORCID 0009-0008-2976-4326, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.
* Corresponding author: cralvarez@unal.edu.co

Introduction: Selection in Brahman cattle at the San Juan de Bedouth herd (SJB) is conducted using an selection index developed from the breeding value of four growth traits, two reproductive traits, and one carcass quality trait. The genetic gain of an index increases as the number of included traits decreases. **Objective**: To verify whether the breeding value for the first coefficient of a random regression model can replace the breeding values of growth traits in the selection index used in Brahman cattle at the SJB herd, based on correlated response results. **Methods**: Growth data (60,509) and pedigree information (42,603 animals) of Brahman cattle from the SJB herd located in Puerto Berrío, Antioquia, were utilized. A random regression model was applied, considering seven classes of heterogeneous residual variances, with Legendre polynomials of orders 3, 4, 3, and 5 to model direct additive genetic effects, permanent environmental effects of the animal, maternal additive genetic effects, and maternal permanent environmental effects, respectively. Using the R Project software, the correlated response between the direct additive breeding value and maternal additive breeding value for the first coefficient of the random regression and direct additive and maternal additive breeding values for weight at four months and at weaning (PD), as well as direct additive breeding values for weights at 18 and 24 months, age at first calving (EPP), calving interval, and loin eye area (AOL) were estimated. The breeding values of these traits were predicted in a previous study using a single-trait animal model. **Results and Discussion:** Correlated responses were positive with growth traits (direct additive effects) and varied between 0.35 and 20, being higher for PD and lower for AOL; responses were negative with preweaning traits for maternal effects and with reproductive traits. **Conclusion**: The first regression coefficient could replace the direct additive breeding values of growth traits and the additive breeding value for EPP in the selection index, resulting in greater genetic gain in the index by reducing the number of included traits.

Keywords: Animal breeding, genetic correlations, growth, Legendre polynomials
Palabras clave: Mejoramiento genético, correlaciones genéticas, Crecimiento, polinomios de Legendre

Choosing a random regression model for describing growth in Brahman beef cattle

Elección de un modelo de regresión aleatoria para descripción del crecimiento en ganado Brahman

Cristina Álvarez Múnera[1]*, Alejandra Álvarez Múnera[2], Diana M Bolívar Vergara[1], Jorge Hidalgo[2], Matías Bermann[2], and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias, Colombia, ORCID 0009-0008-2976-4326, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753. [2]University of Georgia. Department of Animal and Dairy Science, Athens, GA, USA, ORCID 0000-0002-0783-381X, ORCID 0000-0002-5374-0710, ORCID 0000-0003-1746-1287

*Corresponding author: cralvarez@unal.edu.co

Introduction: Longitudinal models, such as random regression models (RRM), are valuable tools that use all available records to evaluate animal growth over time. These models allow the incorporation of specific environmental effects and capture differences in the shape of each animal's growth curve due to genetics. **Objective**: To test different orders of Legendre polynomials to identify the best random regression model for describing the growth curve in Brahman cattle. **Methods:** Growth (60,509 phenotypes) and pedigree data (42,603 animals) from Brahman animals from a farm located in Puerto Berrío, Antioquia, were used. There were 915 age classes. The model included fixed effects of year and season of birth (YB and SB), parity number and dam's conception method, sex, and individual age. The random effects considered in the animal model were direct additive genetic (AD), maternal genetic (MG), permanent environmental of the animal (PEA) and dam (PED), and temporary environmental (TE). The effect of TE was modeled starting with 20 classes of residual variances and decreasing up to 4 classes. The random effects AD, MG, PEA, and PED were modeled with polynomial orders ranging from 2 to 6. The best model was the one that obtained lower values of AIC, BIC, and/or lower standard errors of the estimates throughout the growth trajectory. Statistical analyses were implemented using the WOMBAT software. **Results and Discussion:** All models showed successful convergence. The AIC and BIC criteria analyses revealed that the most parameterized model was considered the best. However, graphical modeling of additive and environmental variances and explanation of the first principal components suggest that a less parameterized model can efficiently explain the same information. **Conclusion**: The model with the best description of the growth curve considered 3, 4, 3, and 5 polynomials for the effects of AD, MG, PEA, and PED, respectively, and 7 classes of heterogeneous residual variances. Further research will focus on including cross-validation to improve the accuracy of the model.

Keywords: Beef cattle, maternal genetic, permanent environment, variance components

Palabras clave: Ganado de carne, genético materno, ambiente permanente, componentes de varianza

Prediction of longevity in Brahman breed using machine learning methodologies

Predicción de longevidad en raza Brahman mediante metodologías de machine learning

Juan M Bonilla Hernández[1]*, Manuela Liebano Arango[1], Diana M Bolívar Vergara[1] and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0006-4219-2161, ORCID 0009-0004-0439-745, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.

*Corresponding author: jubonillah@unal.edu.co

Introduction: Early longevity prediction (LONG) could have a positive impact on the economy due to the reduction of replacement costs and the possibility of having a higher proportion of cows with a higher number of births. **Objective**: To compare the predictive capacity for longevity of three machine learning methodologies in the Brahman breed. **Methods**: LONG was defined in two categories: 1 (long-lived) and 2 (not long-lived), using two different criteria: 1. LONG1, defined as the ability of a female to remain until 72 months of age in the herd, giving birth at least three times. 2. LONG2, defined as the ability of a female to have five effective births in her productive life. We evaluated phenotypic information of first calving for 836 (LONG1) and 823 (LONG2) cows from the San Juan de Bedouth herd, located in the municipality of Puerto Berrio, Antioquia. The effects considered in the models were: The weight at birth of the first calf (BW), weaning age of the first calf (WA), first calving interval (CI), year of birth of the cow (YOB), and age of the cow at the first calving (AFC) were analyzed. Three machine learning methodologies were employed in RStudio: logistic regression (LR), K-nearest neighbors (KNN), and decision trees (DT). For each methodology, a training set comprised 60% of the data, and then 40% of the remaining animal phenotypes were predicted. The methodology with the best longevity prediction was determined based on the confusion matrix (prediction accuracy, sensitivity and specificity). **Results and Discussion**: The proportion of long-lived cows was 35.88 and 52.49% for LONG1 and LONG2, respectively. The best prediction method was AD with a prediction accuracy of 85.63% (95% CI: 0.814-0.892), sensitivity of 84.17% and specificity of 86.45% for LONG1 and an accuracy of 75.15% (95% CI: 0.7015-0.7969), with a sensitivity of 78.29% and specificity of 71.70% for LONG2. **Conclusion**: AD was the best prediction methodology for both criteria of longevity. The LONG1 with the AD model had a better prediction than the LONG2.

Keywords: Decision trees, k nearest neighbors, logistic regression, prediction, stay ability

Palabras clave: Árboles de decisión, k vecinos más cercanos, regresión logística, predicción, habilidad de permanencia

Disease incidence in a Colombian dairy herd and their potential association with the Dairy-Well-Being-Index (DWP$)

Incidencia de enfermedades en un hato lechero colombiano y su potencial asociación con el Índice de Bienestar Lechero (DWP$)

Luis M Cohen Teheran[1], Mónica M Ávila Sarmiento[2], José F Guarín[3] and **Jesús A Berdugo Gutiérrez**[1*]

[1] Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0005-5921-5916, ORCID 0000-0002-1556-6387 .[2]IAGENETICA, Asesorías en Genética Lechera, ORCID 0009-0003-8421-7388. [3]Universidad de Antioquia. Facultad de Ciencias Agrarias, Medellín, Colombia, ORCID 0000-0001-7795-0184 .
*Corresponding author: jaberdugog@unal.edu.co

Introduction: In modern productive systems, the welfare of the animals in the dairy industry has become very important. The Dairy Wellness Profit®, DWP$®, is a genomic index that includes production, fertility, functionality, longevity, calving easy, health, milk quality, and welfare in calves and dams. **Objective:** Describe the disease events recorded in a dairy herd and compare their frequency with the predicted values of the Dairy Welfare Index. (DWP$). **Methods:** Data of diseases associated with DWP$ from a Holstein dairy herd between August 2019 and December 2023 located in Oicata, Boyaca, Colombia, were analyzed. DNA was extracted from blood obtained in an FTA card, and the Genotyping was performed in a microchip designed by Zoetis. An index for 11 different diseases was calculated. A specific data sheet was created, and the data were processed using R. Genomic indexes for diseases and farm observations were compared using a confusión matrix method. **Results and Discussion:** 843 disease events out of 191 animals were recorded, 297 of them were associated with The distribution of disease was: abortion (30.642%), lameness (4.04%), diarrhea of calves (11.78%), hypocalcemia (8.42%), mastitis (34.68%), metritis (7.74%), pneumonía (0.34%), ovarian cysts (1.01%) y placenta retention (1.35%). A significant variation in the values of prevalence and sensitivity (0.18-0.71) positive predicted value (PPV) and negative predictive value (NPV) of diseases from the 67 genotyped animals was observed. The model has higher sensitivity to detect healthy animals. Using this model, it is necessary to highlight the interaction between environment, genetics, and health. **Conclusion:** The results obtained highlight the complexity of the possible relationship between the presentation of diseases and the genomes of individuals. It has shown valuable information for developing management strategies and prevention of diseases adapted to the farmers' needs and applied to the dairy bovine population.

Key words: Dairy, genomics, health, sensibility and specificity analysis, wellbeing
Palabras clave: Lechería, genómica, sanidad, sensibilidad y análisis de especificidad, bienestar

Daily weight gains in crossings between Bon, Angus and Holstein in the colombian high tropic

Ganancias diarias de peso en cruces entre Bon, Angus y Holstein en trópico alto colombiano

José J Echeverri Zuluaga[1*], Santiago Jaramillo Sepúlveda[1] and Iván A Celis[2]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0002-9613-0621, ORCID 0009-0002-7310-289. [2]Institucion Universitaria Colegio Mayor de Antioquia. Grupo de Investigación GIET, ORCID 0000-0001-8953-7012.
*Corresponding author: jjecheve@unal.edu.co

Introduction: The Blanco Orejinegro, BON, is a breed with important qualities represented in its adaptation and rusticity, suitable for crossing programs, seeking complementarity with breeds that provide productivity in beef and milk yield. **Objective**: To evaluate the inclusión effect of BON on daily weight gains pre-weaning (DWGPW) and post-weaning (DGWPOW) up to one year in a herd in the Colombian high tropics. **Methods**: Information from 84 animals in two different breeding systems (BS) (BS1 and BS2) was used. An independent model was used for each BS in which the effects of sex (S), birth year (BY), birth season (BS), the interaction (BS*BY) and the effect of breed as fixed effect and also as a covariate using Rstudio. **Results and Discussion**: The average for DWGPW was 0.860 kg and 0.910 kg for BS1 and BS22 respectively. In both breeding systems, breed had a significant effect (P<0.001) on DWGPW. For the DWGPOW, the averages for the different crosses were 0.800 kg for BS1 and 0.810 kg for BS22 respectively. Breed had a significant effect (P<0.001) on DWGPOW in BS1, but it was not so for the other breeding system. For BS1, the genetic group with highest mean for DWGPW was F1 Holstein*BON (0.836 kg), the lowest mean was BON 0.748 kg. For BS22 the highest mean was 31/32 HO*1/32BON with 0.857 kg, the lowest corresponded to the 13/16 HO* 3/16 BON with 0.743 kg. **Conclusion**: With the results obtained, it can be indicated that the percentage of BON had greater significance on the DWG in BS1, but in neither of the two BS2 had negative effect on DWGPW and DWGPOW. This indicates that the BON can be successfully used in crossbreeding programs in the Colombian high tropics, allowing the other benefits of the breed to be taken advantage of, such as hardiness and adaptability. Derived from the project "Potenial of bovine meat from milk yield breeds in typical Colombian gastronomy", financed through a Colmayor de Antioquia. 2021.

Keywords: Beef cattle, Blanco orejinegro, heterosis
Palabras clave: Ganado de carne, Blanco Orejingro, heterosis

Conditional probability for the number of disturbances in first lactations of Lucerne cows

Probabilidad condicional para número de perturbaciones de primeras lactancias de vacas Lucerna

Juan C Ramírez Herrera[1*], Oscar E Yepes Higuita[2], Juan C Rincón Flórez[2] and Luis G González Herrera[2]

[1]Universidad de Antioquia. Medellín, ORCID 0000-0003-2703-6145. [2]Universidad Nacional de Colombia sede Medellín, ORCID 0009-0002-3166-5518, ORCID 0000-0002-6769-6407, ORCID 0000-0001-7156-9753.
*Corresponding author: jcramirezhe@unal.edu.co

Introduction: The occurrence of lactation perturbations (LP) has negative impacts on milk production systems. Environmental effects have a direct relationship with the productive behavior of cows regarding LP. This can also be defined as the period between an initial decrease in milk production on a control day (DMPCD) and its subsequent recovery, because this decrease is understood as a fall in DMPCD that is not due to normal physiological processes **Objective:** To identify the probability of experiencing lactation perturbations according to farm effects, calving season, age at calving, and initial milk production level, using conditional probability analysis. **Methods:** Test day milk yield (TDMY) of 2725 first lactations of Lucerne cows were considered. The Wood model was used to estimate lactation curve parameters (a, b, and c). Conditional probability (CP) of experiencing at least one perturbation was calculated based on the factors: Farm (F1 and F2), calving season (CS, A, B, C, and D), age of the cow at calving (ACC), and initial milk production level (PL), these last two variables are categorized as low (less than 1 standard deviation), medium (between -1 and 1 standard deviation), and high (greater than 1 standard deviation) according to the distribution of each variable. **Results and Discussion:** The probabilities of experiencing disruptions for each level of each studied effect were: 0.87 and 0.93 (F1 and F2 respectively); 0.83 and 0.91, and between 0.86 and 0.94 for CS A to D in F1 and F2, respectively; between 0.79 and 0.94, and between 0.92 and 0.96 for ACC low to high in F1 and F2 respectively; between 0.84 to 0.87, and between 0.91 to 0.94 for PL low to high for F1 and F2, respectively. The PC by CS was higher in CS C (F1) and A (F2). Intermediate ACC and LP showed higher PC in both farms. **Conclusion:** Farm F2 exhibits a higher number of LP. The CP of LP according to CS, ACC, and LP changes according to the farm.

Keywords: Creole cattle, environmental effects, lactation curves, test day milk yield
Palabras clave: Ganado criollo, efectos ambientales, Curvas de lactancia, producción de leche en el día control

Genetic evaluation and variance components for longevity in Brahman breed

Evaluación genética y componentes de varianza para longevidad en la raza Brahman

Manuela Liébano Arango[1*], Juan M Bonilla Hernández[1], Diana M Bolívar Vergara[1] and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0004-0439-7452, ORCID 0009-0006-4219-2161, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.
*Corresponding author: mliebano@unal.edu.co

Introduction: Genetic evaluation for longevity (LONG) in cattle is crucial to improve productivity, decrease replacement costs and increase genetic progress due to increased selection intensity. **Objective**: To compare two genetic evaluation models taking into account two criteria for longevity in Brahman cows. **Methods:** Two criteria were evaluated: 1) LONG1 defined as the ability of a female to remain until 72 months of age in the herd, giving birth at least three times. 2) LONG2 defined as the ability of a female to have five effective deliveries in her productive life. We evaluated phenotypic information of first birth for 836 (LONG1) and 823 (LONG2) cows from the San Juan de Bedouth herd, located in the municipality of Puerto Berrio, Antioquia. Estimated variance components for LONG with the GIBBSF90 program; two categories were defined: 1 (long-lived), 2 (non-long-lived). Both models considered the year of birth of the cow (AN) as a fixed effect; weight at birth of the first calf (PN), weaning age of the first calf (ED), first interval between births (IEP) and age of the mother at first birth (EPP) as covariates. Heredities (h^2), standard deviations (SD) and average reliability of genetic values (CONFVG) were compared for these models. The correlation between the rankings of genetic values (CORVG) was estimated. **Results and Discussion:** For LONG1, h^2 was obtained from 0.12±0.07, CONFVG from 0.17. For LONG2, h^2 from 0.36±0.12 and CONFVG from 0.30 and CORVG was 0.014. **Conclusion:** The CORVG indicates difference in the ranking of animals between models. The h^2 para LONG2 was higher, along with a higher CONFVG, therefore, selecting for this criterion would allow for greater genetic progress.

Keywords: Heritability, productive lifeselection, stayability
Palabras clave: Heredabilidad, selección vida productiva, habilidad de permanencia

Analysis of first lactation disturbance numbers in Lucerne cows using Poisson distribution

Análisis de número de perturbaciones en primeras lactancias de vacas Lucerna usando distribución Poisson

Oscar E Yepes Higuita[1]*, Juan C Ramírez Herrera[2], Juan C Rincón Flórez[1] and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia, sede Medellín, Colombia, ORCID 0009-0002-3166-5518, ORCID 0000-0002-6769-6407, ORCID 0000-0001-7156-9753. [2]Universidad de Antioquia. Medellín, Colombia, ORCID 0000-0003-2703-6145.
*Corresponding author: oyepes@unal.edu.co

Introduction: The occurrence and frequency of lactation perturbations (NP) during lactation have negative impacts on dairy yield systems. Multiple factors influence the occurrence of NP; identifying these factors is essential for creating corrective strategies. **Objective:** To identify factors associated with the number of perturbations using a generalized linear model from the Poisson distribution family. **Methods:** Test day milk yield (TDMY) of 2493 first lactations of Lucerne cows were considered. Lactation perturbation is defined as the period between an initial decrease in TDMY and its subsequent recovery, as this decrease is understood as a drop in TDMY not due to normal physiological processes. The Wood model was used to estimate lactation curve parameters (a, b, and c). In the generalized linear model using the Poisson distribution family, the fixed effects considered were: calving season (CS) categorized as A (January-March), B (April-June), C (July-September), and D (October-December); calving year (CY, 1984-2019), farm (F, 2 levels), age of the cow at calving (ACC), initial level (IL), and milk production persistence (PER), with these last three variables categorized as low (less than 1 standard deviation), medium (between -1 and 1 standard deviation), and high (greater than 1 standard deviation), according to the distribution of each variable. The analyses were performed in R Project. **Results and Discussion:** The NP varied between 1 and 8 perturbations. In the generalized linear model, no significant differences were found for NP between farms. Years after 2003, CS D, medium IL, medium and low PER are associated with higher NP ($p < 0.05$). ACC is not associated with NP. **Conclusion**: Producers should pay more attention to cows calving on CS D, with medium IL, medium and low PER in order to implement strategies aimed at reducing NP, thereby reducing the negative economic impact that perturbations can have.

Keywords: Creole cattle, environmental effects, lactation curves, linear model
Palabras clave: Ganado criollo, efectos ambientales, curvas de lactancia, modelo lineal

Birth weight and weaning of crossbreeding with blanco orejinegro in colombian high tropic

Peso al nacimiento y destete de crías cruzadas con blanco orejinegro en trópico alto colombiano

Santiago Jaramillo Sepulveda[1]*; José J Echeverri Zuluaga[2] and Iván A Celis[3]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0002-7310-289, ORCID 0000-0002-9613-0621. [2]Institucion Universitaria Colegio Mayor de Antioquia. Medellín, Colombia, ORCID 0000-0001-8953-7012.
*Corresponding author: sajaramillose@unal.edu.co

Introduction: Crossbreeding Blanco Orejinegro (BON) individuals with other Bos Taurus breeds can be an improvement alternative for traits such as hardiness and adaptability in the Colombian high tropics, and as an alternative to milk production systems in these areas. **Justification:** It is necessary to evaluate different crosses that allow determining the best racial options to achieve good productive parameters and animals adapted to the high tropics. **Objective:** To evaluate the effect of the inclusion of BON in different percentages on birth weight (BW) and weaning weight (DW) in offspring crossed with animals of breeds specialized in meat and milk production in the high tropics. **Methods:** 84 records of births and weaning weights of animals raised under two different rearing systems (SC1 and SC2) were analyzed. SC1 corresponded to animals separated from the mother and fed with a bucket and SC2 to animals reared with the mother until approximately 6 months of age. Two independent linear models for each breeding system (SC) were fitted to determine the effect of the inclusion of different percentages of BON on Bos Taurus Angus and Holstein breeds. **Results and Discussion:** For SC1, the PN and PD had a mean of 30.66 kg and 218.81kg respectively, the type of crossbreeding had no statistical significance ($P>0.05$), similar results were found for SC2, for which the means were 34.65 kg and 118.09 kg for PN and PD, respectively. In the case of PD, the linear regression analysis allowed determining that for each percentage unit of BON, the PD decreased 318 grams, but this coefficient was not statistically significant ($P=0.0513$). **Conclusion:** The inclusion of BON in crossbreeding programs with Holstein and Angus does not affect the PN and PD of the resulting offspring, achieving parameters similar to those of purebred animals, with the additional advantages of crossbreeding with BON, such as hardiness and adaptability. Derived from the project "Potential of discarded milk beef from different racial groups in typical Colombian gastronomy", financed through Colmayor de Antioquia call for proposals. 2021.

Keywords: Adaptability, beef cattle, crossbreeding, rusticity
Palabras clave: Adaptabilidad, ganado de carne, cruzamiento, rusticidad

Correlated response for economically important traits by weaning coefficient selection in cattle

Respuesta correlacionada para rasgos económicamente importantes por selección del coeficiente de destete en bovinos

Susana Misas Vargas[1]*, Samir J Calvo Cardona[2], and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia, sede Medellín. Colombia, ORCID 0009-0005-8364-6599, ORCID 0009-0005-8364-6599, ORCID 0000-0001-7156-9753, ORCID. [2]DATA PLUS CIC, ORCID 0000-0003-3400-5208 ORCID 0000-0003-3400-5208.

*Corresponding author: smisasv@unal.edu.co

Introduction: the characteristic weaning coefficient (WC) is the relationship between the weaning weight of the calf and the weight of the cow at weaning, it is used as a selection criterion for females in the Bohemia ranch, looking for females with higher WC**. Objective**: To estimate the correlated response (CR) between the weaning coefficient and other important characteristics. **Methods:** Productive and reproductive records from a livestock farm located in La Virginia, Risaralda, Colombia, were used. Records of 77 Blanco Orejinegro (BON) cows and 76 Brahman (BR) cows and their offspring were analyzed. Information records of 21 years (females between one and eight births in both breeds) were considered. A single-trait animal model was used to predict direct (D) and maternal (M) additive breeding values for birth weight (DBW and MBW), weaning weight (DWW and MWW) and only direct additive breeding values for yearling weight (YW), calving interval (CI), age at first calving (AFC) and WC. All traits were evaluated in MTDF software. The correlation of genetic values is an approximation to the genetic correlation between traits and was calculated using Pearson's test. **Results and Discussion**: In BON, the correlations were: -0.11, -0.04, 0.14, 0.23, 0.13, 0.11 and 0.16, the CR being -0.198 kg, -0.024 kg, 1.302 kg, 0.811 kg, 2.051 kg, 1.967 days and 4.304 days, for DBW, MBW, DWW, MWW, YW, CI and AFC respectively, showing in this breed desirable correlations with growth traits (BW, WW and YW) and undesirable correlations with reproductive traits; in BR, the correlations were 0.06, -0.03, 0.02, -0.04, -0.11, -0.03 and -0.06, the CR being 0.019 kg, -0.006 kg, -0.266 kg, -0.257 days and -0.614 days, for DBW, MBW, DWW, MWW, YW, CI and AFC respectively. In this breed, the correlations obtained with reproductive traits (CI and AFC) are favorable, but of very low magnitude. **Conclusion**: Selection by weaning coefficient reflects favorable and low responses for growth traits in the BON breed, and in BR breed, it shows favorable responses for reproductive traits, albeit very low.

Keywords: Efficiency, genetic progress, meat production, productivity

Palabras clave: Eficiencia, progreso genético producción de carne, productividad

Comparison of genetic and phenotypic results for weaning coefficient in two cattle breeds

Comparación de los resultados genéticos y fenotípicos del coeficiente de destete en dos razas bovinas

Susana Misas Vargas[1]*, Samir J Calvo Cardona[2], and **Luis G González Herrera**[1]

[1]Universidad Nacional de Colombia, sede Medellín. Colombia,. ORCID 0009-0005-8364-6599, ORCID 0000-0001-7156-9753. [2]DATA PLUS CIC, ORCID 0000-0003-3400-5208.

*Corresponding author: smisasv@unal.edu.co

Introduction: the characteristic weaning coefficient (WC) is the relationship between the weaning weight of the calf and the weight of the cow at weaning, it is used as a selection criterion for females in the Bohemia ranch, looking for females with higher. **Objective**: To compare between the Brahman (BR) and Blanco Orejinegro (BON) breeds, the genetic parameters, phenotypic and adjusted averages, and phenotypic and genetic tendencies that were obtained in the genetic evaluation for WC. **Methods**: Productive and reproductive records from a cattle ranch located in La Virginia, Risaralda, Colombia, were used. Records of 77 BON cows and 76 BR cows and their offspring were analyzed. Information records of 21 years (females between one and eight births in both breeds) were considered. The WC was calculated for each cow at each calving. The animal model included as fixed effects the covariate cow age at calving (ACC), calf sex (SX) and calving year (YC). For the estimation of parameters and genetic values, MTDF software was used by means of a single-trait animal model. **Results and Discussion:** The unadjusted average WC is 46.37% for the BON breed and 48.1% for the BR breed; the estimated regressors for ACC were 0.5013, -0.00094 and 0.0000066 and 0.5004, -0.000806 and 0.0000074 for b0, b1 and b2 in BON and BR, respectively, indicating a trajectory with higher WC at the beginning and end of productive life. The average difference between males and females is 5.27% unadjusted and 4.91% adjusted in BON; in the BR breed this difference was 5.07% unadjusted and 4.72% adjusted. The lowest and highest adjusted differences with the base YC in BON were 3.7% in 1999 and 13% in 2009 and 4.2% in 2018 and 13.3% in 2012 in BR. The estimated heritability was 0.31±0.19 in BON and 0.09±0.11 in BR. Both the genetic and phenotypic tendencies have a similar behavior, showing a stabilization in recent years. **Conclusion:** Selection by weaning coefficient will be more efficient in BON. The influences of the factors on WC were similar in both breeds.

Keywords: Animal breeding, efficiency, maternal ability, meat production

Palabras clave: Cría de animales, capacidad materna, eficiencia, producción de carne

IMPACTO AMBIENTAL

Ruminal methane is mainly excreted by exhalations from lungs, not by eructs

El metano es excretado principalmente por las exhalaciones pulmonares, no por los eructos

Héctor J Correa Cardona[1]*, Sebastián Castrillón Mojica[1], Brandon S Bustamante Castañeda[1] and Ligia J Jaimes Cruz[2]

[1]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0000-0002-7371-4640, ORCID 0009-0001-0138-0469, ORCID 0009-0004-6690-3736. [2]Institución Universitaria Visión de las Américas sede Medellín. Colombia, ORCID 0000-0002-3327-0360.
*Corresponding author: hjcorreac@unal.edu.co

Introduction: domestic ruminants are one of the most important sources of anthropogenic methane worldwide. Justification: There is confusion about the relative importance of burping and lung exhalation as pathways for excretion of enteric methane. Objective: to quantify the relative excretion of enteric methane through belching and pulmonary exhalation (PE) in lactating cows. **Methods**: from the Paysandú Agrarian Station of the National University of Colombia, Medellín headquarters, six lactating cows were selected and an electronic spirometric mask (ESM) was installed for at least 30 minutes while resting in a paddock. The ESM was fitted with a methane sensor in front of the nostrils to detect burps, while at the ESM outlet another was installed to measure methane (ppm) concentrations during burps and PEs. Additionally, the ESM was joined by a turbine flow meter of 1" to measure the total volume of exhaled air (L/min). All information was saved in MicroSD memory in an EXCEL file. Additionally, a digital recorder was installed to quantify the duration of each burp (ms) as well as the interval between burps (s). The emission of methane by burps and PEs was calculated every 200 ms: exhaled air volume (L/min) x methane (ppm)/1000000. MATLAB's FINDPEAK program identified burps, then placed them in the EXCEL database and calculated the belch impact time on exhalations. A T test was performed to compare the time and excretion of methane by burps and PE. **Results and Discussion**: methane excreted by PEs represented 91.4 3.16% of the total methane excreted by these routes. The time spent during PEs represented 91.5 3.16% of the total time while the sound duration associated with belching was on average 338 147 ms and the belching interval was 67.3 21.8 s. **Conclusion**: more than 90% of enteric methane excreted via the cranial, is eliminated by PEs. This experiment was executed within the HERMES Project 57857 of the Universidad Nacional de Colombia.

Keywords: Arduino, cattle, FINDPEAKS, MATLAB
Palabras clave: Arduino, bovinos, FINDPEAKS, MATLAB

Excretion of uructed methane in dairy cows

Excreción de metano eructado en vacas lactantes

Héctor J Correa Cardona[1]*, Sebastián Castrillón Mojica[1], Brandon S Bustamante Castañeda[1] and Ligia J Jaimes Cruz[2]

[1]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0000-0002-7371-4640, ORCID 0009-0001-0138-0469, ORCID 0009-0004-6690-3736. [4]Institución Universitaria Visión de las Américas sede Medellín, Colombia, ORCID 0000-0002-3327-0360.
*Corresponding author: hjcorreac@unal.edu.co

Introduction: Methane is a potent greenhouse gas (GHG) produced during enteric fermentation in ruminants and is primarily excreted through belching and exhalation (Proyecto HERMES 57857). **Justification:** The literature is ambiguous regarding whether the route of methane excretion from ruminants is through the mouth or through the nostrils. This is crucial for designing equipment and methods to measure methane emitted by these animals and to enhance understanding of eructation physiology. **Objective:** To determine the relative excretion of methane eructed through the nostrils and mouth in resting, grazing, and rumination dairy cows. **Methods:** Four lactating cows equipped with an electronic spirometric mask (ESM) containing an internal methane sensor to measure gas concentration in air expelled through the nostrils and an external sensor placed on the upper lip to quantify gas concentration excreted through the mouth were utilized from the Paysandú Agricultural Station. While wearing the ESM, the cows were kept in the paddock, and data were recorded for at least five minutes during rest, grazing, and rumination. Methane concentration recorded every 200 ms was analyzed using MATLAB's FINDPEAK program to identify eructations, while comparison of methane concentrations excreted through the nostrils and mouth during eructations was performed using the McNemar test for paired samples. **Results and Discussion:** No methane was detected through the mouth in any of the recorded activities. **Conclusion:** Lactating cows, while resting, ruminating, and grazing, eruct ruminal methane only through the nostrils, not through the mouth.

Keywords: Arduino, data logger, exhalations, gases, lungs
Palabras clave: Arduino, exhalaciones, gases, pulmones, registrador de datos

Quantitative and qualitative characteristics of large and very large beef farms in nine Colombian departments

Características cuantitativas y cualitativas de fincas grandes y muy grandes de carne bovina en nueve departamentos de Colombia

Johana M Leiva Méndez[1*], Ricardo González Quintero[2], María S Sánchez Pinzón[3], Belloncy Gallego Rey[4], Maribel Echeverry Tangarife[4], Antonio Duque Ramírez[4], Sebastián Castrillón Mojica[1] and Rolando Barahona Rosales[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0002-9762-2131, ORCID 0009-0001-0138-0469. ORCID 0000-0002-4246-7835. [2]International Center for Tropical Agriculture (CIAT), Nairobi, Kenya, ORCID 0000-0002-9893-0120. [3]Gerencia de Sostenibilidad NUTRESA, Medellín, Colombia, ORCID 0009-0003-7258-1609. [4]Alimentos Cárnicos S.A.S., Medellín, Colombia, ORCID 0009-0001-4477-4142, ORCID 0009-0002-8059-9158, ORCID 0009-0009-8966-9619.
*Corresponding author: jleivam@unal.edu.co

Introduction: The efficiency and productivity of a livestock system is determined by its technical, productive, reproductive, and environmental characteristics. Characterization studies make it possible to identify inefficiencies and recommend improvements in agricultural practices, technological strategies, and differential public policies for the development of the agricultural sector, emphasizing on increasing productivity and reducing negative environmental impacts. **Objective**: This study aimed to characterize beef production farms located in nine departments of Colombia. **Methods**: Qualitative and quantitative information was collected by applying surveys on 39 farms located in nine Departments (Antioquia, Bolívar, Casanare, Cesar, Córdoba, Magdalena, Meta, Norte de Santander and Santander). The questionnaire used included five components: general farm information, composition and management of the livestock herd, pasture management practices, livestock productive and reproductive information, and environmental information. **Results and Discussion**: Two farm groups (clusters) were identified in the production systems evaluated. The farms in Cluster 2 had lower ($P \leq 0.05$) mortality steer rates, lower steer slaughter age, and tended to have a larger flat land area (P=0.11) than the farms grouped in Cluster 1. Furthermore, the farms in Cluster 2 declared to have higher ($P \leq 0.05$) daily weight gain values compared to those in Cluster 1. Farm characteristics explain their productive results, as greater flat land surface area is associated with lower steer metabolizable energy requirements, lower steer final slaughter age implies shorter time spent within the production system and lower mortality leads to a greater number of kilograms obtained at the end of the cycle, all of which is associated with greater productivity. **Conclusions**: The productivity of the beef production systems evaluated is mainly influenced by their topography, steer mortality and residence time of the animals. There are additional effects of characteristics such as grass species and the adoption of grass management practices, which affect both the nutritional value of the diet and animal dry matter intake.

Keywords: Agricultural practices, farm characterization, livestock productivity, weight gain
Palabras clave: Prácticas agrícolas, caracterización agrícola, productividad ganadera, Aumento de peso

The importance of production animals in humanitarian aid

La importancia de los animales de producción dentro de la ayuda humanitaria

Julia I Lema Vélez[1*] and Diego A Hernández Pulido[2]

[1]Universidad Católica de Manizales. Colombia, ORCID 0009-0009-2178-8400. [2]Fundación Universitaria Agraria de Colombia. Colombia, ORCID 0000-0001-5111-4890.
*Corresponding author: julialemav@gmail.com

Introduction. As we have seen in recent decades, disasters do not distinguish between developing and industrialized countries, nor between rich and poor, however, the frequency and impact of disasters tends to be greater in low-income communities with a high level of vulnerability, and this lack of preparedness and limited resources makes them less resilient and less able to recover. When people depend on their productive animals as a means of subsistence for survival, any resulting losses caused by disasters will be acutely felt, the local economy deteriorates, food insecurity increases, there is loss of livelihoods and disruption of some social determinants such as income, employment, housing, transportation, education and access to healthy food, clean air and water, and health care services that are key to disaster risk management. **Rationale.** Humanitarian aid attempts to assist people after or during a crisis, such as a disaster. It has been observed that if the livelihoods of affected people are not considered in the response, it is more difficult for them to rebuild their lives. **Objectives.** To provide immediate assistance to crisis-affected communities through livestock-focused interventions; To protect key livestock assets of crisis-affected communities; To reconstitute key assets among crisis-affected communities. **Methods.** The Livestock Emergency Livestock Interventions Standards and Guidelines LEGS is applied as a participatory method where communities affected by humanitarian crisis, NGOs, in-country government agencies can and ideally should be part of the process, response options should ensure Animal Welfare, is linked to each technical intervention, focuses on indicators connected to Animal Welfare domains. **Results and Discussion:** Proper selection and validation of a specific intervention improves

and provides a positive impact towards production animals and thus can help people who are economically dependent on them by verifying the advantages and disadvantages, minimum standards of each intervention, ensuring community participation with a gender approach, responding to climate change, supporting preparedness and early action. **Conclusion.** Production animals are of vital importance within humanitarian aid, by including them in disaster response we help people to recover their economies, have food security and reactivate their economies.

Keywords: Animal welfare, disasters, livestock, livelihoods
Palabras clave: Bienestar animal, desastres, ganadería, medios de subsistencia

NUTRICIÓN Y ALIMENTACIÓN

In vitro methane production from ruminant diet supplemented with biofermented palm kernel cake

Producción de metano *in vitro* en dietas para rumiantes suplementadas con torta de palmiste biofermentada

Aldo J Ibarra-Rondón[1*], Pedro J Fragoso-Castilla[1], Rolando Barahona-Rosales[2] and José E Mojica-Rodríguez[3]

[1]Universidad Popular del Cesar. Programa de Microbiología, Colombia, ORCID 0000-0002-9937-4488, ORCID 0000-0002-3437-8664. [2]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0002-4246-7835. Corporación Colombiana de Investigación Agropecuaria. Centro de Investigación Motilonia, Agrosavia, Colombia, ORCID 0000-0001-7751-8631.

*Corresponding author: aldoibarra@unicesar.edu.co

Introduction: Following a biorefinery and circular bioeconomy approach, lignocellulosic waste from oil palm can be bioconverted to fungal biomass, becoming a highly nutritional alternative feed for ruminants, with potential in ruminal methane (CH_4) mitigation. **Objective**: To evaluate the changes in the nutritional value of palm kernel cake fermented with *Pleurotus ostreatus* (FPKC-Po), as well as to evaluate changes in the fermentation parameters and *in vitro* methane production in tropical forage diets from extensive and silvopastoral systems with the inclusion of 20% FPKC-Po. **Methods**: Palm kernel cake was cultured with *P. ostreatus* under a solid-state fermentation (SSF) process for 13 days. Diets based on forages from extensive systems were formulated with *Megathyrsus maximus* cv. Agrosavia sabanera and silvopastoral systems with *Leucaena leucocephala* and *Guazuma ulmifolia* including 20% of FPKC-Po. These diets were evaluated in a short-term (48 h) *in vitro* gas production experiment, measuring degradation parameters and *in vitro* methane production. **Results and Discussion**: Fermentation with *Pleurotus* decreased ($p< 0.05$) the contents of neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin (LIG) by 29%, 20.5% and 46.6% respectively and increased the crude protein (CP) by 69.65%. The inclusion of FPKC-Po in the diets resulted in increases ($p< 0.05$) in the degradation of dry matter, NDF, ADF and CP in the range of 16.94% to 17.32%, 10.96% to 23.86%, 25.75% to 27.5% and 11.68% to 30.4%, respectively. Acetate production decreased ($p< 0.05$) and propionate increased ($P< 0.05$), resulting in a low A:P ratio in the diets with the inclusion of FPKC-Po. The synthesis of net CH_4, CH_4/g incubated DM and mL CH_4/g degraded DM, decreased ($P< 0.05$) between 15% to 24.3%, 15.6% to 24.9% and 27.3% to 35.9%, respectively in the diets with FPKC -Po. **Conclusion**: The inclusion of FPKC-Po in tropical diets for ruminants improves the nutritional quality of the rations, optimizes ruminal fermentation parameters, and reduces methane production *in vitro*.

Keywords: Agro-industrial byproducts, Animal feed, bioconversion, bioeconomy

Palabras clave: Productos agroindustriales, Alimentación animal, bioconversión, bioeconomía

Comparative analysis of chemical fractions in three types of silages in northern Cesar

Análisis comparativo de fracciones químicas en tres tipos de ensilajes en el norte del Cesa**r**

Alejandro Strauch[1*], Hanzel A Hortúa Castro[1], Dalia M Rodríguez Jiménez[1] and Aldo J Ibarra Rondón[1]

[1]Centro de Desarrollo Tecnológico del Cesar, CDT Cesar. Unidad de Investigación Ganadera, Valledupar, Cesar, Colombia, ORCID 0000-0001-6175-2570, ORCID 0000-0003-2393-0633, ORCID 0000-0001-5860-9765, ORCID 0000-0002-9937-4488.

*Corresponding author: alejandrostrauch@hotmail.com

Introduction: The northern of Cesar exhibits a bimodal curve in precipitation distribution, with the period between December and April being the driest. Consequently, one of the main alternatives for supplementing cattle is ensilage. However, producers are unaware of the chemical characteristics of this feed. **Objective:** To identify differences in chemical fractions among three types of silages from 15 livestock farms for self-consumption. **Methods:** Five silage samples were collected from three different raw materials (sorghum, maize, and cut grass). These samples were sent to the Laboratorio de Análisis Químico y Bromatológico de la Universidad Nacional de Colombia – Sede Medellín, where the contents of moisture (H), Crude Protein (CP), Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF), lignin (L), fat (EE), starch, gross calorific value (GE), ash, calcium (Ca), phosphorus (P), magnesium (Mg), and potassium (K) were analyzed. Differences between the types of silage were identified using ANOVA. **Results and Discussion:** No significant differences ($p>0.05$) were found for H (73.2%), ADL (7.07%), P (0.23%), K (2.16%), while significant differences ($p<0.05$) were found for CP (6.22, 8.0, and 2.9%), ADF (43.3, 35.4, 46.1%), NDF (64.5, 56.0, and 68.3%), fat (1.70, 2.20, and 1.64%), starch (2.5, 16.4, and 2.7%), GE (4192, 4427, and 4154 cal/g), Ash (11.37, 6.6, and 11.81%), Ca (0.44, 0.23, and 0.42%), and Mg (0.19, 0.14, and 0.22%) among the three ensiled materials (sorghum, maize, and cut grass). The chemical profile found in the silages allows us to deduce that maize silage could have the best impact on a livestock production system. Being rich in starch, it can be used as an energy source in cattle diets. Additionally, it tends to be more palatable compared to the others, which could result in higher intake. **Conclusion:** Maize silage showed advantages over sorghum and cut grass silages

in chemical fractions such as CP, ADF, NDF, fat, starch, and GE, while showing no differences in H, ADL, P, and K.

Keywords: Cutting grass, chemical analysis, maize, sorghum, supplementation
Palabras clave: Pasto de corte, análisis químico, maíz, sorgo, suplementación

Partially replacing total mixed ration with lucerne maintains *in vitro* methane emissions

Sustituir parcialmente ración totalmente mezclada por alfalfa mantiene las emisiones de metano *in vitro*

Camila Moreira[1]*, Lucia Toledo[1], Cecilia Cajarville[1] and Alejandro Britos[1]

[1]Universidad de la República (UdelaR). Departamento de Producción Animal. Facultad de Veterinaria, Uruguay, ORCID 0000-0001-5776-2688, ORCID 0000-0003-1091-5346, ORCID 0000-0003-3603-3739. *Corresponding author: camimorei22@gmail.com

Introduction: Methane accounts for 51.4% of greenhouse gasses produced in Uruguay, and enteric fermentation provides almost the total. In addition to negative effects on the environment, methane emissions represent a productive inefficiency. Partial mixed rations improve system profitability and capitalize the benefits of TMRs without reducing consumption and production, depending on the proportion and quality of pastures. In addition, pasture inclusion is related to favorable consumer perceptions, animal welfare, and nutritionally healthier dairy products. **Objective:** Evaluate the effect of replacing 40% of a TMR diet with mid-vegetative or early bud lucerne on methane emissions in the rumen simulation technique. **Methods:** A completely randomized design was used with three treatments in duplicate, and three 12-day runs (7 days to balance the system, and 5 days of sampling). Treatments consisted of 3 diets formulated for high-producing dairy cows: (1) 60:40 RTM: mid-vegetative lucerne; (2) 60:40 RTM: early bud lucerne; (3) 100:0 RTM (control). **Results and Discussion:** Daily methane production, per gram of dry matter, organic matter, and neutral detergent fiber degraded, and per mM of volatile fatty acids produced had no differences between treatments (P>0.05). The quality and type of forage influence methane production in the rumen. Young, high-quality pastures produce lower amounts of methane, likely due to their lower fiber content, higher soluble carbohydrate content, and increased digestibility. Lucerne is rich in saponins, a secondary metabolite that inhibits ciliated protozoa and causes a possible decrease in methanogenesis, as part of rumen methanogens live in association with them. **Conclusion:** The results of this study suggest that the substitution of 40% TMR for mid-vegetative or eary bud lucern in dairy cows diets does not affect methane emissions. This represents an alternative to reduce the cost of livestock feed without negatively affecting the environment.

Keywords: Environment, fermentation; *in-vitro,* methanogenesis, partial mixed ration, pasture
Palabras clave: Ambiente, fermentación, *in-vitro*, metanogénesis, ración parcialmente mezclada, pastura

Productive response of tropical grasslands to weed control with different chemical treatments

Respuesta productiva de praderas tropicales al control de malezas con diferentes tratamientos químicos

Cindy A Taborda Piedrahita[1]*, Julián Mejía Orozco[2], José L Guzmán Mendoza[3], Jorge M Romero Kleber[4], Daniel F Ovalle Orjuela[2] and Rolando Barahona Rosales[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0009-9799-0402, ORCID 0000-0002-4246-7835. [2]Corteva Agriscience, Bogotá, Colombia. [3]Distribuciones Hernández & Cia Ltda. Córdoba, Colombia. [4]Coacosta S.A.S. Barranquilla, Colombia.
*Corresponding author: ctaborda@unal.edu.co

Introduction: Most Colombian livestock systems use extensive grazing of grasses in monoculture. Typically, forage productivity has many limitations, among them the presence of weeds that must be controlled to guarantee the permanence and persistence of pastures. **Objective**: This study aimed to evaluate the agronomic response, the productive response of typical cattle in the Colombian Caribbean region and the economic response of pastures subjected to chemical weed control treatments. **Methods**: In four locations, with the presence of *Bothriochloa pertusa* or *Brachiaria brizantha*, three chemical treatments were evaluated in plots of 20 x 10 m each (T1: Aminopyralid 25 gai/L, Fluroxypyr 50 gai/L, 2.4-D 250 gai/L. T2: Picloram 80 gai/L, 2.4-D 160 gai/L + metsulfuron methyl 600 gai/L T3: Picloram 15, 2.4-D 150 + metsulfuron methyl 600 gai/L; dosed according to local weed conditions. The type and state of the weeds and the condition of the forage were determined by a comparative yield method and bromatological analysis. For two of the locations, productivity and stocking rate were estimated using the LRNS software. **Results and Discussion:** Forage production (kg DM/ha) in the plots that received the chemical treatments, annual average for all locations, corresponded to T1: 10,000, T2: 7,064, and T3: 7,428 kg DM/ha, higher than for the control treatment, where 5791Kg DM/ha were produced (P< 0.05). This represented forage biomass productions of 1.73, 1.14 and 1.28 times that observed with the control treatment, for treatments T1, T2 and T3, respectively, (P<0.05). Regarding animal productivity, increases in stocking rate (UGG/ha) and productivity (liters of milk/ha/year) obtained above those observed for the control treatment, were 0.9 UGG/ha and 764 in T1, 0.7 and 639 in T2 and 0.5 and 540 in T3, respectively. **Conclusion**: The chemical control of weeds increased forage productivity, allowing greater animal production per hectare. There were lower production costs per liter of milk in the treatments with

the highest forage biomass production, with T1 showing the highest production. Nutritional quality was not affected by weed control treatments.

Keywords: Dry matter intake, nutritional quality, pasture productivity, undesirable plants
Palabras clave: Consumo de materia seca, calidad nutricional, productividad forrajera, plantas indeseables

Feeding strategies and infrequently supplementation for grazing pregnant beef heifers in the tropic

Estrategias de alimentación y suplementación infrecuente para novillas de carne gestantes en pastoreo en el trópico

Deilen P Sotelo Moreno[1]*, Luciano Prímola de Melo[2] Román E Maza Ortega[3] and Edgar A Martínez[1]

[1]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Departamento de Producción Animal, Colombia, ORCID 0000-0002-4282-8864, ORCID 0000-0003-4719-2479 [2]Universidade Federal de Viçosa. Departamento de Zootecnia, Brasil, ORCID 0000-0001-5876-2030. [3]Universidad de Pamplona. Facultad de Ciencias Agrarias, Departamento de Zootecnia, Colombia, ORCID 0000-0002-7925-2264.
*Corresponding author: desotelo@unillanos.edu.co

Introduction: Beef cattle production systems in tropical regions typically have low production efficiency, which is partially a consequence of the reproductive and productive inefficiency of the dams (Sousa et al. 2012). **Objective**: To evaluate the supplementation effects during the second (MID) and third (LAT) trimesters of the pregnancy and infrequent supplementation on metabolic responses of grazing super-precocious Nellore heifers. **Methods:** Thirty-five pregnant Nellore heifers were used, averaging 407±21.6 kg initial body weight, and 5.7±0.20 body score condition. The experimental design was completely randomized in a 2×2+1 factorial arrangement, with two supplementation frequencies: daily or infrequent; and two amounts of supplement: 1 kg/animal/day of supplement in the MID and LAT phase, or 0.5 and 1.5 kg/animal/day of supplement in the MID and LAT phase, respectively, plus a control treatment. The supplement was composed of 97.5% wheat meal and 2.5% urea/ammonium sulphate and containing 250 g/kg crude protein. Differences were considered significant at $P \leq 0.10$. **Results and Discussion:** In the MID phase, serum urea nitrogen (SUN) was greater ($P< 0.10$) on the second collection day to heifers that received daily or infrequent supplementation in amount of 1 kg. No effect ($P>0.10$) of supplementation or supplementation strategies was observed on blood concentrations of total proteins, albumin, glucose, insulin-like growth factor, non-esterified fatty acid (NEFA), or β-hidroxibutirato (βHB). In the LAT phase, heifers supplemented daily with 1.5 kg/day and heifers supplemented infrequently, all showed higher levels of SUN ($P<0.10$) on the second collection day. The NEFA concentration was higher in unsupplemented heifers ($P<0.10$) on the second day. There was no effect ($P>0.10$) of treatments on blood total proteins, albumin, glucose, and βHB concentrations. The higher concentration of SUN is associated with greater crude protein intake via supplement and indicates the capacity to recycle nitrogen and adjust its excretion, while NEFA levels suggest a better energy status in supplemented heifers (Chimonyo et al. 2002; Moreno et al. 2023). **Conclusion:** Supplementation during pregnancy improves beef heifers' SUN levels under grazing conditions. The frequency of supplementation and the amount offered between the second and third trimesters of pregnancy do not impact metabolic responses.

Keywords: *Brachiaria decumbens*, infrequent supplementation, performance, pregnancy
Palabras clave: *Brachiaria decumbens,* suplementación infrecuente, desempeño, preñez

Pennisetum purpureum silage with of fruit juice and pulp as a replacement for molasses

Ensilaje de *Pennisetum purpureum* con zumo y pulpa de frutas como reemplazo de la melaza

Edgar A Martínez[1]*, Amanda Silva Parra[1], Luis C Ramírez Villa[1] and Deilen P Sotelo Moreno[1]

[1]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Colombia, ORCID 0000-0003-4719-2479, ORCID 0000-0001-9872-790X, ORCID 0000-0003-1498-9932, ORCID 0000-0002-4282-8864.
*Corresponding autor: ealejo@unillanos.edu.co

Introduction: Molasses has been culturally used as a source of soluble carbohydrates, an external input that can increase production costs, therefore, the use of other sources of these is considered, as fruit juices (pineapple and mango). **Objective:** To evaluate the fermentative and comparative dynamics of silage Pennisetum purpureum additive with molasses, pineapple (*Ananas comosus*) or mango (*Manguifera indica*) in different concentrations. **Methods:** Chopped and silaged *Pennisetum purpureum* cutting grass with molasses, pineapple or mango was used as sources of soluble carbohydrates in different concentrations (3, 5 and 7%) and two presentations (juice or juice plus pulp). After silage, pH, T° and humidity (24, 48, 72 and 96 hours), chemical composition, and silage palatability (30, 45 and 60 days) were evaluated. **Results and Discussion:** The concentration of dry matter, crude protein, fiber and pH was higher ($P<0.05$) in silage with juice and juice plus 5% and 7% pulp compared to those without any additives or molasses. On the other hand, there are similarities ($P>0.05$) between treatments on temperature and palatability.

Conclusion: The use of pineapple or mango as a source of soluble carbohydrates improves the fermentative dynamics and some chemical characteristics of *Pennisetum purpureum* silage as crude protein, fiber and pH. However, it maintains similarities with the use of molasses, so it can be a sustainable substitute for the production of cutting grass silage.

Keywords: Alimentation, fiber, fermentative dynamic, soluble carbohydrate
Palabras clave: Alimentación, fibra, dinámica fermentativa, carbohidratos solubles

Ruminal probiotic to improve the health and productivity of dairy calves

Fernando Rodríguez Villamizar[1]*, Erika P Grijalba Bernal[1], Juan C Ovalle Masmela[1], Martha L Chaparro Rodríguez[1], Martha I Gómez Álvarez[1] and Hugo R Jiménez Sabogal[1]

[1]Agrosavia, Colombia, ORCID 0000-0002-3798-1717, ORCID 0000-0001-7385-3408, ORCID 0000-0002-7024-0849, ORCID 0000-0003-3534-4551, ORCID 0000-0003-4919-2747, ORCID 0000-0002-7277-8132.
*Corresponding Author: frodriguez@agrosavia.co

Introduction: The excessive use of antibiotics has increased the resistance of pathogenic microorganisms. Probiotics have emerged as one of the alternatives for their replacement and have demonstrated their effectiveness in improving the health and productivity of ruminants. Colombia has a Bank of Rumen Microorganisms isolated from native cattle breeds and its bioprospecting and study reveals its potential in improving the livestock enterprise. **Objective**: Improve the health and productivity of calves by supplying a probiotic of rumen origin. **Methods:** 172 neonatal calves from three dairy farms in the Bogotá savanna were dosed with a microbial consortium of rumen origin and their body weight gains were recorded until the moment of milking, as well as their response in incidence of diarrhea. **Results and Discussion:** The group of calves that received the ruminal probiotic achieved weight gains greater than 22% g/d ($P \leq 0.01$) and simultaneously the number of diarrhea episodes and their severity were lower by 80-90% ($P \leq 0.01$), compared to the untreated control group. **Conclusion**: The probiotic based on microorganisms of rumen origin positively impacted the productive response of the dosed calves and demonstrates its potential as an alternative in replacing antibiotics.

Keywords: Diarrhea, probiotic, rumen, ruminal microorganism
Palabras clave: Diarrea, probiótico, rumen, microorganismo ruminal

Carbon capture by trees and shrubs in different silvopastoral arrangements in tropical dry forest conditions

Captura de carbono por árboles y arbustos en diferentes arreglos silvopastoriles en bosque seco tropical

Gonzalo Villegas[1], Julián Chará[1], Enrique Murgueitio[1] and **Rolando Barahona Rosales**[2]*

[1]Centre for Research on Sustainable Agriculture. CIPAV, Cali, Colombia, ORCID 0000-0002-5241-1181, ORCID 0000-0001-6561-4546, ORCID 0000-0001-6956-4187. [2]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia. ORCID 0000-0002-4246-7835.
*Corresponding author: rbarahona@unal.edu.co

Introduction: The incorporation of trees in pastures allows carbon capture and reduces the carbon footprint of livestock farming. The carbon sequestration potential of agroforestry systems is highly variable and must be measured to estimate the balance between emissions and captures in a given productive ecosystem. **Objective**: To determine the potential for carbon capture by trees and shrubs in different silvopastoral arrangements in tropical dry forest. **Methods**: Fifteen farms located in the Cesar River Valley were included. The arrangements studied were: (1) intensive silvopastoral with timber (ISPS+M), 8,000 plants ha^{-1} *Leucaena leucocephala* (lam.) de wit *cv* Cunningham, *Megathyrsus maximus* (Jacq.) B.K. Simon & S.W.L. Jacobs and strips of *Eucalyptus tereticornis* trees plus native trees with 294 trees/ha; (2) intensive silvopastoral (ISPS), 16,000 plants ha-1 *L. leucocephala*, *M. maximus, Bothriochloa pertusa* (L.) A. Camus and 58 native trees/ha, and (3) dispersed trees (DT), *M. maximus, B. pertusa* and 133 native trees/ha. The aboveground biomass of trees and shrubs was determined using allometric equations and the carbon content in trees and branches fallen on the ground, leaf litter and underground biomass was also estimated. **Results and Discussion**: The carbon content (Mg/C/ha) was higher ($P<0.05$) in ISPS+M (24.9) than for ISPS (7.0) and DT (7.4), while the annual carbon capture rate (Mg/C/ha) of ISPS+M (2.46) and ISPS (1.56) was greater than that of DT (0.64). Considering the emissions (CO_2-eq/ha/year) reported for bovine fattening in the respective silvopastoral arrangements, captures by trees and shrubs could offset 103.6, 65.7 and 48.4% of these emissions in ISPS+M, ISPS and DT, respectively. Likewise, the emissions intensity (CO_2-eq/ha/year per kg of weight gain) would be -0.33, 3.1 and 6.2 in ISPS+M, ISPS and DT, respectively, very low values compared to the 15.5 Colombian overall value. **Conclusion**: The presence of trees and shrubs in the different silvopastoral arrangements constitutes a highly efficient way to reduce the carbon footprint in tropical dry forest livestock systems, with ISPS+M and ISPS being the arrangements with the greatest impact in this regard.

Keywords: Beef, carbon footprint, intensive silvopastoral systems, *Leucaena leucocephala*
Palabras clave: Carne bovina, huella de carbono, sistemas silvopastoriles intensivos, *Leucaena leucocephala*

Measurement of fermentation gas production with ruminant feed using a demonstrative continuous flow biodigester

Medición de la producción de gases de fermentación con alimentos para rumiantes usando un biodigestor de flujo continuo demostrativo

Ligia J Jaimes Cruz[1], José E Escobar Riomalo[1], Sara Muñoz[1] and **Héctor J Correa Cardona**[2*]

[1]Institución Universitaria Visión de las Américas sede Medellín. Colombia, ORCID 0000-0002-3327-0360. [2]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0000-0002-7371-4640.
Corresponding author: hjcorreac@unal.edu.co

Introduction: Determining fermentative activity in the rumen is of paramount importance for the nutritional evaluation of ruminant feed. Continuous flow biodigesters incorporating mechanisms to control the physicochemical environment can serve as an alternative for conducting such studies (Proyecto HERMES 57857). **Justification:** Restrictions on the use of surgically modified animals for research purposes are increasing, necessitating the exploration of alternative techniques. **Objective:** To determine gas production from molasses, corn meal, and kikuyu grass hay in a partially controlled continuous flow biodigester. **Methods:** A continuous flow biodigester was assembled using a 20 L plastic container equipped with a 20 rpm mixer, a heating blanket with a thermostat set to 39 °C, and sensors for temperature and pH monitoring. Additionally, a 5 mm outlet with a valve for fermentation gases was incorporated. Fresh bovine feces were used as inoculum mixed in a 1:1 ratio with tap water at 39 °C, occupying 75% of the biodigester space. After two days of incubation, the biodigester was fed with 26 g of molasses, 50 g of corn meal, or 75 g of kikuyu grass hay ground to 2 mm, with three repetitions in different sequences over three consecutive days, with approximately two-hour intervals between each feeding. A 1 m long silicone hose was connected to the fermentation gas outlet, with its end inserted into an inverted 100 ml burette filled with water to measure gas volume displacement. Gas production kinetics parameters were estimated. **Results and Discussion:** Gas production from fermentation was highest and fastest with molasses and lowest with kikuyu grass (P<0.01). **Conclusion:** The continuous flow biodigester using fresh bovine feces can be an alternative for conducting studies on ruminant feed fermentation.

Keywords: Corn meal, fermentation kinetics, kikuyu, molasses
Palabras clave: harina de maíz, Cinética de fermentación, kikuyo, melaza

Suplementación con fuentes orgánicas de microminerales sobre parámetros reproductivos y productivos en vacas lecheras

Supplementation with organic sources of microminerals on reproductive and productive parameters in dairy cows

Jairo A Pardo[1], Diana C Mogollón[2], María J Muñoz[3], Saira Romero[1], Vladimir Tovar[1] and Román Castañeda[1]

[1]Universidad del Tolima. Departamento de Producción Animal, Ibagué, Colombia. [2]Universidad Cooperativa de Colombia, Ibagué, Colombia. [3]Biopres Sas. Tolima, Colombia.
*Corresponding author: japardo@ut.edu.co

Introduction: Dairy production efficiency and reproductive indicators are critical in dairy farming. Microminerals, such as copper (Cu) and zinc (Zn), are vital for these processes. Justification. Investigating the organic and inorganic sources of these microminerals in dairy cows can determine the effectiveness at the productive and reproductive levels. **Objective:** To evaluate the effect of organic Cu and Zn microminerals sources on reproduction, production and milk composition parameters in Gyr x Holstein cows. **Methods:** Forty-five multiparous cows were used, with an average live weight (BW) of 500±28 kg during 180 days of lactation. The study was carried out at Hacienda Pedregal, department of Huila, Colombia. Three treatments were assigned: T0, without Zn and Cu minerals; T1, with inorganic Zn and Cu (zinc oxide and copper sulfate sources); and T2, with organic Zn and Cu minerals (amino acid chelated mineral sources). The cows were kept on Brachiaria decumbens rotational pasture and were supplemented during milking twice a day with commercial concentrate and the different mineral sources according to treatment, together with the rest of macro and microminerals. In addition, they were fed corn silage ad libitum for 3 hours before the afternoon milking. Nutritional requirements were adjusted according to NRC (2001) recommendations for a 500 kg cow with a milk production of 20 kg/day, 34 g/kg milk fat and 32 g/kg crude protein. **Results and Discussion:** Results showed that the inclusion of the organic mineral sources Zn and Cu had a significant effect (P<0.05) on total days open and services per conception compared to T0 and T1 treatments. However, no significant differences in milk production and milk quality were observed among treatments. **Conclusion:** organic mineral supplementation improved reproductive parameters in Holstein x Gyr dairy cattle, suggesting its potential benefit in reproductive management in this type of cattle.

Keywords: Dairy cattle, mineral supplementation, microminerals
Palabras clave: Ganado de leche, microminerales, suplementación mineral

Evaluation of different protein sources in cattle and their effect on productive indices

Evaluación de diferentes fuentes proteicas en bovinos y su efecto sobre los índices productivos

Jorge D Caballero Mascheroni[1]*, Angel M Benítez Rodríguez[1], Tania Fariña Díaz[1] and Guido A Portillo[1]

[1]Universidad Nacional de Asunción. Facultad de Ciencias Agrarias, San Lorenzo, Paraguay, ORCID 0000-0002-1722-8883, ORCID 0000-0003-2649-948X, ORCID 0000-0002-7151-0476, ORCID 0000-0003-0749-0826.
*Corresponding author: daniel.caballero@agr.una.py

Introduction: The beef sector holds significant importance for Paraguay, it is a cornerstone of the economy providing substantial employment opportunities for millions of families. Bovine feedlot system plays a pivotal role shortening production cycles for beef producers. Among the various costs associated with feedlot operations, diet constitutes the highest percentage, prompting the need to find suitable diet components that optimize productive efficiency while minimizing costs. **Objective**: This research aims to assess productive indicators of beef feedlot by using different protein sources while maintaining consistent levels of protein and energy intake in the diet. **Methods:** The experiment took place in the Caaguazú department of Paraguay over a period of 70 days. A completely randomized design with three treatments, three repetitions, and five sample units per repetition, totaling 45 experimental units, was employed. The sample units were nelore steers averaging 30 months of age weighing approximately 420 kilograms. The treatments were T1: soybean meal (15%), ground corn (45%), wheat bran (25%), and soybean hulls (15%); T2: corn distiller's grains (30%), ground corn (40%), wheat bran (15%), soybean hulls (15%); T3: coconut (*Acrocomia aculeata)* meal (30%), ground corn (45%), wheat bran (15%), soybean hulls (10%). The variables analyzed included daily weight gain (DWG), total weight gain (TWG), voluntary intake, feed conversion ratio (FCR), hot carcass weight (HCW), and carcass yield. Statistical analysis was conducted using ANOVA followed by Tukey's test at a significance level of 5%. **Results and Discussion:** The results indicate no significant differences between treatments, with average values for DWG at 1.26 kg/day, TWG at 89 kg, voluntary intake at 2.43% of body weight, FCR at 9.76 kg/kg, HCW at 56.42%, and HCW weight at 276.87 kg. **Conclusion:** It is concluded that all diets analyzed were technically feasible across all studied variables.

Keywords: Coconut, corn, feedlot, soybeans, steers, wheat
Palabras clave: Coco, maíz, confinamiento, soja, novillos, trigo

Intake and digestibility in calves with different nutritional management in a dual-purpose system

Consumo y digestibilidad en terneras con diferente manejo alimenticio en un sistema doble propósito

Luis Altahona Buelvas[1]*, José Garcés Urrego[1] and René M Patiño Pardo[1]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0009-0007-8476-0857, ORCID 0000-0009-0007-5066-4138, ORCID 0000-0001-6137-6384.
*Corresponding author: lgaltahona@gmail.com

Introduction: Dual-purpose bovine production systems (SDP) are widespread in the Caribbean region of Colombia. **Justification:** In the SDPs of the region, poor performance of the calves has been noted, due to the nutritional management given. **Objective:** To evaluate the effect of three supplementation strategies on feed intake, digestibility and weight variation of lactating female calves in a SDP. **Methods:** Twenty-one female calves (127.5±16 Kg) were, randomly, assigned to three treatments: T1 (Control): Hay + mineral mixture (SM); T2: Hay + multiple mix (SP) and T3: T1 + Concentrate (CON; 0.5% LW). SM and SP were offered ad libitum, the latter being a commercial product with minerals, energy, and protein sources. The experimental period was 72 days, within which nine were dedicated to the study of the feed intake and digestibility of DM and NDF, using the marker technique. Weight variation was studied in the last month. **Results and Discussion:** Supplement intake was 0.2 (SM), 0.29 (SP) and 1 Kg/d (CON). A trend (P=0.084) of increase in DMI was observed when offering SP and CON supplements (T2=1.92 and T3=2.31 kg/d), compared to T1 (1.87 kg/d). Hay (1.62 kg DM/d) and NDF (1.19 kg/d) intake did not vary (P>0.05) between treatments, but a greater intake of NDT was observed in T3 (1.48 kg/d), *vs* T1 (0.85 kg/d) and T2 (1.05 kg/d). The digestibility of DM differed between treatments (P<0.001), with values of 45.2, 49.8 and 56.2%, for T1, T2 and T3, respectively, while that of NDF was lower (P=0.001) in T3 (35.1 %) *vs* T1 (43.9%) and T2 (41.9%), which did not differ from each other. Weight gain varied (P<0.05) as follows: T1 (0.44 kg/d), T2 (0.47 kg/d) and T3 (0.67 kg/d). **Conclusion:** The offer of multiple and balanced supplements improved dry matter intake (additive effect) and its digestibility; however, despite the better performance, a reduction in NDF digestibility was noted in the animals fed concentrate.

Keywords: Concentrates, hay, minerals, performance, ruminants
Palabras clave: Concentrados, desempeño, heno, minerales, rumiantes

Nutritional changes in the phenological curve in a meadow intended for haymaking

Cambios nutricionales en la curva fenológica en una pradera destinada para henificación

María K Gómez Morales[1*], Alejandro Ramírez Madrigal[1] and Jorge M Noreña Grisales[1]

[1]Institución Universitaria Visión de las Américas. Colombia, ORCID 0009-0004-4642-4818, ORCID 0000-0002-3386-3043, ORCID 0000-0002-0668-9369.
*Corresponding author: maria.gomezmo@uam.edu.co

Introduction: Determining the appropriate cutting age of pastures is fundamental for the correct management of livestock systems, this maximizing the proportion of nutrients and aerial biomass of pasture; to that extent it becomes strategic to know the phenological curve of the pasture supplied to the animals in relation to its biomass and nutritional value agile and fast for timely decision making. **Objective:** To characterize the phenological curve of a grass crop destined for hay in tropical dry forest by means of remote sensing. **Methods:** The study was carried out at the Cotove agricultural station, Santa Fe de Antioquia, in a tropical dry forest ecosystem (B-st) in a plot intended for hay production with dominance of Angleton (*Dichanthium aristatum*) and Climacuna (*Dichanthium annulatum*) grasses. During a period of 8 weeks, an aerial RGB image was taken weekly via unmanned aerial vehicle at an altitude of 100 m, covering the entire field. Each image was processed using the 2aai-rgb algorithm in three previously defined quadrants. The data were processed using the statistical package R Version 4.3.2, identifying for each image the mean of protein, net lactation of energy, minerals and biomass, generating a weekly nutritional value with which a phenological curve was constructed. **Results and Discussion:** Regarding the values of protein, net lactation energy, K, P, Mg, Cu, S and biomass, a growth of their value was observed from the second week to the sixth week, the rest of the minerals and fibers found a peak of concentration in the third week. **Conclusion:** Protein and NDF growth rates are responsible for nutritional composition of the pasture, with the third week being the point of inflection in the phenological curve.

Keywords: Biomass, nutrients, pastures, phenology, remote, sensors
Palabras clave: Biomasa, nutrientes, pasturas, fenología, remotos, sensores

Improvement in fiber degradability with microencapsulated probiotic additives versus monensin sodium in beef

Mejora en la degradabilidad fibras con aditivos probióticos microencapsulados versus monensina sódica en ganado

Josué N Ramón Estévez[1], Javier M Agudelo Rendón[2], Wilyer García Arboleda[2], Iván Pino[2], Andrés Acevedo[1] and **Juan C Arroyave Manco** [1*]

[1]Grupo de investigación nutrición y salud animal, Bialtec SAS, ORCID 0009-0002-7314-338X. ORCID 0000-0002-4696-1777, ORCID 0000-0002-3060-330X, ORCID 0000-0003-2303-7255. [2]Somex SA. ORCID N/A, N/A.
*Corresponding author: jcamilo.arroyave@bialtec.co

Introduction: Sodium monensin, a common antibiotic in cattle feed, poses risks such as toxicity and reduced fertility, prompting regulatory scrutiny and interest in probiotic alternatives to improve gastrointestinal health and nutrient absorption. Microencapsulated probiotics offer potential as substitutes for antibiotics, aiming to enhance ruminal function and weight gain, explored through *in vitro* and *in vivo* models. **Justification:** In response to growing concerns about antibiotic resistance, the livestock industry, which continues to rely on antibiotics and growth-promoting agents, seeks solutions to improve rumen efficiency in systems based on tropical pastures. **Objective:** To evaluate the feed efficiency of cattle subjected to 2 isoenergetic and isoproteic diets: a commercial diet with monensin vs a diet of microencapsulated probiotics (FF) (Fortcell Feed, Bialtec S.A.S). **Methods:** A semi-continuous Rusitec fermenter with 8 vessels was used for a 17-day incubation period, evaluating treatments with sodium monensin and probiotics. Additionally, field tests were conducted on commercial cattle farms, involving 270 animals, to compare weight gain performance between a product containing antibiotics and microencapsulated probiotics. **Results and Discussion:** *In vitro* test results showed that the microencapsulated probiotic treatment had higher degradability (P<0.05) in various parameters, such as dry matter by 11%, and organic matter by 8%. The *in vivo* test evidenced higher daily weight gain (115 g/day/animal) with microencapsulated probiotics than with sodium monensin treatment. Significant differences in body weight gain between diets were found through Monte Carlo simulation, suggesting that diets with better feed conversion ratios offered a better gross margin. **Conclusion:** The use of microencapsulated probiotics in cattle feed salt shows promise as a potential alternative to sodium monensin.

Keywords: Antibiotics, bacteria, Monte Carlo, rumen, rusitec
Palabras clave: Antibióticos, bacterias, Monte Carlo, rumen, rusitec

Use of coffee by-products as an alternative for the supplementation of dual purpose cows

Utilización de subproductos del café como alternativa para la suplementación de vacas doble propósito

Juan L Cardona Iglesias[1*], José F Peñaloza García[2], Juan M Niño Arcila[2], Hugo Velandia León[2], Juan Rueda Albarracín[2], Viviana L Cuarán[1] and Yesid Avellaneda Avellaneda[1]

[1]Corporación Colombiana de Investigación Agropecuaria (Agrosavia), Colombia, ORCID 0000-0001-5225-8108, ORCID 0000-0001-7295-0046, ORCID 0000-0003-2471-5863. [2]Asociación Comunera de

Ganaderos-ASOCOGAN, Colombia, ORCID 0009-0003-6584-2831, ORCID 0009-0005-4861-9384, ORCID 0009-0005-3054-7773, ORCID 0009-0002-9467-1253.
Corresponding author:* jlcardona@agrosavia.co

Introduction: The context of climate change decreases the forage supply and increases the price of commercial supplements, that is why it is pertinent to validate the supply of by-products of the coffee chain to incorporate them in bovine feeding, which promotes a sustainable use of tons of these organic residues that do not have a clear final destination. **Objective:** To evaluate the effect of supplementation with coffee husk and mucilage silage on the productivity of dual purpose cows grazing. **Methods:** This study was carried out in a producer's farm in the municipality of Palmas del Socorro-Santander. The treatments were: grazing + coffee by-product silage (T1) and grazing + balanced feed (T2). The animals grazed *Brachiaria humidicola* pastures. The silage had a storage time of 10 months and was offered at a rate of 2 kg/animal/day and the balanced feed 900 g/animal/day, distributed in two milkings. Twelve dual-purpose cows averaging 105 days of lactation were used. The effect of silage was evaluated during two measurement sequences, each of 12 days (seven days of adaptation and five days of measurement). Using an over-change design, milk production (L/cow/d), protein (% P), fat (% F), total solids (% ST), lactose (% Lac) and milk urea nitrogen (NUL mg/dL) were analyzed. Data were analyzed by ANAVA, (Tukey<0.05), with the MIXED procedure of SAS (version 9.1). **Results and Discussion:** In this study there was no effect of supplementation with coffee by-products silage (P>0.05) on milk production 13.5 and 14.2 L/cow/day, for cows supplemented with silage and concentrate, respectively, nor on milk composition variables; other studies in Colombia and abroad have not shown any effect on milk production when using coffee by-products. **Conclusion:** Coffee by-products can be a promising alternative for bovine supplementation, however, in Colombia it is necessary to continue evaluating aspects of compositional quality, optimal levels of use and animal response, which will provide better tools to give recommendations for the management and use of this type of by-products.

Keywords: Coffee farmer, silage, livestock, recycling, Santander
Palabras clave: Caficultor, ensilaje, ganadería, reciclaje, Santander

Effect of anionic mineral supplementation in prepartum in a dairy

Efecto de la suplementación mineral aniónica en el preparto en un hato lechero

Maria E Bohórquez López[1], Santiago Berrío Calle[1], Oscar A Sáenz Ruíz[1], René Ramírez García[1] and **Juan F Naranjo Ramírez**[1]*

[1]Universidad CES. Grupo de Investigación en Ciencias Animales INCA–CES, ORCID 0003-4597-1089, ORCID 0002-5211-0178, ORCID 0002-3230-6974, ORCID 0002-8026-174X, 0003-3897-5965.
*Corresponding author: jnaranjo@ces.edu.co

Introduction: The transition period in high-yielding cows is a critical phase and has direct effects on the postpartum productive and health status. The nutritional management of prepartum production cows has been tested in research and has been shown to contribute to the postpartum health status by preventing the onset of metabolic deficiency diseases. **Objective**: To evaluate the effect of an anionic supplement in the prepartum of high-yielding cows and monitor some biochemical and metabolic indicators in a dairy herd in San Pedro de los Milagros. **Methods**: 17 non-lactating, multiparous, pregnant cows were randomly divided into two groups: a group called treatment group TTO (n = 13), received 3 kilograms of prepartum balanced feed with the inclusion of anionic mineral supplement at a rate of 360 g / day; the second group called control group CON (n=4), received the same balanced feed without the inclusion of anionic mineral supplement. Both groups received kikuyu grass (Cenchrus clandestinus) with a dry matter offer per animal equivalent to 5% of live weight per day. **Results and Discussion**: In this research, the serial measurements of pH in the urine of cows before calving indicated that the average of the control cows and the treated cows in the prepartum was statistically different (8.24) for the control cows vs (7.5) for the treated cows ($P \leq 0.01$). Although a trend of lower values in urine pH is observed in cows with the anionic treatment, no statistically significant differences were presented when compared with the cows in the control group. There were no notable changes in the serum values of metabolic analytes in cows treated with anionic salts. Differences in iCa+ levels were also not found between the two groups. **Conclusion**: The use of an anionic supplement significantly reduces the urine pH in the prepartum of dairy cows (8.24 vs 7.55), but does not affect the biochemical and metabolic indicators in the early postpartum of dairy cows measured in this study.

Keywords: Calcium, hipocalcemia, metabolism, transition, supplementation
Palabras clave: Calcio, hipocalcemia, metabolismo, suplementación, transición

Evaluation of feeding strategies for female calves in a dual-purpose system

Evaluación de estrategias de alimentación de terneras en un sistema doble propósito

Luis Altahona Buelvas[1]*, René M Patiño Pardo[1] and Moisés A Gaibao Pérez[1]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0009-0007-8476-0857, ORCID 0000-0001-6137-6384, ORCID 0009-0004-6854-3316.
*Corresponding author: lgaltahona@gmail.com

Introduction: Livestock, under the dual purpose (DP) system, is a prominent economic activity in the Caribbean region. **Justification:** The nutritional management to which the offspring are normally subjected limits the performance and efficiency of the system. **Objective:** To evaluate the economic viability and the effect of three supplementation strategies on ingestive behavior and weight gain in calves in a DP system. **Methods:** Twenty-one four-month-old calves (95.9 ±11.5 Kg) remained for 72 days in separate pens from 07:00 to 05:00 the next day, where they were taken to the milking room. Three treatments were evaluated: T1: Hay + mineral mixture (MM); T2: Hay + commercial multiple mix (SP) and T3: T1 + concentrate (0.5% PV), with free access to hay (6.3% CP) and water. The behavioral variables (food and water intake, rumination, rest, walking and idle) were evaluated visually during daylight hours. Weighings were carried out every 21 days. The economic analysis considered weight gain and the cost of the supplement. **Results and Discussion:** T2 animals spent more time (>32%) consuming hay (*P*=0.21), *vs* T1 and T3, which did not vary between each other; Likewise, in these animals (T2) a trend (*P*=0.06) of shorter rest time was noted. The other behavioral variables were not affected by the treatments. The daily consumption of SM was 20 and 30 g in T1 and T2, respectively, that of SP was 0.27 kg and that of concentrate was 1 kg. Weight gain was 0.167, 0.457 and 0.550 kg/d for T1, T2 and T3, respectively, with no differences between T2 and T3, which exceeded T1 (*P*=0.001). The best economic viability corresponded to T2. **Conclusion:** The offer of multiple mixture ("proteinated salt") and concentrate plus mineral mixture improves the weight gain of lactating calves, however, the offer of multiple mixture caused a greater consumption of hay (additive effect) and a performance similar to those that received concentrate, so this alternative presented a better economic benefit.

Keywords: Bovine, calves, performance
Palabras clave: Vacunos, crías, desempeño

Fermentative profile of cassava bagasse silages added with different forages

Perfil fermentativo de ensilados de bagazo de yuca adicionados con diferentes forrajes

René M Patiño Pardo[1]*, Diego A Moya Martínez[1] and Aramy J Vásquez Hermosilla[1]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0000-0001-6137-6384, ORCID 0009-0003-7161-1087, ORCID 0009-0006-1643-0381.
*Corresponding author: rene.patino@unisucre.edu.co

Introduction: During the production of cassava starch (*Manihot esculenta* Crantz), a co-product bagasse is obtained, which is difficult to handle due to its high moisture, disfavoring the environmental impact of the activity. **Justification:** The use of cassava bagasse as food for ruminants is possible, but forms of conservation must be sought that make its use viable. **Objective:** To evaluate the ensilability of cassava bagasse subjected to different drying times and added with different forage resources. **Methods:** Thirty microsilos were used consisting of mixtures of cassava bagasse (CB) and forage foliage: 100% CB (T1); 35% CB + 65% *Guazuma ulmifolia* (T2), 35% CB + 65% *Manihot esculenta* (T3), 35% CB + 65% *Gliricidia sepium* (T4) and 35% CB + 65% *Thitonia diversifolia* (T5), without o with five hours of bagasse drying, for a total of 10 treatments. Dry matter, effluent production, titratable acidity, aerobic stability, pH, sensory quality, and microbial populations were studied. **Results and Discussion:** The DM content increased (P>0.05) with the addition of *G. ulmifolia* (T2), without effect of drying time. The highest effluent production occurred in T1 (*P*<0.05). The titratable acidity increased (*P*<0.05) with the drying in T1 and T3 and with the additions of forage in T2, T3 and T4. The highest temperature values, after the opening of the silos, occurred in the materials without air conditioning and after 24 hours of aerobic exposure. The pH peaks occurred between 3 and 6 days of ensiling, with a general trend of stabilization from day 15, with values of 3.38, 4.11, 3.95, 4.02 and 3.52 for T1, T2, T3, T4 and T5, respectively. The addition of forage led to an improvement in the sensory score. Some differences (P<0.05) were noted between treatments in relation to the proportions of microbial populations (Gram positive - Gram negative). **Conclusion:** Under the conditions of the study, the addition of forage for the preparation of silage based on cassava bagasse reduced effluent losses, maintaining favorable ensilability conditions, with the benefit of drying for five hours in terms of aerobic stability, mainly.

Keywords: Agroindustry, fermentation, ruminants
Palabras clave: Agroindustria, fermentación, rumiantes

Frequency and amount of supplement for grazing beef heifers on productive performance

Frecuencia y cantidad de suplemento para novillas de carne en pastoreo sobre el desempeño productivo

Nelson S Peña Barreto[1]*, Sonia X Maldonado Soto[1], Luciano Prímola de Melo[2] and Deilen P Sotelo Moreno[1]

[1]Universidad de los Llanos, Facultad de Ciencias Agropecuarias y Recursos Naturales, Programa de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0009-0009-9023-3249, 0009-0005-7546-498X, 0000-0002-4282-8864. [2]Universidade Federal de Viçosa, Departamento de Zootecnia, Brasil, ORCID 0000-0001-5876-2030.
*Corresponding author: sonia.maldonado.soto@unillanos.edu.co

Introduction: Supplementation programs for cattle in tropical systems favor the productive and reproductive efficiency of meat-type matrices based on the increased supply of nutrients **Objective:** To evaluate the effect of daily and

infrequent supplementation during the second (MID; 94 to 188 days of gestation) and third (LAT; 189 of gestation at delivery) third of the pregnancy on the productive performance of Nelore heifers in grazing of Urochloa decumbens. **Methods:** 33 pregnant Nelore heifers with average body weight (BW) of 407 21.6 kg and body condition score (BCS) of 5.7 0.20 were used, distributed in a completely random experimental design with factorial arrangement 2 2+1, with two frequencies of supplementation (Daily [7x] and Infrequent [3x] per week and three quantities of supplement (1 kg/day in the MID phase; and LAT and 0.5 kg/day in the MID phase and 1.5 kg/day in LAT), plus a control treatment (not supplemented). The supplement was formulated to present 25% crude protein. Heifers were weighed at the beginning and end of each experimental phase. Milk production and composition were estimated in the postpartum and measurements were made by ultrasonography of the loin eye area (LEA) and subcutaneous fat thickness at the level of Longissimus dorsi (SFTL) and rump (SFTR). Calves were weighed at birth and at the end of the experiment. **Results and Discussion:** The supplemented heifers had greater BW and average daily gain (ADG) during the MID and LAT phases compared to the nonsupplemented ones (P<0.10). No effect of treatments on BW, postpartum ADG, BW and ADG of calves was observed. Additionally, supplementation strategies or quantities did not affect the composition of milk, BCS, LEA and SFTL at the end of the experiment (P>0.10). **Conclusion:** Supplementation during pregnancy improves the productive performance of beef heifers in grazing in the middle and final third of gestation.

Keywords: Nellore, pregnancy, supplementation, *Urochloa*
Palabras clave: Nelore, preñez, suplementación, *Urochloa*

Supplementation effect and parity order of beef cows at postpartum in tropical pasture

Efeito da suplementação e ordem de parto em vacas de corte no pós-parto em pastagem tropical

Yeikot S Escobar Aguilar[1]*, Camila S De Oliveira[2] and Deilen P Sotelo Moreno[3]

[1]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Programa de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0009-0008-7533-3535. [2]Universidade Federal de Viçosa, Departamento de Zootecnia, Brasil, ORCID 0000-0001-9046-9627. [3]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Departamento de Producción Animal, Colombia, ORCID 0000-0002-4282-8864.

*Corresponding author: yeikot.escobar@unillanos.edu.co

Introduction: Postpartum nutrition in beef cows can improve reproductive and productive performance. Studies show that supplementation can help maintain postpartum body condition, influencing cow cyclicity and fertility. However, there is little research on the impact of supplementation on Nellore cows in tropical pastures. **Objective:** To evaluate the effect of postpartum supplementation on the productive response and metabolic status of Nellore cows of different orders of delivery in tropical pasture. **Methods:** Forty Nellore cows were used, 16 primiparous (2.5 0.5 years) and 24 pluríparas (6.2 2.3) with body weight (BW) of 429 40.9 kg and 523 24.0 kg, and body condition score (BCS) of 6.4 0.3 and 6.3 0.6, respectively. The animals were distributed in a completely randomized design in factorial scheme 2 2, resulting in four treatments: P1N, primiparous without supplementation; P1S, primiparous receiving 1 kg/day of supplement; P2N, pluríparas not supplemented; P2S, pluríparas receiving 1 kg/day of supplement. All animals received ad libitum mineral mixture and had free access to water. The supplement was formulated to contain 25% crude protein. The evaluations began on the day of delivery and ended on the 42nd day postpartum for each animal. **Results and Discussion:** There was an interaction effect (P<0.10) between the order of birth supplementation, where independent pluríparas supplemented or primiparous had higher BW compared to the primiparous not supplemented. Supplementation increased (P<0.10) the final BW, BCS, ADG, and BW and ADG of calves at 42 days of age. In turn, there was an effect (P<0.10) of the calving order in which rain cows presented higher final BW, ADG and BW at birth, final BW and ADG of calves up to 42 days of age. On the other hand, there was no effect of supplementation on milk production corrected for 4% fat or total solids. However, rain cows showed higher levels of these elements. **Conclusion:** Supplementation improves the productive performance of beef cows regardless of the order of delivery.

Keywords: Pluriparous, primiparous, protein, supplement
Palabras clave: Pluríparas, primíparas, proteína, suplemento

REPRODUCCIÓN

Prepartum and postpartum supplementation for grazing beef heifers on metabolic response and ovarian morphometry

Suplementación preparto y posparto para novillas de carne en pastoreo sobre la respuesta metabólica y morfometría ovárica

Bryan S Sánchez Beltrán[1]*
and Deilen P Sotelo Moreno[1]

[1]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Colombia, ORCID 0009-0008-9672-5036, ORCID 0000-0002-4282-8864.
*Corresponding author: bryan.stiven.sanchez@unillanos.edu.co

Introduction: Nutrition and reproduction are fundamental but often neglected aspects in beef heifers, which exhibit a high degree of interaction associated with reproductive stress and high nutrient demand. This contributes to reproductive inefficiency in primiparous cows. **Objective:** To evaluate the effect of prepartum and postpartum supplementation on metabolic response and ovarian morphometry in grazing beef heifers. **Methods:** Twenty-eight Nelore heifers with 5.4±0.5 months of gestation, 459.7±6.8 kg, and 5.8±0.10 body condition score (Scale 1-9), respectively, were used. The experiment lasted 210 days and was conducted according to a completely randomized design with four treatments. The treatments were: 0.0, 0.4, 0.8, and 1.2 kg/animal/day of a protein supplement with 25% crude protein. All animals received *ad libitum* mineralized salt and had free access to water. Blood samples were collected 15 days before the expected calving date (–15), and 30 (+30) and 60 (+60) days postpartum to quantify serum urea nitrogen (SUN), non-esterified fatty acids (NEFAs), glucose, total proteins, globulins, triglycerides, and progesterone concentrations. Additionally, on days 30, 45, 60, and 75 postpartum, ovarian (diameter, circumference, and follicle number) and follicular (diameter and volume) measurements were taken from all animals via ultrasonography (Mindray DP-1100 Plus/DP-2200; 5 MHz linear probe). The results were subjected to analysis of variance and decomposed through orthogonal contrasts. Differences were considered significant at P<0.05. **Results and Discussion**: There were no effects (*P*>0.05) of supplement amounts on the diameter, circumference, and number of follicles present in each ovary, nor on the diameter or volume of the largest and second-largest follicle. Supplement amounts increased (*P*<0.05) blood concentrations of SUN and total proteins, with higher concentrations observed in cows receiving a greater amount of supplement. However, no treatment effect (*P*>0.05) was observed on serum levels of NEFAs, glucose, triglycerides, globulins, and progesterone. **Conclusion:** Offering a maximum of 1.2 kg/day of protein supplement to grazing beef heifers during prepartum and postpartum does not improve the energetic status or ovarian morphometry.

Keywords: Follicle, Nelore, nitrogen, supplement
Palabras clave: Folículo, Nelore, nitrógeno, suplemento

Exploring intersex disorder in a Male Gyr Breed from different approaches

Explorando el desorden del intersexo en un macho de la raza Gyr desde diferentes enfoques

Daniel Guzmán Zapata[1]*, René Ramírez[2],
Luis E López[1] and Rodrigo Urrego Álvarez[2]

[1] Universidad CES. Instituto Colombiano de Medicina Tropical, Colombia, ORCID 0000-0003-2545-1994, ORCID 0000-0003-1736-1307. [2] Universidad CES, Medellín. Facultad de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0002-8026-174X, ORCID 0000-0001-5716-5832.
*Corresponding author: rurrego@ces.edu.co

Introduction: Intersex cattle exhibit male and female sexual characteristics with relatively low frequency. However, it has implications for the animal's health and reproductive performance. Identification of these cases is essential for the proper management of the affected individual, as well as the health of the herd in general. Some factors that can contribute to the development of this sexual disorder such as genetic mutations, hormonal imbalance, environmental and nutritional factors, and stress, among others. **Objective:** To evaluate the case of a female-appearing individual of the Gyr race from the birth of twins. **Methods:** At first, it was believed that this was a case of freemartinism due to the presence of rudimentary organs that resemble the vulva, uterine horns, and ovaries. Histological and cytogenetic examinations and sequencing of the total genome of the animal were performed. **Results and Discussion:** The histological examination makes it clear that the cells found in these organs were not female, instead, the structure of the epididymis is observed. Furthermore, through cytogenetic analysis, the Y chromosome was identified in its karyotype. To establish whether this phenotype is associated with changes in a gene or genes related to the development of the male gonad, the animal's complete genome was sequenced (Admera Health), using the Illumina platform, 2x150bp in both directions. Variant and annotation data were compared to the Brahman reference genome. From the sequencing data, 88% of the variant classes were found to be single nucleotide variants (SNVs). Of these SNVs, 40% are found in introns and

51% in intergenic regions which participate in the regulation of the coding genome and could be altering the expression of genes related to sexual development. About the coding regions, 57,000 nonsense variants and 66,000 synonymous variants were found. **Conclusion:** Through histological and cytogenetic studies, a Freemartin syndrome was ruled out and when analyzing the sequencing data, modifications were found in non-coding regulatory regions associated with genes that participate in sexual differentiation.

Keywords:. Freemartins, reproducción, sequencing, sexual development
Palabras clave: Freemartins, reproduction, secuenciación, desarrollo sexual

Effects of body condition score changes on the milk production peak in dairy cows with metritis

Efecto del cambio de condición corporal sobre la producción de leche al pico de lactancia de vacas con metritis

[1]**Daniel Scandolo**[1*], Diego Scandolo[2] , Alejandra Cuatrin[3], Pablo Lopez del Cerro[4], Edgardo Ortega[4], Manuel Casas[4], Antonella Picca[4], Diego Camisasso[5], Javier Camisasso[5], Gustavo Zimmermann[6] and Martin Maciel[2]

[1]EEA INTA. Rafaela, Argentina, ORCID 0000-0001-5469-7462. [2]Facultad de Ciencias Veterinarias, Esperanza, Argentina, ORCID 0009-0008-8397-8499. [3]EEA INTA Paraná, Argentina, ORCID 0000-0001-7327-6110. [4]Actividad Privada, Argentina. [5]La Querencia SRL, Saturnino María Laspiur, Argentina. [6]Laboratorio Over, San Vicente, Argentina.
*Corresponding author: scandololucini.d@inta.gob.ar

Introduction: Cows diagnosed with metritis during the postpartum examination have lower milk production compared to healthy cows. However, there is limited information describing what milk production is like at peak of lactation in cows diagnosed with metritis with variations in their body condition score during the postpartum period. **Objective:** The aim of the present work was to evaluate the effect of body condition score (ΔBCS) changes on milk production at the peak of lactation in dairy cows diagnosed with puerperal metritis. **Methods:** 112 Holstein cows (52 primiparous and 60 multiparous) with metritis, diagnosed during the postpartum examination, were analyzed. They calved between 1/1/22 and 12/31/23 at the La Querencia SRL dairy, Saturnino María Laspiur, Argentina. The scale 1 to 5 of Body Condition Score (BCS) was evaluated at 12.1±5.9 days postpartum (BCS12) and at 64.1±6.1 (BCS64), where the difference between BCS12 and BCS64, was classified into three categories: with gain from 0.25 to 1.0 points (GΔBCS), no change (NCΔBCS) or loss from -0.25 to -0.75 points (LΔBCS). The days in milk (DIM) and the highest milk yield, according to official milk record, were considered. The difference in production between the groups was determined by the Kruskal Wallis Test. **Results and Discussion:** Between day 12 and 64 postpartum, 35.7% of the cows lose BCS, 42.0% showed no changes and the remaining 22.3% gained BCS, lower proportions than the 82.9% reported in cows with various postpartum reproductive events that LΔBCS or NCΔBCS during 40 days potpartum. The DIM at production peaks occurred between the ΔBCS were similar (P>0.05). Peak milk yield was similar in primiparous cows with ΔBSC (P=0.065), while in multiparous cows, it was higher (P=0.03) in cows with LΔBCS (41.7±6. 6 L/d) in relation to cows that NCΔBCS (36.8±7.6 L/d) or GΔBCS (36.3±6.2 L/d). **Conclusions:** Of multiparous cows diagnosed with puerperal metritis, those with loss of BCS within 60 days postpartum have a higher peak milk production in relation to cows that maintain or gain BCS. In this case, BCS changes had more effect on milk production then the puerperal disease.

Keywords: Changes in body condition, metritis, dairy cows, milk production
Palabras clave: Cambios en condición corporal, metritis, ganado de leche, producción de leche

Conception rate of heifers detected in estrus and inseminated twice daily with sexed and conventional semen

Concepción de vaquillonas detectadas en celo e inseminadas dos veces por día con semen sexado y convencional

Daniel Scandolo[1*], Diego Scandolo[2] , Alejandra Cuatrin[3], Pablo Lopez del Cerro[4], Edgardo Ortega[4], Manuel Casas[4], Antonella Picca[4], Diego Camisasso[5], Javier Camisasso[5], Gustavo Zimmermann[6] and Martin Maciel[2]

[1]EEA INTA Rafaela, Argentina, ORCID 0000-0001-5469-7462. [2]Facultad de Ciencias Veterinarias, Esperanza, Argentina, ORCID 0009-0008-8397-8499. [3]EEA INTA Paraná, Argentina, ORCID 0000-0001-7327-6110. [4]Actividad Privada, Argentina. [5]La Querencia SRL, Saturnino María Laspiur, Argentina. [6]Laboratorio Over, San Vicente, Argentina.
*Corresponding author: scandololucini.d@inta.gob.ar

Introduction: The use of sexed semen (SS) in heifers increased from 1.4% in 2006 to 17.8% in 2008, decreasing its use as the number of inseminations (AI) increases. SS is expected to be widely used over the coming decades associated with its continued improvements in fertility and the increased number of replacement heifers. **Objective:** The aim of the present work was to compare the conception rate (CR) of heifers inseminated with sexed or conventional semen (CS), according to the AM-PM rule. **Methods:** During the study (4/1/2023 to 11/30/2023) 7774 AI were performed to heifers belonging to La Querencia S.R.L, Saturnino María Laspiur, Argentina. For the analysis, 1115 services were considered that met two premises: heifers with $\leq$3 services with and empty at pregnancy diagnosis and AI technicians with similar CR either with SS and SC. Heat detection

was carried out by daily observation of tail paint. Those in heat (unpainted) were ramdomly inseminated, according to the AM-PM rule with five CS bulls and three SS bulls with proven fertility. The sperm concentration of SS and CS was 2.3×106 and 20×106 cells/dose respectively. The association between CR and semen type was determined using Chi-square test. **Results and Discussion:** 541 services with CS (48.5%) and 574 with SS (51.5%) were analyzed. No associations were detected between CR and semen type (P=0.8346). First service CR was 59.5% (91/153) and 51.1% (225/440) (P=0.0749) for CS and SS respectively; differences in CR similar to those reported. The second service CR was 46.4% (104/224) and 40.2% (43/107) and at the third service it was 47.0% (77/164) and 63.0% (17/27) for CS and SS respectively. Overall CR was 50.3% (272/541) with CS and 49.7% (285/574) with SS. CR is optimal when inseminated between -4 to +4 hours after the end of heat or when inseminated between 9 to 32 hours after the start of heat, irrespective of semen type. **Conclusion:** The use of sexed semen in heifers detected in heat and inseminated according to the AM-PM rule presents similar fertility in relation to heifers inseminated with conventional semen.

Keywords: Conception rate, sexed and conventional semen, heifers
Palabras clave: tasa de concepción, semen sexual y convencional, novillas

Effects of body condition score changes on milk production peak and reproductive performance of healthy postpartum cows

Efecto del cambio de condición corporal sobre la producción de leche al pico y el desempeño reproductivo de vacas sanas al examen puerperal

Daniel Scandolo[1], Diego Scandolo[2], Alejandra Cuatrin[3], Pablo López del Cerro[4], Edgardo Ortega[4], Manuel Casas[4], Antonella Picca[4], Diego Camisasso[5], Javier Camisasso[5], Gustavo Zimmermann[6] and Martín Maciel[2]

[1]EEA INTA. Rafaela, Argentina, ORDCID 0000-0001-5469-7462. [2]Facultad de Ciencias Veterinarias, Esperanza, Argentina, ORDCID 0009-0008-8397-8499. [3]EEA INTA Paraná, Argentina, ORCID 0000-0001-7327-6110. [4]Actividad Privada, Argentina. [5]La Querencia SRL, Saturnino María Laspiur, Argentina. [6]Laboratorio Over, San Vicente, Argentina.
Corresponding author: scandololucini.d@inta.gob.ar

Introduction: Body Condition Score (BCS) is an individual and subjective visual estimate that allows determining energy reserves, through fat mobilization and protein catabolism. The changes in BCS that occur during the transition period cause metabolic alterations that affects the health, production and reproduction of dairy cows. **Objective:** to evaluate the effect of Body Condition Score changes (ΔBCS) on milk production at lactation peak and the calving-conception interval (CCI) of primiparous and multiparous dairy cows, healthy at postpartum examination. **Methods:** 886 Holstein cows (379 primiparous and 507 multiparous) diagnosed as Normal during the puerperal examination were analyzed. Calvings were between 1/1/22 and 7/31/23 at the La Querencia SRL dairy, Saturnino María Laspiur, Argentina. The 1 to 5 scale of Body Condition Score (BCS) was evaluated at 5.8±2.9 (BCS6) and 64.4±5.5 (BCS64) days postpartum where the difference was categorized: BCS gain from 0.25 to 1, 0 point (GΔBCS), no change (NCΔBCS) or loss from -0.25 to -1.0 point (LΔBCS). Days in milk (DIM) at the highest milk yield according to official records, were also considered. The cows were inseminated at tail paint removal once a day. Differences between groups were determined by the Kruskal Wallis Test. **Results and Discussion:** Between day 6 and 64 postpartum, 49.7% LΔBCS, 35.8% NCΔBCS and the remaining 14.5% GΔBCS, similar to the 77.6% reported for healthy cows with NCΔBCS or LΔBCS. The DIM at production peak were similar between ΔBCS (P>0.05). Multiparous cows with GΔBCS became pregnant earlier (93.6±30.4 days) (P<0.009) than cows with NCΔBCS (103.5±34.5 days) or LΔBCS (107.4±37.5 days), while in primiparous cows, a trend was observed (P=0.069) in favor of those with GΔBCS (98.1±31.1 days) or NCΔBCS (99.7±34.2 days) in relation to those with LΔBCS (106, 7±34.6 days). Cows with LΔBCS and NCΔBCS have a lower probability of becoming pregnant in relation to GΔBCS. The milk production peak differed (P=0.0001) in primiparous with ΔBCS (GΔBCS: 29.3±4.6 L/d, NCΔBCS: 31.3±4.1 L/d and LΔBCS:33.2± 4.5 L/d), while in multiparous cows it was similar and higher in NCΔBCS (42.0±5.7 L/d) and LΔBCS (42.3±6.1 L/d) cows in relation to those with GΔBCS (39.4±6.2 L/d) (P=0.0017). Primiparous and multiparous cows that LΔBCS usually produce 3.3 kg/d and 2.1 kg/d more than cows that GΔBCS. **Conclusion:** Changes in BCS 60 days postpartum, affect milk production and CCI of primiparous and multiparous cows. Cows with LΔBCS have higher milk production peaks and higher CCI in relation to GΔBCS cows.

Keywords: Body condition score change, conception, milk peak, dairy cows
Palabras clave: Cambio de puntaje de condición corporal, concepción, pico de leche, vacas lecheras

Superovulatory response of Hartón del Valle cattle in the recovery of embryos for *in vitro* conservation

Respuesta superovulatoria de bovinos Hartón del Valle en la recuperación de embriones para conservación *in vitro*

David E Quintero-Bastidas[1]*, José H Velázquez Penagos[2], Miguel A Peña Joya[2], Luis F Vargas Vivas[1] and Sonia D Ospina Hernández[3]

[1]Agrosavia. Centro de Investigación Palmira, Colombia, ORCID 0009-0003-3916-0992, ORCID 0009-0002-1338-5264. [2]Agrosavia. Centro de Investigación La Libertad, Colombia. ORCID 0000-0001-7617-6588, ORCID 0000-0002-1957-3381. [3]Zootecnista PhD, Colombia, ORCID 0000-0002-7761-767X.
*Corresponding author: dequintero@agrosavia.co

Introduction: Superovulation biotechnology allows the recovery of embryos of some animal species and has been used in the conservation processes of Animal Germplasm Banks (BGA) that safeguards Agrosavia in Colombia. **Objective:** To evaluate the superovulatory response of Hartón del Valle (HDV) cattle in the recovery of embryos for cryopreservation. **Methods:** Ten HDV females from the BGA of Agrosavia were used and managed in grazing, with water and mineralized salt *ad libitum.* Superovulatory treatment included: day zero, intravaginal device, estradiol benzoate and progesterone. Days 4 to 8, 250 IU of follicular stimulating hormone (FSH) + 250 IU of luteinizing hormone (LH) in decreasing doses, every 12 hours. Day 6, cloprostenol. Day 7, intravaginal removal device. Day 8, gonadorelin and artificial insemination. Day 9, insemination and day 15, embryo collection. The variables recorded were age, number of births, interval between births, weight, body condition (BC), ovarian area and volume, total follicles (TF), total corpora lutea (TCL), total collected structures (TCE), embryos for cryopreservation (ECC), embryos for fresh transfer (EFT) and total embryos (TE). The variables were analyzed with descriptive statistics and Pearson correlations. **Results and Discussion:** The 10 cows were in heat and were inseminated. The TFs were 27 and the TCLs were 115, with an average of 3 and 12 structures per animal, respectively. The average ovarian area and volume were 10.29 cm^2 (±2.86) and 19.30 cm^3 (±7.82) respectively. The TCEs were 86, where 27% corresponded to ECC and 21% to ETF. Positive correlations ($p<0.05$) were found between TF with the animal's weight and BC and between TCL with ovarian area and volume. Cows with BC of 3.0 and 3.5 had a higher TCL count, while those with a higher BC had a higher TF count. This result was probably an effect of the FSH, and the dose applied to cows with higher BC, causing follicular overstimulation without ovulation necessarily occurring. **Conclusion:** These results demonstrate that it is viable to use superovulation to recover embryos from HDV Creole cattle for in vitro conservation purposes; however, research must continue to improve the number of embryos collected.

Keywords: Animal genetic resources, biotechnology, cryopreservation, germplasm
Palabras clave: Recursos zoogenéticos, biotecnología, crioconservación, germoplasma

Effect of low oxygen tension and oocyte origin affect the *in vitro* embryo production rate in bovines

El efecto de la baja tensión de oxígeno y el origen de los ovocitos afectan la tasa de producción de embriones in vitro en bovinos

Diego F Carrillo González[1*], Jesús A Sánchez Viafara[2] and Rafael J Otero Arroyo[1,2]

[1] Universidad de Sucre. Departamento de Zootecnia, Facultad de Ciencias Agropecuarias, Sincelejo, Sucre, Colombia. ORCID 0000-0002-0326-0815, ORCID 0000-0002-5692-3010. [2]Centro de Desarrollo Tecnológico del Cesar, CDT Cesar. Unidad de Investigación Ganadera, Valledupar, Cesar, Colombia. EMBRIOTECNO - Corporación de Ciencias Biotecnológicas, Montería, Córdoba, Colombia. ORCID 0000-0001-7527-3300.
*Corresponding author: diego.carrillo@unisucre.edu.co

Introduction: Although substantial progress has been made in procedures for in vitro maturation, fertilization, and culture of bovine oocytes, the percentage of embryos that can normally develop is still less in the in vitro produced than in those in vivo produced. **Objective:** The present work compared two culture systems, which employ different O_2 tension, evaluating the in vitro production rate of bovine embryos and their kinetic development. **Methods:** A total of 1372 bovine cumulus-oocyte complexes (COCs) were obtained and selected by Ovum pick-up (OPU, 703) and slaughterhouse (669) cows, and subsequently *in vitro* maturated and fertilized. Subsequently, the presumed zygotes of each group were stripped and randomly cultured in one of the two culture systems analyzed. The culture systems evaluated were SOFaa medium and culture for 7 d under 5% CO_2 (adjusted) in air, at 38.5 °C (control); SOFaa medium and culture for 7 d under 5% CO_2 and 5% O_2 (adjusted) at 38.5 °C (treatment). Cleavage rates were evaluated 48 h post-insemination and the blastocyst rates at D6 and D7 post-insemination. The data were analyzed with a GLM and a one-way analysis of variance using Statistica software version 14.0. **Results and Discussion:** In the cleavage rate, no statistical difference was observed ($P>0.05$) between the groups of embryos from oocytes obtained by OPU in high (68.1±9.5%) or low tension (78.7±2.2%) respectively and those from the slaughterhouse in high (82.7±3.8%) and low tension (79.5±3.3%). However, in the embryonic development rate, those embryos coming from COCs by OPU had no statistical difference ($p>0.05$) between high or low tension at day 6 (21.9±9,5% and 22.2±4.3%) and day 7 (25.6±8.5% and 33.33.0%) respectively. On the other hand, embryos from slaughterhouse COCs showed different development kinetics, with a higher ($P<0.05$) embryo production rate at day 6 in low oxygen tension (26.7±2.4%) compared to those grown in high oxygen tension (15.4±3.8%). However, on day 7 a statistical difference was not shown with low tension: 37.2±5.0% vs. high tension: 21.2±4.2%. **Conclusion:** The use of low oxygen tension during the in vitro culture of bovine embryos favors the development kinetics of those embryos from oocytes of lower quality, such as those from slaughterhouses.

Keywords: Bovine embryo, low tension, oxygen, ruminants
Palabras clave: Embriones, baja tensión, bovinos, oxígeno, rumiantes

Cyclic effect of cytoskeleton destabilizing substances on nuclear migration on *in vitro* maturation of bovine oocytes

Efecto cíclico de sustancias desestabilizadoras del citoesqueleto en la migración nuclear, sobre maduración *in vitro* de ovocitos bovinos

Edgar R Moreno Jerez[1*], Brayan S Mantilla Delgado[2], Diego F Dubeibe Marín[3], Deisy J Díaz Sánchez[2] and Martha Y Gutiérrez Ibáñez[1]

[1]Corporación Colombiana de Investigación Agropecuaria, AGROSAVIA. Agustín Codazzi, Cesar, Colombia, ORCID 0000-0001-6784-9250, ORCID 0000-0002-8180-9797. [2]Universidad Cooperativa de Colombia, UCC. Bucaramanga, Colombia, ORCID 0009-0007-9608-6927, ORCID 0000-0003-4134-470X. [3]Universidad de Ciencias Aplicadas y Ambientales, UDCA. Bogotá, Colombia, ORCID. ORCID 0000-0002-9293-7532.
*Corresponding author: ermoreno@agrosavia.co

Introduction: Chemically induced enucleation of oocytes has the capacity to facilitate somatic cell nuclear transfer, treatments with demecolcin in oocytes induce the formation of a protrusion in the cytoplasmic membrane whose content is the condensation of maternal chromosomes that can be eliminated with minimal damage before nuclear transfer is performed. **Justification:** High rates of enucleation based on micromanipulation are evidenced, the effectiveness of these techniques presents low percentages in nuclear transfer results. A direct influence of the presence of the corpus luteum on oocyte quality and final blastocyst production has been observed. **Objective:** To determine the effect of the presence or absence of the corpus luteum and its influence on the rate of nuclear migration in oocytes subjected to *in vitro* maturation and induced with democolcin. **Methods:** Ovaries obtained from a processing plant were classified according to the presence or absence of the corpus luteum for the extraction of oocyte cumulus complexes. Two experimental designs were carried out, the first to determine the effect exerted by the corpus luteum on oocytes subjected to the process of nuclear migration chemically induced by demecolcine at 0.05 µg/mL for two hours, with previous *in vitro* maturation, the second was evaluated on the kinetic process of nuclear maturation. **Results and Discussion:** The rate of nuclear migration on oocytes extracted between ovaries with presence of corpus luteum (CL+) and absence of corpus luteum (CL-), did not determine a statistically significant variability, obtaining percentages of 57.0±7.4 and 54.6±5.6 respectively. The function of the cytoskeleton destabilizing substance is antimitotic and inhibits the organization of microtubules, causing the arrest of the cell cycle in metaphase stage, preventing the formation of the achromatic spindle, ensuring nuclear protrusion with the reagent, observing the polar corpuscle in the cortical region of the oocyte, observing condensed nuclear material. The rate of nuclear maturation of oocytes at 24 hours of maturation, no statistical significance was observed between CL+ and CL- reaching the metaphase II stage. **Conclusion:** Ovarian cyclic status has no influence on the rate of nuclear migration and protrusion in oocytes under democolcin treatment as a promoter of chemical enucleation.

Keywords: Corpus luteum, demecolcin, nuclear maturation, ovarian cyclicity, somatic cell nuclear transfer
Palabras clave: Cuerpo lúteo, demecolcina, maduración nuclear, ciclicidad ovárica, transferencia nuclear de células somáticas

Capacidad antioxidante del plasma seminal de toros criollos colombianos

The antioxidant capacity of seminal plasma from Colombian Creole bulls

Diego A Velasco-Acosta[1], María C Londoño Méndez[2] and **Fabián L Rueda Alfonso**[1]*

[1]Corporación Colombiana de Investigación Agropecuaria (AGROSAVIA), Colombia. Centro de Investigación Tibaitatá, ORCID: 0000-0002-2167-0930, 0000-0002-5502-2544. [2] University of Alberta. Agricultural, Food and Nutritional Science, Animal Science, Canadá, ORCID 0000-0003-2884-6035.
*Corresponding author: frueda@agrosavia.co

Introduction: The biologic antioxidant capacity (BAC) in semen plays a crucial role in its fertilizing capability. This biological system serves to counteract the production of reactive oxygen species (ROS) and encompasses various antioxidant enzymes such as superoxide dismutase (SOD), glutathione peroxidase (GPX), and catalase (CAT). **Objective:** This study aims to determine and compare the levels of some enzymes associated with BAC and oxidative stress in semen from bulls of two creole breeds in the Colombian tropics: Romosinuano (ROMO) and Sanmartinero (SM). **Methods:** Semen from ten ROMO bulls, aged 3.2±0.3 years and housed at the Turipaná Research Center, and ten SM bulls, aged 3.7±1.1 years and housed at La Libertad Research Center, were utilized for this experiment. Semen samples were collected via electroejaculation at three different intervals with a 15-day gap. Seminal plasma was isolated by centrifugation at 3500 x g, 4 °C for 15 minutes and stored in liquid nitrogen until further analysis. BAC was assessed by measuring the activities of SOD, GPX, and CAT in seminal plasma, while oxidative stress was evaluated through lipid peroxidation (LPO) levels in sperm cells. All assays were performed using specific ELISA kits (Abcam, Cambridge, UK) in a 96-well plate reader. Statistical analysis was conducted using a t-test in the SPSS software. **Results and Discussion:** ROMO bulls exhibited significantly higher activity (P<0.05) of SOD, GPX, and CAT enzymes in seminal plasma (103.66±34.7; 72.11±22.3; 0.35±0.16 mU/mL, respectively) compared to SM bulls (45.86±16.1; 17.03±9.2; 0.17±0.08 mU/mL). Additionally, LPO levels were found to be elevated in SM sperm cells (P<0.05) compared to ROMO sperm cells (568.71±212.3 vs 275.75±115.2 nmol malondialdehyde/mL). **Conclusion:** Under their respective conditions, ROMO bulls demonstrated higher enzymatic activity associated with semen BAC, suggesting a more efficient mechanism for mitigating LPO effects in sperm cells. This advantage could be particularly valuable in the context of semen cryopreservation procedures.

Keywords: Antioxidant activity, bovine reproduction, lipid peroxidation, oxidative stress, seminal plasma

Palabras clave: Actividad antioxidante, reproducción bovina, peroxidación lipídica, estrés oxidativo, plasma seminal

Use of ovulation inducing drugs to improve the reproductive parameters of a cattle herd

Uso de medicamentos inductores de ovulación para mejorar los parámetros reproductivo de un hato ganadero

Lina M Pérez Arenas[1*], Jesús A Berdugo Gutiérrez[1], and Elizabeth Quenza[2]

[1]Universidad Nacional de Colombia sede Orinoquia. Arauca, Colombia, ORCID 0000-0002-1556-6387, ORCID 0009-0000-8048-2019. [2]Finca Villa Eliza, Arauca-Arauca, ORCID 0009-0008-9616-4347.
*Corresponding author: linperezar@unal.edu.co

Introduction: The bovine productive system and its parameters have values that are fundamental for herd profitability and sustainability. These can be affected by environmental conditions. To improve reproductive indeces, drugs are used: releasing hormone analogues (GnRH) and progestogens that promote ovulation. **Objective:** To evaluate the effect of the administration of drugs to stimulate ovarian function on short-term pregnancy rates in a herd in the municipality of Arauca, Arauca. **Methods:** This work was carried out between May and December 2023 at the end of the rainy season with an average temperature of 31 °C, in a mestizo cattle herd with a racial variety, located in Arauca, Arauca. Thirty-two randomly selected calving cows aged 6±3.2 years, weighing 300±37 kg, body condition between 2.5 and 3.5 were used. The animals were managed under a feeding regime of savanna grazing, minerals and water ad libitum. They were divided in two groups 17 treated and 15 untreated. The treated were divided into two subgroups: treated group1 (n=9) was given a vaginal implant of progesterone plus estrogen, which was withdrawn after 9 days, and treated group2 (n=8) an intramuscular GnRH analogue. Each batch was left with one bull, and genital check-up was performed at 4 and 6 months to evaluate the pregnancy rate. **Results and Discussion:** 76.4% of treated cows became pregnant, compared to 13.3% of untreated cows, showing a significant difference (*P*=0.001). Among the treatments, 70% of the cows with progesterone and 85.7% with GnRH became pregnant, with no significant difference between them (*P*=0.865). Eighty-eight percent of pregnancies occurred in the first 4 months post-treatment. **Conclusion:** The use of ovulation inducing drugs has a positive effect on ovarian function as evidenced by the increase in pregnancy rate, suggesting simple and effective strategies for the reproductive management of cattle according to the climate of the region. Similar research in the dry season will evaluate how temperature and humidity affect pregnancy.

Keywords: Cattle, improving, pregnancy rates, sincronization

Palabras clave: Vacas, mejoramiento, tasas de preñez, sincronización

Vitrification in Cryotop of bovine *in vitro* embryos guarantees their cryopreservation and survival after warming

La vitrificación en soporte criotop de embriones bovinos producidos *in vitro*, garantiza su crioconservación y supervivencia posterior al calentamiento embrionario

Diego F Carrillo González[1*], Brayan S Mantilla Delgado[2] and **Rafael J Otero Arroyo**[1]

[1]Universidad de Sucre. Sincelejo, Sucre, Colombia, ORCID 0000-0002-0326-0815, ORCID 0000-0002-5692-3010. [2]EMBRIOTECNO-Corporación de ciencias biotecnológicas, Montería, Córdoba, Colombia, ORCID 0009-0007-9608-6927.
*Corresponding author: diego.carrillo@unisucre.edu.co

Introduction: Vitrification protocols for bovine blastocysts have been performed since the 90s by increasing cooling and heating rates, reducing embryonic exposure times to cryoprotectants, and decreasing the volume of culture media. However, many embryo storage supports have been tested during these years, showing very controversial results. **Objectives:** To assess the recovery rate, post-devitrification survival and development resumption of bovine *in vitro* embryos produced and vitrified in cryotop support. **Methods:** A total of 3000 bovine *in vitro* derived embryos were vitrified on day 7 of development using the kit by the Embriotecno - Biotechnology Sciences Corporation. Briefly, the embryos were transferred individually, first in equilibration solution (5 minutes), second in vitrification solution 1 (60 seconds), and third in vitrification solution 2 (30 seconds). Subsequently, each embryo was taken off with the cryotop support and immediately submerged into liquid nitrogen. For warming, each cryotop strip was placed in a warming solution drop of 100 µL during 5 minutes. Then, embryos were transferred to the diluent solution (5 minutes) and washed twice in washing solution (5 min each time) and transferred to the SOF medium drops (70 µL) for 60 h for their posterior re-expansion and hatching assessment. A t student analysis was conducted using Statistica software version 14.0. **Results and Discussion:** Overall, 115 cryotops were subjected to the devitrification process where a recovery rate of 87% (100/115) was found. 65%±10% of blastocysts resumed their development in the first 6 hours. At 18 hours, 60% of blastocysts showed characteristics in cytoplasmic color and morphology that could be validated as viable (60% survival rate), with a hatching rate of 25% and the remaining (75%) expanded embryos. At 24 hours post-devitrification, the hatching rate increased to 33.3%. The results showed similarity with the reports made by Oliveira et al., 2020, Leme et al. 2020; Leme et al. 2020 and Arshad et al.

2021 in terms of embryonic cryosurvival and continuation in development. **Conclusion:** The Cryotop use as a support for the vitrification and storage in the nitrogen of bovine *in vitro* embryos produced guarantees cryopreservation and survival after embryonic warming.

Keywords: Blastocyst, cryopreservation, cryotolerance, ruminants
Palabras clave: Blastocistos, criopreservación, criotolerancia, rumiantes

Freezability of semen from Chino Santandereano breed bulls evaluated by sperm functional competence test
Congelabilidad de semen de toros Chino Santandereano evaluada por prueba de competencia funcional espermática

Norberto Villa Duque[1]*, Ricci Terraza Martínez[1], Elkin O Romero Cárdenas[1], Jorge E Franco Rodríguez[1], and Julián Valencia[2]

[1]Instituto Universitario de la Paz-UNIPAZ, Barrancabermeja. Escuela de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0003-2096-4272, ORCID 0000-0001-8693-1276. ORCID [1]0000-0002-1062-3354, ORCID 0000-0002-3573-442. [2]Universidad Antonio Nariño sede Popayán. Facultad de Medicina Veterinaria, Colombia, ORCID 0000-0003-3983-0389.
*Corresponding autor: norberto.villa@unipaz.edu.co

Introduction: Good seminal quality is necessary for cryopreservation to achieve proper post-thaw sperm survival, especially when it benefits endangered breeds. Functional tests that assess different characteristics within the same spermatozoon, such as the Sperm Functional Competence Test (SFCt; plasma membrane integrity, membrane functionality, acrosomal integrity and sperm morphology), promise greater precision in identifying an optimal subpopulation. **Objective:** To set a new SFCt and determine the association with ejaculates of good (GFE) and poor (PFE) freezability in semen from Chino Santandereano breed bulls. **Methods:** The study was conducted at the Laboratory of Animal Reproductive Biotechnology (LABRA) of the Paz University-UNIPAZ in Barrancabermeja-Santander. Thirty ejaculates from ten bulls were cryopreserved, then classified by freezability level using two-step cluster analysis based on variables: membrane integrity, sperm morphology, and sperm motility using fluorescence, phase-contrast, and computer-assisted sperm analysis (CASA) respectively. The SFCt outcomes in fresh and frozen-thawed semen and compared between both freezability groups through IBM Statistics 27 software. Correlation analysis was conducted for all variables. **Results and Discussion**: Statistic analysis revealed a positive and highly significant correlation (P<0.01) between fresh SFCt and post-thaw motility (r: 0.581), and post-thaw membrane integrity (r: 0.594). This may be because the SFCt evaluates sperm resistance to hypotonic shock, a fundamental characteristic of cells in the freezing protocol. There was no significant difference (P>0.05) between GFE and PFE groups in SFCt levels in fresh semen. However, post-thaw SFCt showed highly significant differences (P<0.01) between freezability groups. The SFCt, by evaluating different sperm characteristics simultaneously, replaces motility and membrane integrity analysis for ejaculate classification by freezability**. Conclusion:** The SFCt evaluated in fresh semen is related to post-thaw sperm variables but does not predict freezability. However, this test, when performed post-thaw, serves to classify ejaculates by freezability, replacing conventional análysis.

Keywords: Cryopreservation, membrane integrity, motility, sperm quality, thawing
Palabras clave: Criopreservación, integridad de membrana, motilidad, Calidad seminal, descongelación

SALUD PREVENTIVA Y BIOSEGURIDAD

Subclinical mastitis determination using the California mastitis test and somatic cell score methods

Determinación de mastitis subclínica mediante los métodos california mastitis test y recuento de células somáticas

Caterine López Sánchez[1]*, Cristian C Rúa Giraldo[1], Juan P Arismendy Morales[2], Cristina Úsuga-Monroy[3] and Albeiro López-Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0005-6937-1082, ORCID 0000-0003-1389-7462, ORCID 000-0003-1444-3470. [2]Colanta, Colombia, ORCID 0000-0002-0524-3162. [3]Corporación Universitaria Remington, Colombia, ORCID 0000-0001-6101-2994.
*Corresponding author: catlopezsan@unal.edu.co

Introduction: Subclinical mastitis affects dairy cows worldwide, causing economic losses due to decreased milk production (up to 30%), increased costs associated with treatments (up to 12.9%), and discards of unproductive animals. **Objective:** Determine the effect of subclinical mastitis (assessed by the California Mastitis Test - CMT and Somatic Cell Score - SCS methods) on udder health and the amount of milk produced in specialized dairy production systems in Antioquia, Colombia. **Methods:** Study population: 224,714 cows currently under milking conditions from specialized dairy systems (mechanical or traditional) in the Aburrá Valley and north and east regions of Antioquia. Sample size: 200 cows located in 20 Colanta dairy control program herds. Samples of 10 animals were randomly taken from each herd. Two visits were made per herd; in each visit (to each cow), the CMT was performed, a milk sample was taken to determine SCS by flow cytometry and CFU, and individual production was recorded. **Results and Discussion:** An average SCS of 134,000/mL and a CMT index of 0.52 were obtained, with a high and positive correlation (90%) between SCS and CMT. These results suggest that CMT is an effective tool to evaluate the mammary health of cows. Additionally, CMT and milk production are negatively correlated (-20%), showing how production is affected in the presence of subclinical mastitis. **Conclusion:** The CMT is a rapid, effective, and low-cost test. Therefore, it would be the test of choice for use in dairy herds since SCS is more expensive and time-consuming to perform. Diagnosing subclinical mastitis is necessary since it has a negative economic impact due to decreased milk production.

Keywords: Compositional quality, diagnosis, disease, production, profitability
Palabras clave: Calidad composicional, diagnóstico, enfermedad, producción, rentabilidad

Effect on productive parameter in specialized bovine dairy of the bovine viral diarrhea and *Neospora caninum*

Efecto sobre parámetros productivos en lecherías bovinas especializadas de la seropositividad a diarrea viral bovina y *Neospora caninun*

Cristian C Rúa-Giraldo[1]*, Albeiro López-Herrera[1] and Tatiana Ruíz-Cortés[2]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0003-1389-7462, ORCID 0000-0003-1444-3470. [2]Universidad de Antioquia. Facultad de Ciencias Agrarias, Biogénesis, Colombia, ORCID 0000-0003-2253-863X.
*Corresponding author: crcruagi@unal.edu.co

Introduction: Bovine viral diarrhea (BVD) and bovine neosporosis (Nc) are transmitted postnatally or in a vertical way (transplacental) and affect reproductive and productive performance in bovines. **Objective:** To determine seropositivity to BVD and Nc in specialized dairy cattle from the department of Antioquia (Colombia), and its effect on productive and reproductive performance. **Methods:** A total of 599 blood samples were taken from 53 dairy herds. Seropositive and seronegative animals were determined by ELISA testing. Productive and reproductive information was obtained from 1363 lactation records. The mean of seven production characteristics: adjusted milk production (MPa), adjusted protein percentage (PPa), adjusted protein kilograms (KgPROa), adjusted fat percentage (PFa), adjusted fat kilograms (KgFATa), somatic cell score (SCS), and lactation duration (DurL); as well as the mean of four reproductive indices: number of services per conception (S/C), age at delivery (ADel), open days (OD) and interval between deliveries (IDel) were associated with seropositivity to BVD and Nc, and their interaction was analyzed using a generalized linear model (GLM). **Results and Discussion:** Seroprevalences of 28.48% and 22.7% were calculated for Nc and BVD, respectively. Nc seropositivity was significantly associated with S/C (P=0.008); BVD seropositivity did not have a significant effect on any parameter, but it tended to affect KgFATa (P=0.08); animals seropositive for both BVD and Nc were significantly affected in IDel (P=0.05). Overall, seropositivity to the two pathogens was significantly associated with a PFa (P=0.03), but not with S/C (P=0.198), nor with ADel (P= 0.349); it was a tendency to affect OD (P= 0.069), KgFATa (0.095) and IDel (P=0.061). **Conclusion:** A significant effect was found between Nc positivity and S/C, in addition to a negative trend in the interaction between the two pathogens evaluated on OD, KgFATa and IDel of specialized dairy herds, negatively affecting the profitability of dairy herds. These results show the

importance of implementing a program to control and prevent the spread of these pathogens to avoid the associated economic reproductive losses.

Keywords: Compositional quality, diagnosis, disease, production, reproduction
Palabras clave: Calidad composicional, diagnóstico, enfermedad, producción, reproducción

Circulation of bovine leukosis virus in specialized dairy herds in Antioquia – Colombia

Circulación del virus de leucosis bovina en hatos de lechería especializada en Antioquia - Colombia

Cristian C Rúa-Giraldo[1]*, Caterine López Sánchez[1], Juan P Arismendy Morales[2], Cristina Úsuga-Monroy[3] and Albeiro López-Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0003-1389-7462,ORCID 0009-0005-6937-1082, ORCID 0000-0003-1444-3470. [2]Colanta, Colombia, ORCID 0000-0002-0524-3162; [3]Corporación Universitaria Remington, Colombia, ORCID 0000-0001-6101-2994.
*Corresponding author: crcruagi@unal.edu.co

Introduction: Bovine leukosis virus (BLV) is a retrovirus that causes enzootic bovine leukosis (EBL). Infected animals remain as carriers and sources of infection throughout their entire life. Transmission occurs through immune cells (B lymphocytes) infected via fluids such as blood, saliva, semen, milk, and colostrum. **Objective:** Establish BLV seropositivity in specialized dairy herds from three regions of the high tropics of Antioquia, Colombia. **Methods:** Twenty specialized dairy herds located in three main dairy subregions of the high tropics of Antioquia were sampled: Aburrá Valley, north, and east. In each herd, 10 production cows were randomly selected. Blood samples were taken from the middle coccygeal vein per animal to obtain sera, which was used to evaluate BLV seropositivity by the ELISA test. **Results and Discussion:** An overall seropositivity of 68.5% for BLV was found in the dairies of Antioquia. In addition, high variability was recorded concerning the results found within the herds, obtaining seroprevalences ranging from 0 to 100%. Only 5% of the herds evaluated (n=1) did not register seropositivity to BLV. Nevertheless, 35% of the herds (n=7) recorded positivity below the general average, and 60% (n=12) recorded values above the average for general positivity. Three of the 12 herds with higher seropositivity showed 100% positivity for infection. Seropositivity varied between 0 and 100% in the subregions, with the northern having the highest BLV circulation. **Conclusion:** The seropositivity data show highly variable BLV circulation in specialized dairy herds in the high tropics of Antioquia, indicating that seroprevalences are generally high. Hence, having productive cows with unidentified leukosis may be favoring transmission.

Keywords: Dairy herds, diagnosis, ELISA, enzootic bovine leukosis, seropositivity, variability
Palabras clave: Hatos lecheros, diagnóstico, ELISA, leucosis bovina enzootica, seropositividad, variabilidad

Subclinical Mastitis in smallholders' dairy farms in Simijaca Cundinamarca

Mastitis Subclínica en hatos de pequeños productores en el municipio de Simijaca Cundinamarca

Andrés F Rodríguez Reyes[1]*, David J González Arenas[1] and Marbel Y Monroy González[1]

[1]Universidad de Cundinamarca seccional Ubaté. Facultad de Ciencias Agropecuarias, Colombia, ORCID 0009-0009-8513-1774 ORCID 0000-0002-7427-3162. [2]Universidad Nacional de Colombia sede Bogotá. Facultad de Ciencias Agrarias, ORCID 0000-0002-5109-1657.
*Corresponding author: myuliethmonroy@ucundinamarca.edu.co

Introduction: Subclinical mastitis is a common disease of the mammary gland that affects the milk production and causes economical losses in smallholders dairy farms. **Objective:** Calculate the incidence of subclinical mastitis and its association with milking routine factors in smallholder dairy herds in Simijaca Cundinamarca. **Methods:** Seven herds were visited two weeks apart for three months, this herd were located in Simijaca Cundinamarca. The presence of subclinical mastitis was evaluated using CMT test, milking routine data was observed and noted in each visit. The prevalence and incidence rate of the disease were calculated, and variables associated with the presentation of subclinical mastitis were determined. A binary logistic regression model was designed and the magnitude of the association was calculated through the OR; any value of $P<0.05$ was considered significant. **Results and Discussion:** The incidence rate of subclinical mastitis was 1 to 2 new cases per 100 animals-day-risk, the prevalence range between 35 and 48%, it was determined that washing hands and disinfecting the teats before milking generates less occurrence of subclinical mastitis cases (OR: 0.3 95% CI: 0.1-0.7, $P=0.007$ and OR: 0.34 95% CI: 0.2-0.7, $P=0.007$, respectively), additionally washing the teats (OR: 0.4 95% CI : 0.2-0.9, $P=0.036$), milk dry teats (OR: 0.4 95% CI: 0.1-0.9, p=0.027 and perform post-milking disinfection (OR: 0.3 95% CI: 0.1-0.7, $P=0.007$) will be adjusted with a lower presentation of the disease. Conclusion. Carrying out a good milking routine, especially washing hands, disinfecting and milking dry teats are factors that protect cows from presenting prevalent subclinical mastitis that affects approximately half of the cattle evaluated and that without. intervening in the milking routine generates new cases of disease.

Keywords: Incidence, risk factors, prevalence
Palabras clave: Incidencia, factores de riesgo, prevalencia

Molecular diagnosis of *Mycobacterium avium* subes. *paratuberculosis* in cattle from Ibagué – Tolima

Diagnóstico molecular de *Mycobacterium avium* subes. *paratuberculosis* en bovinos de Ibagué – Tolima

Jhefferson D Díaz Rojas[1*], Heiner F Uribe García[2], Viviana M Ramírez Navarro [1], Ricaute Lopera Vásquez[1] and Iang S Rondón Barragán[2]

[1]Universidad Cooperativa de Colombia, ORCID 0000-0002-4104-3846, ORCID 0000-0002-2263-7729, ORCID 0000-0001-6792-1961. [2]Universidad del Tolima, ORCID 0000-0001-9115-757X, ORCID 0000-0001-6980-892X.

*Corresponding author: jhefferson.diaz@campusucc.edu.co

Introduction: *Mycobacterium avium* subspecies *paratuberculosis* (MAP) is a Gram-positive, slow-growing acid-fast bacillus, which due to its characteristics of resistance to thermal and chemical changes can be found in the environment for up to a year. This infectious disease with worldwide distribution is one of the most relevant from an economic point of view. Clinically affected animals show progressive weight loss and diarrhea; with involvement in multiple species such as horses, pigs and some wild animals where chronic granulomatous enterocolitis is observed. Additionally, the importance of this bacteria in Crohn's disease in humans has been studied, but its etiological responsibility has not been confirmed. There are different diagnostic techniques used for the detection of MAP, although the molecular PCR technique is ideal for this type of organism and complex heterogeneous samples, it has better sensitivity and specificity characteristics, which, unlike serological tests, will depend on the stage of infection. the illness. **Objective**: To carry out the molecular diagnosis of MAP in cattle from the municipality of Ibagué-Tolima using the nested PCR molecular technique. **Methods**: 265 samples of fecal matter have been collected, obtained from cattle ≥2 years old, the genomic DNA was extracted using the CTAB + protocol. PCI, the presence of DNA was verified with a 0.5% agarose integrity gel and the DNA concentration was measured with the Thermo Fisher Scientific™ NanoDrop equipment. Additionally, conventional PCR was run using the GoTaq® Flexi DNA polymerase enzyme, for the reference gene (e.g. 16s ribosomal). The diagnosis of MAP was carried out by means of the nested PCR technique using specific primers for IS900, an insertion sequence exclusive to MAP. **Results and Discussion**: The prevalence of the processed samples was 55.5%, and risk factors associated with the disease were identified. In addition, the positivity of the individuals was related to sudden deaths without signs of disease, represented with a P value of 0.011. **Conclusion**. The nested PCR proved to be effective in the detection of *M. paratuberculosis* for fecal samples from cattle from the municipality of Ibagué and surrounding areas.

Keywords: Cattle, Colombia, is900, johne's disease, nested PCR
Palabras clave: Ganado Colombia, is900, enfermedad de johne, PCR

PCR and qPCR rapid diagnostic techniques to detect *E. coli* O157 in beef

María Yepes Pérez[1*], Karent Carrero Contreras[1], Neil Vásquez Araque[1] and Amanda L Mora Martínez[1]

[1]Universidad Nacional de Colombia Sede Medellín, Colombia, ORCID 0000-0002-0523-6990, ORCID 0009-0000-2628-3801, ORCID 0000-0002-6492-452, ORCID 0000-0002-3925-2278.
*Corresponding autor: msyepes@unal.edu.co

Introduction: Enterohemorrhagic *E. coli* O157 infections are the leading cause of Hemolytic Uremic Syndrome (HUS) in children. Consumption of raw or undercooked beef from infected cattle can transmit the bacteria, which can adhere to human enterocytes and release Shiga toxins 1 and 2 (Stx 1 and 2), traveling through the bloodstream and severely affecting the kidneys and other smooth tissues. **Objective**: To compare the diagnostic capability of PCR techniques for detecting *E. coli* O157 in beef by amplifying the virulence genes of stx_1 and stx_2. **Methods**: DNA was extracted from *E. coli* O157:H7, ATCC 43895, and protocols for PCR and qPCR were developed to detect stx_1 and stx_2, validating each with cutoff limits, inclusivity, exclusivity, robustness, and testing on a meat matrix. **Results and Discussion**: Cutoff limits for PCR were $3.3x10^{-2}$ ng μL^{-1} and $9.9x10^{-2}$ ng μL^{-1} for stx_1 and stx_2, respectively; for qPCR, they were $1.7x10^{-3}$ ng μL^{-1} and $3.5x10^{-3}$ ng μL^{-1} for stx_1 and stx_2, respectively. Both techniques showed 100 % inclusivity, exclusivity, and robustness. In the artificially contaminated meat matrix, detection was achieved up to 4 CFU mL^{-1} for both qPCR and PCR, with the latter being less reliable. These results confirm the high sensitivity and specificity of molecular techniques, without the need for sample enrichment as required by culture tests, enabling rapid and reliable results to prevent potential foodborne infections. **Conclusion**: With the validation of PCR and qPCR protocols for stx_1 and stx_2, these could be implemented as rapid and reliable diagnostic techniques for detecting contamination in meat with a reduced number of *E. coli* O157, semi-quantitatively with PCR, or quantitatively with qPCR.

Keywords: Cutoff limit, DNA, HUS, Stx toxins, validation
Palabras clave: Límite de corte, ADN, SUH, toxinas Stx, validación

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Evaluation of a portable glucose meter for use in healthy calves

Evaluación de un medidor portátil de glucosa sanguínea en terneros sanos

Daniel Scandolo[1*], Diego Scandolo[2], Alejandra Cuatrin[3], Gustavo Zimmermann[4] and Martin Maciel[2]

[1]EEA INTA Rafaela, Argentina, ORCID 0000-0001-5469-7462.. [2]Facultad de Ciencias Veterinarias, Esperanza, Argentina, ORCID 0009-0008-8397-8499, ORCID 0000-0001-7354-5202. [3]EEA INTA Paraná, Argentina, ORCID 0000-0001-7327-6110. [4]Laboratorio Over, San Vicente, Argentina.
Corresponding autor: scandololucini.d@inta.gob.ar

Introduction: There are various portable meters on the market designed to analyze the blood glucose concentration of humans. However, the low accuracy of these devices for determining glucose in dairy cows would limit their use in veterinary clinical practice. Constant and proportional differences were also described between a portable glucometer and the reference method in sick calves. The aim of the work was to compare the plasma glucose concentration of healthy calves analyzed by a portable glucometer for human use in relation to laboratory enzyme analyzes used as a reference. **Methods:** The work was carried out in a commercial dairy located in Estación Clucellas, Santa Fe, Argentina with 26 Holstein calves during their artificial rearing. At 35 and 42 days of life, blood samples were obtained by jugular venipuncture before the afternoon milk intake. Immediately after that, blood glucose was determined with a portable glucometer (Freestyle Optium Neo Xceed) and 4 mL were deposited in EDTA/Fluoride (Fluoride) tubes that were centrifuged and the plasma separated within 2 hours of sampling. Plasma glucose was determined by the Glucose Oxidase/Peroxidase method, as a reference method. In both determinations it was expressed in mg/dL. Normality of data was determined using the Shapiro-Wilks test (modified). Glucose concordance between the portable meter and the laboratory enzymatic method was performed using the Concordance Correlation Coefficient (CC). Additionally, glucose values were correlated using Pearson Correlation. **Results and Discussion:** The CC was 0.55 between the portable meter and the enzymatic method, which is consistent with poor accuracy. These concordance results differ and are lower than those reported in steers in previous works. A positive correlation was observed in glucose concentration between methods (r=0.67 (*P*<0.0000003)). **Conclusion:** Based on these results, it is concluded that the low accuracy of the portable glucometer, used in the present work, to determine blood glucose in calves would limit its use in clinical practice.

Keywords: Agreement, calves, glucose, portable meter
Palabras clave: Acuerdo, terneros, glucosa, medidor portátil

Productive characterization of dairy farms in three regions of the Colombian high tropic

Caracterización productiva de fincas lecheras en tres regiones del trópico alto de Colombia

José C Montes Vergara[1*], Juan L Cardona Iglesias[2], Edwin Castro Rincón[2], Ronnal E Ortíz Cuadros[2] and Claudia P Rendón Ocampo[2]

[1]Universidad de Córdoba. Facultad de Medicina Veterinaria y Zootecnia, Colombia, ORCID 84559060. [2]Corporación Colombiana de Investigación Agropecuaria (Agrosavia), Colombia, ORCID 52258108, ORCID 98418242, ORCID 39771462, ORCID 11466039.
*Corresponding author: josemontesv@correo.unicordoba.edu.co

Introduction: In the Colombian high tropic, the milk production is one of the main economic activities for the sustenance of many families; however, in some cases the productive performance is low and is reflected in the farmer's profit. **Justification:** Each farm is a scenario that is important to understand in a particular way and as part of the associativity schemes of the producers, so that those differential factors can influence the improvement of the productive performance of the farms. **Objective:** To analyze the productive performance of farms belonging to four associations dedicated to milk production in the high tropic of Colombia. **Methods**: 44 dairy farms located in the municipalities of Cucunubá (Cundinamarca), Belén and Santa Rosa de Viterbo (Boyacá) and Pasto and Cumbal (Nariño) were selected. Data on milk production, compositional quality and profit were obtained, which were used for the classification of producers through a principal component analysis (PCA) and cluster analysis, the characterization of the groups obtained was carried out by descriptive statistics. **Results and Discussion:** Four groups of farms were identified (1, 2, 3 and 4), made up of 9, 10, 15 and 10 producers, respectively. The monthly production of liters of milk per hectare was 589.3L, 258.5L, 934.1L and 666.1L for group categories 1, 2, 3 and 4, respectively. Group 3 was made up of 73% farms from the Cumbal association, which had a better value per liter of milk for compositional quality, while the highest average value of daily production per cow (13. 8L), was presented in group 2 with a greater participation of farms from Cundinamarca (70%). **Conclusion:** The compositional quality of milk represents a differentiating factor for the profit of farmers, especially in a context of payment for quality. Within associations, milk quality programs must guarantee the collective effort and benefit of members.

Keywords: Cluster analysis, indicators, milk production, profit
Palabras clave: Análisis de conglomerados, indicadores, producción lechera, rentabilidad

Implementation of Multilayer Perceptron in predicting the weight of Brahman cattle at differents Ages

Implementación de Perceptrón Multicapa en la predicción del peso de bovinos Brahman a diferentes edades

Luis M Cohen Teherán[1*], Freddy Hernández Barajas[1], Diana M Bolívar Vergara[1] and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0005-5921-5916, ORCID 0000-0001-7459-3329, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.
*Corresponding author: lcohent@unal.edu.co

Introduction: Livestock farms in Colombia generally have limited information on the weights of their animals. The use of the Multilayer Perceptron model for regression (MPR) is a useful tool for data imputation and improving the availability of information on farms for decision-making. **Objective:** To evaluate the predictive capacity of the MPR model to improve weight information at different ages in Brahman animals. **Methods:** A database with 33,948 weights of 4958 Brahman cattle, collected between 2003-2020, was used, along with information on fluctuating variables (sex, conception method, weighing season and year, calving order, and age); in addition to genealogy data. Binary feature matrices representing fluctuating variables of each animal were created using weighing information. A matrix with exact kinship relationships (MC) and a binary kinship matrix (MB) (0: no kinship, 1: kinship) were created using genealogy information. Weights were predicted with and without the use of MC and MB matrices. For each case, the database was split into 80% for training and 20% for validation. Three MPR models were tested, varying in the number of hidden layers and neurons; M1 (128, 64), M2 (200, 100, 50, 50, 50, 30), and M3 (500, 300, 200, 100, 50, 30), using the ReLU activation function. The models were trained for 1000 epochs and evaluated using mean squared error (MSE), coefficient of determination (R2), mean absolute error (MAE), and correlation between actual and predicted weights. **Results and Discussion:** The models presented adequate weight predictions. MSE ranged from 511.24 to 913.81, R2 from 90% to 94%, MAE from 17.47 to 21.7, and correlations between 94 and 97%. The MC matrix provided more stability in the metrics, and the simplest model showed similar results to the most complex model. **Conclusion:** The MPR model captured the nonlinear relationships between genealogy and fluctuating variables of cattle weights, showing high predictive capacity for missing weights.

Keywords: Artificial neural networks, cattle, growth, predictions
Palabras clave: redes neuronales artificiales, bovinos, crecimiento, predicciones

Application of transfer learning in the classification of three bovine breeds using artificial neural networks

Aplicación de transfer learning en la clasificación de tres razas bovinas mediante redes neuronales artificiales

Luis M CohenTeherán[1*], Diana M BolívarVergara[1] and Luis G González Herrera[1]

[1]Universidad Nacional de Colombia sede Medellín., Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0005-5921-5916, ORCID 0000-0002-8063-7874, ORCID 0000-0001-7156-9753.
*Corresponding author: lcohent@unal.edu.co

Introduction: The use of Transfer Learning allows leveraging previously acquired knowledge by a model in one task and adapting it to another related task, for example, in the classification of bovine breeds from images. **Objective:** To develop a precise and efficient bovine breed classification model using Transfer Learning and convolutional neural networks. **Methods:** 517 images were collected from internet sources for each of the three bovine breeds analyzed: Brahman, Guzerat, and Holstein. These were organized into separate folders for each bovine breed and processed using the TensorFlow ImageDataGenerator library in Python to augment the dataset and improve model generalization; pixel normalization was performed to range between 0 and 1, and 20% of the data was assigned for validation while the rest was used for training. Transfer Learning was employed using the pre-trained MobileNet V2 model. The model was trained with a dense output layer to provide classification results. Once trained, it was incorporated into an interactive web page designed with the Streamlit package, allowing users to upload images and make breed predictions. **Results and Discussion:** The model showed an increase in accuracy and a decrease in loss function throughout training, reaching 93% accuracy and 0.17 loss. Evaluation of the model with the validation dataset demonstrated 94% accuracy and 0.17 loss. Utilizing a pre-trained model as a starting point yielded promising results with a relatively small dataset. **Conclusion:** The use of Transfer Learning in bovine breed classification through convolutional neural networks is a viable and effective technique that can be implemented in practical applications using images.

Keywords: Cattle, classification image, races, tensorflow
Palabras clave: Ganado bovino, clasificación de imágenes, razas, tensorflow

Assessment of compositional quality of bovine milk in the municipality of Boyacá-Boyacá

Evaluación de la calidad composicional de la leche bovina en el municipio de Boyacá-Boyacá

Olga L Torres-Neira[1]*, Elkin S Mendoza Doncel[1], Yesid O González-Torres[1] and Diego Hernando Angulo-Florez[1]

[1]Fundación Universitaria Juan de Castellanos, Facultad de Ciencias Agrarias y Ambientales, Colombia, ORCID 0000-0002-5504-6749, ORCID 0000-0001-8748-8421, ORCID 0000-0002-8693-1097.
*Corresponding author: otorres@jdc.edu.co

Introduction: Bovine milk plays a crucial role in the economy and diet of different regions of Colombia. Due to its nutritional content, including proteins, sugars, and minerals, it is recognized as a fundamental component in human nutrition. However, the compositional characteristics of milk can be influenced by various factors, which in turn can affect its quality and, therefore, the payment received by producers. **Objective:** To evaluate the compositional characteristics of bovine milk in the municipality of Boyacá-Boyacá. **Methods:** A descriptive longitudinal study was conducted over a period of 6 months to study quantitative variables important to milk quality in the municipality of Boyacá-Boyacá. A diagnosis was carried out in the study area, 20 producers were selected, and 30 ml samples were collected twice a week, following the protocols of the international standard ISO 707, IDF 50. The samples were processed in the Lactoscan Combo equipment (BOECO, Germany) in the milk laboratory of the Juan de Castellanos University Foundation. The protein (%) and fat (%) variables were tabulated and categorized as excellent (>3.5%), very good (3.2 to 3.49), good (2.9 to 3.19), and poor (<2.89). The total solids (ST) variable was tabulated and categorized as excellent (>12%), very good (11.5% to 11.9%), good (11% to 11.49%), and poor (<10.9%). The data were subjected to descriptive statistical analysis to determine the behavior of the different compositional variables evaluated. **Results and Discussion:** No significant differences were found in the evaluated variables (P>0.05). The average protein, fat, and total solids (%ST) in the collected milk samples were 3.1%, 3.7%, and 12.5%, respectively. Additionally, it was observed that 4.4%, 60.4%, and 71.1% of the analyzed samples were categorized as excellent in the protein (%), fat (%), and total solids (%) variables, respectively, according to the established standards. **Conclusion:** It was determined that 81.1% of the collected milk samples comply with the fat (%) standard, while 93.7% comply with the total solids (%) standard and 91.8% comply with the non-fat solids (%) standard, as required by Decree 616 of 2006. This indicates that the majority of the analyzed samples are suitable for commercialization and processing.

Keywords: Fat, lactose, protein
Palabras clave: Grasa, lactosa, proteína

Respuesta productiva del pasto Guinea (Megathyrsus maximus cv Mombasa) a la aplicación de Diatomita

Productive response of Guinea grass (*Megathyrsus maximus* cv *Mombasa*) to the application of diatomite

Julio Echeverri Gómez[1]*

[1]Universidad de Antioquia. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0001-8721-6004.
*Corresponding author: julio.echeverri@udea.edu.co

Introduction: Fertilization is a cultural practice of utmost importance in the productive response of crops. Specifically, in tropical grasses and forages, alternatives should be sought to improve performance, without affecting the agronomic and economic efficiency of the source used. Diatomaceous soil (diatomite) is a ground natural rock, made up of microfossils of seaweed with high silica content and is beginning to be used globally as a natural fertilizer. There are currently very few research works on the use of diatomite as fertilizer in pastures. **Objective:** To evaluate the agronomic and nutritional response of diatomite in Guinea grass cv Mombasa. **Methods:** Four treatments (doses) of diatomite (T0 = Natural Fertility T1=850 kg/ha, T2=1,600 kg/ha and T3=2,500 kg/ha) were evaluated under a Completely Random Design, in containers with soil volume of 1,300 g. Each container constituted the E.U., with five repetitions per treatment (dose). Dry matter production (kg/ha), dry matter (%), H/T ratio, height (cm), NDF (%), CP (%) and DIVMS (%) were evaluated as experimental variables. **Results and Discussion:** Dry matter production was significantly higher ($P \leq 0.01$) for T2 and T3 (257 g/container and 280 g/container) vs T0 and T1 (156 g/container and 151 g/container). Height was higher ($P \leq 0.01$) for T2 (49.8 cm) vs T0, T1 and T3 (33.8, 34.4 and 33.9) respectively. The percentage of dry matter was higher ($P \leq 0.01$) for T1 (39.05%) in relation to the other treatments (22.47%, 32.16% and 28.11%, for T0, T2 and T3). The H/T ratio was significantly higher ($P \leq 0.01$) in the Diatomite treatments (3.75; 3.49; 3.20 vs 2.75 in T0). No significant statistical differences were found in the nutritional variables for the four treatments. **Conclusion:** Diatomite is a viable alternative to improve some agronomic variables of Guinea grass, especially dry forage production.

Keywords: Algae, doses, fertilizers, forages
Palabras clave: Algas, dosis, fertilizantes, forrajes

RESUMENES

MÓDULO 2

PORCINOS

EXTENSIÓN RURAL

Accompaniment and strengthening of livestock capacities for peasant associations of Catatumbo

Acompañamiento y fortalecimiento de capacidades pecuarias para asociaciones campesinas de El Catatumbo

Heli F Valencia Ocampo[1]*, Nancy Rodríguez Colorado[1] and José M Alba Maldonado[1]

[1]Universidad Francisco de Paula Santander Ocaña. Facultad de Ciencias Agrarias y del Ambiente, ORCID 0000-0002-2627-6414, ORCID 0000-0002-1087-3150, ORCID 0000-0002-5384-7606.
*Corresponding author: hfvalenciao@ufpso.edu.co

Introduction: Rural population in Colombia represents 22.9% of the total population, with a decreasing trend observed; finding that differences between rural and urban areas present a considerable barrier for the sustainable development of rural communities. Therefore, the low level of education and training in the management of biotechnological processes in rural areas has led to a delay in the productive potential of animal production systems guided by traditional management. In this sense, factors such as violence, poverty, presence of armed groups, drug trafficking, among others; are generating an evident phenomenon in the structural changes of rural production in the area. **Objective:** To provide support and strengthen livestock capacities with an emphasis on female members of rural associations in Catatumbo. **Methods:** A survey and quantitative analysis were conducted for the initial diagnosis; likewise, 2 livestock producer associations from Catatumbo participated, with a total of 76 members. **Results and Discussion:** Results show a diverse distribution in terms of age groups, with a significant predominance of individuals in the 27 to 59 age range (60.7%). Female participation was slightly higher than male. In terms of educational level, a variety of levels were observed, with complete high school being the most common (30%). Participation in training sessions reflected in three main topics: artificial insemination in cattle, management and reproduction in pigs, and transformation of dairy and meat products. Regarding knowledge and use of livestock techniques, 55% claimed to know the term "artificial insemination", although only 35% had used this technique in practice. **Conclusion:** Strengthening producers' productive capacities can reduce the gap in productivity and competitiveness of livestock systems. By offering training and updates on new techniques and production strategies, we can enhance the performance of livestock activities, resulting in greater efficiency and profitability for producers.

Keywords: Animal production systems, associations, rural extension, sustainable development
Palabras clave: Sistemas de producción animal, asociaciones, extensión rural, desarrollo sostenible

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Environmental enrichment with the use of *Arachis pintoi* in the production of Creole mulefoot pigs

Enriquecimiento ambiental con uso de *Arachis pintoi* en la producción de cerdos criollos casco de mula

Martha Y Gutiérrez Ibáñez[1]*, Álvaro Rincón Castillo[1], Sonia L Gutiérrez Parrado[1] and Edgar R Moreno Jerez[2]

[1]Agrosavia. Villavicencio, Meta, ORCID 0000-0002-8180-9797, ORCID 0000-0002-2190-1858, ORCID 0000-0002-8329-8302. [2]Agrosavia. Agustín Codazzi, Cesar, ORCID 0000-0001-6784-9250.
*Corresponding author: mygutierrez@agrosavia.co

Introduction: Providing food security in peasant, family and community economy systems through the implementation of an animal welfare strategy in free-range pig production includes aspects such as freedom from hunger, thirst, discomfort, disease, pain, stress and the ability to express normal behaviour (Temple et al. 2011). The current conditions of pig production in small producers in the department of Meta, evidence stress due to inadequate management and extreme temperature conditions with negative consequences for health, welfare and production and even meat quality. In this sense, the aim is to implement environmental enrichment environments to improve the quality of life of confined animals, allowing them to explore and interact with their environment. **Objective:** To implement environmental enrichment strategies with *Arachis pintoi* cv Centauro in a production model based on the five freedoms of animal welfare to improve the production of mule hoof pigs in rotational grazing in Agrosavia. **Methods**: The establishment of the Centauro was carried out with mechanisation of the soil, chemical analysis for fertilisation, establishment in the rainy season with vegetative material, division of 3,600 m2 in 12 paddocks of 300 m^2, installation of drinking troughs and feeding troughs. Planting of shade trees. **Results and Discussion:** The establishment of the forage legume Arachis pintoi cv Centauro offers environmental enrichment of high nutritional value that satisfies the protein requirements of the pig; this outdoor production system stimulates natural foraging behaviour, promotes exercise, provides emotional well-being and reduces the stress generated in traditional pens. The rotational grazing model complies with the five freedoms of animal welfare by promoting health and quality of life during the research with muleteer pigs. **Conclusion:** The legume *Arachis pintoi* cv Centauro is recommended for pig feeding because of its capacity to produce good quality forage, good animal consumption, tolerance to pig grazing and rapid recovery, and is an alternative for environmental enrichment in outdoor systems.

Keywords: Animal welfare, food security, mulefoot, production model

Palabras clave: Bienestar animal, casco de mula, modelo productivo, seguridad alimentaria

GENÉTICA Y MEJORAMIENTO

Growth characterization of the San Pedreño creole pig
Caracterización del crecimiento del cerdo criollo San Pedreño

Jorge G Noriega-Márquez[1]*, Wilson A Barragán-Hernández[1], Sebastián Pineda Sierra[1], Gilberto Tovar Claros[1], Ricardo J Ocampo Gallego[1], Edison J Ramírez Toro[1] and David F Nieto Sierra[1]

[1]Corporación Colombiana de Investigación Agropecuaria – AGROSAVIA. Centro de Investigación El Nus, San Roque, Antioquia, ORCID 0000-0002-9101-6424, ORCID 0000-0003-4808-1201, ORCID 0000-0003-3528-4296, ORCID 0000-0002-1418-6788, ORCID 0000-0001-9993-3561, ORCID 0000-0002-4838-6200, ORCID 0000-0001-5704-7844, ORCID 0000-0003-4808-1201.
*Corresponding author: jnoriega@agrosavia.co

Introduction: Creole pig breeds are considered a genetic resource that present rusticity, adaptation to outdoor conditions and good performance in grazing, characteristics of interest for the development of sustainable production systems in the context of family and community peasant economy. This situation requires knowing its growth to identify parameters of zootechnical interest. **Objective:** Characterize growth in San Pedreño Creole pigs. **Methods:** 26 animals (14 females and 12 males) belonging to the Pig Animal Germplasm Bank of the El Nus Research Center of AGROSAVIA were used. For each animal, weight (kg) and age (months) were recorded; animals with at least 4 weight records were taken into account for the analysis. The animals were fed on pasture, accompanied by a balanced supplement and sugar cane. A health plan was applied in a preventive scheme for outdoor pig production. Brody's mathematical model was used to describe growth, using the NLIN procedure of the SAS statistical package. **Results and Discussion:** For males, the model estimated the parameter β0 (asymptotic weight) at 140.6±9.7, the β1 (integration constant) at 1.125±0.039 and the β2 (growth rate) at 0.112±0.015. On the contrary, for females a value of 115.7±5.28, 1.25±0.057 and 0.158±0.016 was found, for b0, β1 and β2 respectively. Based on these parameters, it was estimated that males reach 75% of their maturity at 5.8 months and 95% at 12 months of age. In the case of females, 75% of their maturity was reached at 4.4 months and 95% at 8.8 months. The results showed a sexual dimorphism with greater weight for males. However, it was observed that females grow earlier, which indicates that they will reach adult weight more quickly. **Conclusion:** The Brody model described the growth of San Pedreño pigs under the conservation core, identifying parameters of interest that allow managing the growth of animals in production systems.

Keywords: Biological development, genetic resources, germplasm banks
Palabras clave: Desarrollo biológico, recursos genéticos, banco de germoplasma

NUTRICIÓN Y ALIMENTACIÓN

Comparison of four diets for weaned "Casco de mula" native pig growth

Comparación de cuatro dietas para cerdos criollos "Casco de mula" destetados

Byron A Hernández Ortíz[1,2*], Álvaro Rincón Castillo[1] and Martha Y Gutiérrez Ibáñez[1]

[1]Agrosavia, Colômbia, ORCID 0000-0002-2390-4323, ORCID 0000-0002-2190-1858, ORCID 0000-0002-8180-9797. [2]Universidade Estadual Paulista - UNESP. Facultad de Medicina Veterinária e Zootecnia - FMVZ, Botucatu, Brasil.
*Corresponding author: byron.hernandez@unesp.br

Introduction: Pig production is increasing both in the number of heads and in the volume of meat produced worldwide; however, global production costs increased significantly in 2022, mainly due to the price of corn and soybean meal. **Objective**: To evaluate the growth of weaned pigs subjected to 4 feeding alternatives. **Methods**: Four feeding treatments with weaned pigs were evaluated: 1. Confinement in a deep litter shed with 100% commercial concentrate (2 kg/animal/day). 2. Free-range animals + 100% commercial concentrate (2 kg/animal/day). 3. Grazing on *Arachis pintoi cv Centauro* + 50% commercial concentrate (1 kg/animal/day). 4. Grazing on *A. pintoi cv. Centauro.* Twelve weaned animals with an average initial weight of 12 kg/animal were used, which remained under evaluation for 157 days. Rotational grazing was performed with five days of occupation and 25 days of rest. Available forages before and after grazing were evaluated, including coverage (%), plant height (cm), cutting height (cm), forage availability (kg DM/ha), and weight gain every 14 days. **Results and Discussion**: Weight gain in animals during the first 30 and 64 days of grazing on *A. pintoi cv. Centauro* showed no significant differences (P>0.05) among the four treatments, with an average of 0.168 and 0.057 kg/animal/day, respectively. From day 91 to day 157, no significant differences (P>0.05) were observed in the confinement + 2 kg concentrate, free-range + 2 kg concentrate, and grazing on *A. pintoi* cv *Centauro* + 1 kg concentrate treatments. The treatment where the animal weight was significantly lower (P<0.05) was the one with only grazing on *A. pintoi cv. Centauro.* **Conclusion**: The rotational grazing system based on *Arachis pintoi* variety *Centauro* with commercial concentrate is a cost-effective alternative for pig production, considering that it can reduce the need for commercial concentrate by up to 50% with competitive growth and weight gains. Acknowledgments: To MADR for funding the project for the conservation of germplasm banks of the Colombian nation.

Keywords: Forage peanuts, grazing, legumes, monogastric, nutrition
Palabras clave: Maní forrajero, pastoreo, leguminosas, monogástricas, nutrición

¿Does *Bacillus subtilis* improve the intestinal structure of the piglet in the post-weaning phase?

¿*Bacillus subtilis* mejora la estructura intestinal del lechón en la fase post-destete?

Víctor H Herrera Franco[1], **Carlos A Maya Ortega**[1], Andrés Gómez Zapata[2] and Jaime E Parra Suescún[1*]

[1]Universidad Nacional de Colombia Sede Medellín. Facultad de Ciencias Agrarias, ORCID 0000-0002-7456-981X, ORCID 0002-5094-7716, ORCID 0000-0003-4472-1326. [2]University of Minnesota. Department of Animal Science, ORCID 0000-0002-1174-0368.
*Corresponding author: jeparrasu@unal.edu.co

Introduction: Weaning is the most critical period during the life of the pig, because its digestive structure has not fully developed at the time of weaning, increasing the appearance of damage to the intestinal structure (barrier), infections (microbial) and diarrhea. The removal of Growth Promoting Antibiotics (GPAs) to prevent infections at the productive level, has increased the commercial development of natural additives that help to reduce the negative effects of early weaning without affecting the health, productivity and profitability of productive systems. **Objective:** To evaluate the addition of different antimicrobials in the food on the productive yield, the genetic abundance of barrier proteins and the intestinal microbiota in weaned piglets. **Methods:** 72 weaned male piglets at 21 days of age were randomized in the following dietary groups: Control Diet 1 (D1-Ctrl): no GPA; Diet 2 (D2-GPA): Ctrl+GPA (bacitracin, 350 ppm); Diet 3 (D3-PROB): Ctrl+*Bacillus subtilis* PB6 (PTA-6737). On 15 and 30 days after weaning, the productive variables were quantified: weight gain-WG and food conversion-FC. On days 1, 15 and 30 postweaning 8 piglets were euthanized by treatment and a portion of the jejunum was removed to quantify the gene abundance of barrier proteins (Ocludin-OCLN, Zónula Occludens-ZO-1 and Claudins-CLAU) and microbiota (diversity and composition). The different variables were evaluated under an experimental design of random complete blocks with 8 replicates **Results and Discussion:** Piglets that consumed during the post-weaning stage the D3-PROB diet had a better productive yield (WG and FC, P<0.05); showed a greater abundance (P<0.05) of CLAU-1,

CLAU-4, OCLN, ZO-1 genes; and increased (P<0.05) the diversity of beneficial genera compared to the addition of D2-GPA (P<0.05)**. Conclusion:** These molecular results may be directly related to the integrity and intestinal health of piglets during postweaning, since supplementation with D3-PROB improved the expression of intestinal barrier genes (CLAU-1, CLAU-2, OCLN and ZO-1) and the distribution and diversity of the intestinal microbiota, which was reflected in the productive parameters (DWG and FCI) evaluated.

Keywords: Growing pigs, gut health, intestinal barrier, microbiome, probiotic
Palabras clave: Cerdos en crecimiento, salud intestinal, barrera intestinal, microbioma, probiótico

Influence of back fat thickness on the beginning of puberty in sows

Influencia del espesor de la grasa dorsal en el inicio de la pubertad en cerdas

Hermes Ordoñez Olivares[1]*, Jorge H Contreras Castro[1] and Jorge E Franco Rodríguez[1]

[1]Instituto Universitario de la Paz. Escuela de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0002-9606-1435, ORCID 0000-0003-3125-8541, ORCID 0000-0002-3573-4421.
*Corresponding author: hermes.ordonez@unipaz.edu.co

Introduction: modern female sows have been selected for a larger production and low-fat percentage. Being more productive and having less reserves of adipose tissue, these sows can also lose weight faster, being fundamental to evaluate body conditions and the nutritional program. Back fat measurement is a tool that allows having a specific control of reserves variation during the replacement cycle, by adjusting feeding and assuring that back fat levels are appropriate. **Objective:** to determine the influence of back fat millimeters in the beginning of puberty's age with the first appearance of the estrous cycle, and the sow's body weight in different breeds, and genetic sow lines in the replacement stage. **Methods:** Experimental, longitudinal, descriptive, and analytical study, supported by a completely randomized DCA design, formulating 3 treatments based on the breeds and genetic lines: T1 – Synthetic line 1 (10 sows), T2 – Synthetic line 2 (10 sows), and T3 – genetic F1 Landrace x Large White (9 sows). For the information analysis, non-parametric statistic was used considering the number of female sows per treatment (lower than 30), based in descriptive and analytic statistic applying the Kruskal-Wallis's test, previously determining normality, equidistributional and homoscedasticity of data, using the Sata 14.0 statistic software. **Results and Discussion:** about the puberty entry age, a significant difference between treatments 1 and 2 was presented, in relation to treatment 3. Regarding the weight of sows, treatment 1 presented significant difference compared to treatments 2 y 3. Concerning back fat millimeters there wasn't significant difference between the three treatments. **Conclusion:** back fat millimeters influence the beginning of puberty by presenting high association (r) in all the treatments (r=0,950, r=0,7663, r=0,9139, respectively), as well as, with body weight in treatment 3 (r=0,7189); nonetheless, mentioned association behavior (r) was opposed in treatments 1 and 2 (r=0,313, r=0,2249, respectively).

Keywords: Association, genetics, nutrition, replacement, swine
Palabras clave: Asociación, genética, nutrición, reemplazo, cerdos

Profitability with Responsibility in pig production

Rentabilidad con responsabilidad en la producción porcina

Miselly López[1]*, Álvaro J Uribe Serrano[1], Blanca C Martínez Morales[1] and Jaime A Ángel Isaza[1]

[1]Unidad de investigación desarrollo e innovación de Promitec. ORCID 0000-0001-8870-6793, ORCID 0000-0002-8417-8687, ORCID 0000-0003-1612-6938.
*Corresponding author: Nutricionanimal@promitec.com.co

Introduction: Pig production in Colombia is a dynamic and growing industry of great importance within the country's livestock sector. Among the significant challenges of current pig farming is maintaining intestinal health throughout the various productive stages of the animals, while also being responsible for environmental and public health. The guidelines of the United Nations' One Health program encourage interdisciplinary collaboration for the care of human, animal, and environmental health in support of public health. Therefore, current pig production systems must integrate new production dynamics while maintaining productivity and profitability. **Objective**: To provide an introduction to the studies and experiences of Promitec Santander regarding the use of different nutraceutical additives to improve the productive health of animals with a focus on replacing food compounds with impacts on public health. **Methods**: For this work, a process of collection, tabulation, and analysis of results from five experimental and field trials conducted by Promitec Santander on the ability of different biotechnological additives as a *Lippia origanoides* essential oils to modulate intestinal health and improve productive yields in pigs during different stages of their life cycle was carried out. **Results and Discussion:** The use of natural biotechnologically based nutraceutical additives has shown the ability to improve productivity and animal health at different moments of the production cycle. This has allowed for pig rearing without the use of growth-promoting antibiotics in both experimental settings and commercial breeding farms, additionally resulting in reductions in mortality and the use of antibiotic treatments in animals. **Conclusion:** The use of these biotechnological compounds serves as an important tool for farms to adapt to new global trends while maintaining productivity and profitability

Keywords: Gut, oregano, pig farming, phytobiotic
Palabras clave: Intestino, orégano, cría de cerdos, fitobiótico

Impact of encapsulated probiotic additives on zootechnical parameters and piglet intestinal microbiota

Impacto de aditivos probióticos encapsulados en parámetros zootécnicos y microbiota intestinal de los lechones

Javier M Agudelo Rendón[1], Juan C Pareja Arcila[2], Oscar A Saenz Ruiz[2], Luis C Veloza Angulo[2], Juan F Naranjo Ramírez[2], René Ramírez García[2], Ángela R Martínez[3] and **Juan C Arroyave Manco[1]***

[1]Grupo de Investigación Nutrición y Salud Animal, Bialtec SAS, ORCID 0000-0002-4696-1777, ORCID 0000-0003-2303-7255. [2]Grupo de investigación INCA-CES, Facultad de Medicina Veterinaria y Zootecnia, ORCID 0000-0002-7220-2141, ORCID 0000-0002-3230-6974, ORCID 0000-0002-3460-5521, ORCID 0000-0003-3897-5965, ORCID 0000-0002-8026-174X. [3]Grupo de investigación Kairos CIPA, CIPA SA, ORCID 0000-0002-3833-8256.
*Corresponding author: jcamilo.arroyave@bialtec.co

Introduction: Feed efficiency is crucial for improving the profitability of the pork industry, as feeding costs constitute approximately 70% of production expenses. **Justification:** The excessive use of antibiotics and therapeutic additives with copper raises environmental and antimicrobial resistance concerns, leading to the exploration of probiotics as alternatives, with the need to improve feed efficiency and intestinal health in weaned pigs. **Objective:** To evaluate feed efficiency in pre-fattening pigs subjected to 4 isoenergetic and isoproteic diets: 2 commercial diets vs 2 diets of microencapsulated probiotics (FF) (Fortcell Feed, Bialtec S.A.S). **Methods:** A total of 108 piglets (Landrace × Large White × Duroc), 21 days old, were randomly assigned to four diets during a 49-day pre-fattening trial, divided into two feeding phases. Each trial consisted of four pens with three repetitions per diet, totaling 27 pigs per treatment. Additionally, experimental data were used for Monte Carlo simulations evaluating the Shapiro Wilk test. Three pigs were randomly selected from each pen, and rectal swabs were collected to characterize their microbiome using NGS. **Results and Discussion:** Although the results did not show significant differences between treatments, Monte Carlo simulation evidenced favorable feed conversion ratios for probiotic treatments. Furthermore, probiotic treatments altered the intestinal microbiota, increasing beneficial bacteria such as *Lactobacillus* spp. and *Succinivibrio*, while decreasing potential pathogens such as *Fusobacteria* and *Verrucomicrobia*. Additionally, probiotics improved alpha diversity in the intestinal microbiota compared to antibiotics and copper sulfate treatments, indicating better intestinal health. Overall, probiotic supplementation demonstrates potential as a sustainable alternative to promote piglet growth and modulate the intestinal microbiota. **Conclusion:** Encapsulated probiotic supplementation improves performance metrics and promotes a healthier intestinal microbiome, enhancing intestinal health and profitability in pork production.

Keywords: 16S rRNA, antibiotics, bacteria, intestinal health, Monte Carlo
Palabras clave: 16S rRNA, antibióticos, bacterias, salud intestinal, Monte Carlo

Economic evaluation of mineral sources of phosphorus (national and imported) in pig feed

Evaluación económica de fuentes minerales de fósforo (nacional e importado) en la alimentación de cerdos

Lady L Restrepo Bolívar[1]*
and Verónica González Cadavid[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 327992516, ORCID 233495543.
*Corresponding author: llrestre@unal.edu.co

Introduction: Food grade inorganic phosphates are normally used for phosphorus (P) supplementation in diets for pigs, since the grains and by-products used in the formulation of diets do not cover the P requirements, these phosphates are normally imported having a high share of the cost within the formulation, therefore it is necessary to find a source of good quality P at a competitive price to maximize the efficiency in the use of this nutrient. **Objective:** To economically and productively evaluate diets made with three sources of national and imported phosphates. **Methods:** The study was carried out at the San Pablo Agricultural Station of the National University of Colombia, in a complete cycle pig production system. 30 pigs were taken in the lifting stage, they were administered 3 diets (Diet A: source of imported monodicalcium phosphate, diet B: source of national monodicalcium phosphate and diet C: source of national monodicalcium phosphate) for a period of 30 days, during which weekly weight, weight gain, consumption, and food conversion were measured. **Results and Discussion**: The productive response of pigs fed with different sources of phosphorus, under this study in terms of final weight, weight gains, consumption and feed conversion did not present a statistically significant difference (P>0.05), however, the diet B presented lower cost. per kg/feed followed by diet A and C respectively, but diet C presented a better cost-benefit since the pigs fed with this diet managed to have better weights with lower feed consumption. **Conclusion:** The sources of phosphorus of national origin used in this work to feed growing pigs are profitable sources that presented a lower production cost per kg of feed and that also showed similar results to the imported sources in terms of the parameters zootechnicians evaluated.

Keywords: Costs, nutrient, phosphates, production
Palabras clave: Costos, nutriente, fosfatos, producción

Effect of preservation methods on the chemical composition and immunological profile of sow colostrum

Efecto de los métodos de conservación sobre la composición química y el perfil inmunológico del calostro de cerda

Mónica M Segura Restrepo[1], **Verónica González Cadavid**[2*], Fuensanta Hernández Ruiperez[1] and Silvia Martínez Miró[1]

[1]Departamento de Producción Animal, Facultad de Ciencias Veterinarias, Universidad de Murcia, 30100 Murcia, España, ORCID 0009-0001-1837-7995, ORCID 0000-0002-8795-416X, ORCID 0000-0002-1350-0886.
[2]Universidad Nacional de Colombia, Sede Medellín, Departamento de Producción Animal, ORCID 0000-0002-3349-5543.
*Corresponding author: vgonzal@unal.edu.co

Introduction: Colostrum contains a large number of bioactive components, crucial for the survival of newborn mammals. In pig farming, it is common to supplement piglets with colostrum from several sows, so it is necessary to establish optimal methods of collection, sanitization and preservation of colostrum to maintain its chemical and immunological integrity and to avoid microbial contamination. Since pigs are not considered a dairy animal, pasteurization protocols have not been established. **Objective:** The aim of this study is to evaluate the effect of various preservation methods, including low temperature-long time pasteurization and freeze-drying treatment, on the chemical composition and IgG level in porcine colostrum. **Methods**: Colostrum samples (80-90 ml) were collected manually from 20 sows with different farrowing numbers (ranging 1-4) during the first 3 hours postpartum. Each sample was divided into three aliquots: one stored at 4 °C with azidiol and analyzed within the first 48-72 hours, one pasteurized (52 °C during 80 min.) and frozen at -20 °C, and a third freeze-dried and stored at -20 °C until reconstitution. Analyses included infrared spectroscopy for composition (fat, protein, lactose and dry matter), somatic cell content (SCC) was analyzed by Fossomatic 5000 counter with flow cytometry (Foss, Hilleroed, Denmark) and IgG content was measured using a commercial ELISA kit. **Results and Discussion:** No significant effect ($P \geq 0.05$) of pasteurization and lyophilization treatment was observed on any of the chemical components analyzed in colostrum samples (fat, protein, lactose, dry matter and somatic cell count). We also found no significant differences ($P \geq 0.05$), between IgG concentration; which allows the use of pasteurization under the protocol applied without having negative consequences on the immunological profile. Currently, marketing of sow colostrum is not possible due to insufficient surplus production. However, some experts suggest that farms should maintain reserves of colostrum to assist in feeding less viable piglets (Devillers et al., 2011). **Conclusion**: The pasteurization, freezing and freeze-drying procedures applied do not change the chemical and immunological properties of the sow colostrum, and these treatments can be performed as needed.

Keywords: Freeze-drying, IgG, pasteurization, piglets
Palabras clave: Liofilización, IgG, pasteurización, lechones

Aceite esencial de orégano mejora la función intestinal y la composición microbiana en lechones posdestete

Oregano essential oil improves intestinal function and microbial composition in postweaning piglets

Víctor H Herrera Franco[1], Jaime A Isaza[1], Carlos A Maya Ortega[1], Andrés Gómez Zapata[2] and Jaime E Parra Suescún[1*]

[1]Universidad Nacional de Colombia Sede Medellín. Facultad de Ciencias Agrarias, ORCID 0000-0002-7456-981X, ORCID 0000-0003-1612-6938, ORCID 000-0002-5094-7716, ORCID0000-0003-4472-1326.
[2]University of Minnesota. Department of Animal Science, ORCID 0000-0002-1174-0368.
*Corresponding author: jeparrasu@unal.edu.co

Introduction: The post-weaning stage is characterized mainly by damage to the surface of the intestinal epithelium, which compromises digestion-absorption processes, and in turn the productive performance of the piglet in this stage. Thus, nutrients that were not digested/absorbed by the animal are available to pathogenic microorganisms capable of inducing damage to the intestinal barrier. Therefore, the removal of Growth Promoting Antibiotics (GPA) at the productive level has increased research on the development of natural additives that help to counteract the negative effects of weaning, while maintaining the productivity and profitability of productive systems. **Objective:** To evaluate the productive performance, the enzymes expression and activity, and the intestinal microbiota in weaned piglets at 21 days with the supplementation of oregano essential oil (*Lippia origanoides*). **Methods:** 72 weaned male piglets at 21 days of age were randomly assigned to 3 diets: Control Diet 1 (D1-Ctrl) without GPA; Diet 2 (D2-GPA): Ctrl+GPA (bacitracin, 350 ppm); Diet 3: oregano essential oil (D3-OEO, 150 ppm). On days 15 and 30 postweaning, productive variables were measured (intake, final weight gain-FWG and feed conversion index-FCI); in addition, 8 piglets were sacrificed per treatment to evaluate the gene expression of enzymes and transporters (ApN, ApA, DpP-IV, MgA, SI and SGLT-1, GLUT-2, GLUT-5), and microbiota (diversity and composition) in jejunum. The different variables were evaluated under an experimental design of random complete blocks with 8 replicates. **Results and Discussion:** piglets that received D3-OEO had a better productive yield compared to treatment with APC ($P<0.05$). The expression and activity of enzymes and transporters was significantly higher ($P<0.05$) with the use of OEO. In addition, the addition of OEO improved ($P<0.05$) microbiome diversity and growth of beneficial genera compared to the addition of D2-GPA. **Conclusion:** The use of oregano essential oil (*Lippia origanoides*) improved function (expression/activity of

enzymes and transporters at enterocyte level) and the distribution and diversity of the intestinal microbiota, which increased the productive yield of piglets during the weaning stage.

Keywords: Enzymes/transporters, gut health, growing pigs, Lippia origanoides, microbiome, OEO
Palabras clave: Enzimas/transportadoras, salud intestinal, cerdos en crecimiento, Lippia origanoides, microbioma, AEO

Determination of heavy metals in carcasses of pigs slaughtered in the slaughterhouse of Guadalajara, Mexico

Determinación de metales pesados en canales de cerdos sacrificados en matadero de Guadalajara, México

Jorge Galindo García[1*], Cecilia Jiménez Plascencia[1], Miguel A Ayala Valdovinos[3], David R Sánchez Chipres[1], Theodor Duifhuis Rivera[5], Georgina G López Santillán[1] and Yenni C Mateus Moreno[1]

[1]Universidad de Guadalajara sede CUCBA. Departamento de Producción Animal, ORCID 0000-0001-8951-9471, ORCID 0000-0003-1705-792X, ORCID 0000-0002-7535-2452, ORCID 0000-0002-5273-0393, ORCID 0000-0002-8748-2481, ORCID 0009-0005-9677-1524, ORCID 0009-0009-0925-297X.
*Corresponding author: jorge.galindo@cucba.udg.mx

Introduction: The *Codex Alimentarius* proposes limiting the maximum levels for lead and cadmium in animal products. In the European Union there is legislation that sets maximum values for heavy metals (arsenic, cadmium, copper, chromium and lead) in animal feed. **Objective:** The purpose of this work is to determine heavy metals (arsenic, cadmium, chromium, copper, and lead) in muscle, liver and kidney of pigs slaughtered in the municipal slaughterhouse of Guadalajara. **Methods:** After sacrifice, 25 animals were randomly selected. Three types of tissues were obtained from each of the pigs (muscle, liver, and kidney) to constitute a set of 75 samples. Once the digestion was carried out, the metals were quantified by flame (arsenic, cadmium, copper, chromium, and lead) in an Atomic Absorption Spectrophotometer. The detection limits of metals in the digestion were: arsenic=0.12 ppm, cadmium=0.0028 ppm, chromium=0.0054 ppm, copper=0.0045 ppm, and lead=0.013 ppm. One-way analysis of variance (ANOVA) was used to analyze the data. **Results and Discussion**: For arsenic, cadmium and lead, the permissible levels in the study tissues, none exceeded the maximum levels reported in the modification to the official Mexican standard, NOM-004-ZOO-1994. The liver samples presented an average of 43,824 mg/L. Of the kidney samples analyzed, they offered minimum concentration values of 1.8437 mg/L and 5.7205 mg/L as a maximum value, presenting an average of 0.9568 ppm. In the present study, the highest concentrations of copper were in the liver, similar to what was reported in another study. With respect to chromium values, the maximum residue levels are not established by the official Standard and for that reason it is not possible to make a comparison of the values found in this study. **Conclusion**: Only 1.33% presented levels higher than the permitted limits of copper, so for the most part the samples met the acceptance levels according to the Official Mexican Standard NOM-004-ZOO.

Keywords: Arsenic, cadmium, chromium, copper, lead, pork
Palabras clave: Arsénico, cadmio, cromo, cobre, plomo, carne de cerdo

REPRODUCCIÓN

The impact of heat stress on the reproductive performance of sows in a temperate climate

Impacto del estrés calórico en el rendimiento reproductivo de cerdas en clima templado

Abel Villa-Mancera[1]*, Marisela Méndez-Rosas[1], Manuel Robles-Robles[1], José Rodríguez-Castillo[1], Fernando Utrera-Quintana[1], Alejandro Córdova-Izquierdo[2] and Noemí Pérez-Mendoza[1]

[1]Benemérita Universidad Autónoma de Puebla. Facultad de Medicina Veterinaria y Zootecnia, Tecamachalco Puebla, México, [2]Universidad Autónoma Metropolitana, Unidad Xochimilco. Departamento de Producción Agrícola y Animal, CDMX, México.
*Corresponding author: abel.villa@gmail.com

Introduction: Heat stress is an important environmental component that negatively affects animal welfare and sow production efficiency. It also causes significant economic losses to the global pig industry. Researchers have developed several heat indices with different characteristics to assess the degree of heat stress in pigs. These indices include the temperature-humidity index (THI), black globe humidity index (BGHI), effective temperature (ET), equivalent temperature index of sows (ETIS) and enthalpy (H), among others. **Objective:** To evaluate the effect of heat stress on reproductive performance using different thermal indices derived from environmental variables in a temperate climate. To compare the level of accuracy between these indices. **Methods:** A total of 2951 reproductive records of sows from a farm in the state of Puebla, Mexico, were analysed. **Results and Discussion:** The average percentages of pregnancy, farrowing and abortion from January to December 2020 were 83.1%, 80.67%, and 5.2%, respectively. Corresponding measurements of temperature, relative humidity and air velocity were 24.3 °C, 63.0%, and 3.7 m/s, respectively. However, average daily temperatures exceeded 25 °C from March to June, above the upper threshold of the thermoneutral zone for sows. Eleven thermal indices were used to assess the degree of impact of heat stress on the reproductive characteristics of the animals. The highest gestation and farrowing rates were observed for THI2 and THI6 values, indicating moderate stress during the gestation and farrowing periods. Statistically significant differences were observed between THI2, THI4, THI6 and ET values and percentages of pregnancy, farrowing, and abortion ($P < 0.05$). **Conclusion:** The results indicate that THI2 performs other heat comfort indices such as THI4, THI6 and ET in assessing the degree of heat stress in sows. These findings may be valuable for accurate assessment of heat stress to minimise its effects and prevent significant economic losses in sows in temperate regions.

Keywords: Heat stress, reproductive performance, sow, temperature–humidity index, thermal indices
Palabras clave: Estrés calórico, desempeño reproductivo, cerda, índice de temperatura-humedad, índices térmicos

Evaluation of lipid peroxidation and membrane integrity of X/Y porcine sperm populations

Evaluación de la peroxidación lipídica y la integridad de membrana de poblaciones de espermatozoides porcinos X/Y

Kelly V Zapata Carmona[1], Juan D Montoya Páez[2], Mauricio Rojas López[3], **Alexandra Úsuga Suárez**[4] and Giovanni Restrepo Betancur[1]*

[1]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0000-0002-3559-5783, ORCID 0000-0002-8427-4433. [2]Politécnico Colombiano Jaime Isaza Cadavid. Facultad de Ciencias Agrarias, Medellín, Colombia, ORCID 0000-0002-9677-0426. [3]Universidad de Antioquia. Facultad de Medicina, Medellín, Colombia, ORCID 0000-0002-7791-9328. [4]Universidad de Antioquia. Facultad de Ciencias Agrarias, Medellín, Colombia, ORCID 0000-0002-0537-0065.
*Corresponding author: grestre0@unal.edu.co

Introduction: The plasma membrane of sperm can be altered by the stress inflicted during sexing. **Justification:** The assessment of the integrity and oxidative damage of the plasma membrane in populations of sperm with X and Y chromosomes, subjected to flow cytometry, could favor the development of strategies to mitigate sperm damage during sexing. **Objective:** To evaluate lipid peroxidation (PL) and membrane integrity (MI) of porcine sperm populations with X and Y chromosomes, subjected to flow cytometry. **Methods:** Ten ejaculates from three male boars were used to perform 100 detection sessions of sperm populations with X and Y chromosomes, using flow cytometry with the Hoechst-33342 probe. The PL and MI of spermatozoa X and Y were evaluated by flow cytometry with the probes BODIPY493/503 and Propidium iodide, respectively. Linear models and comparison of means using the Tukey test were performed. **Results and Discussion:** Lipid peroxidation accounted for 89.9±1.3% of X spermatozoa, and 50.8±4.7% of Y spermatozoa. The proportion of peroxidized sperm with unaltered membrane was 88.2±1.7% for X, and 29.6±6.4% for Y; while sperm with altered membrane and non-peroxidized were 6.9±1.2% for X, and 47.5±6.0% for Y ($P<0.05$). Peroxidation of the plasma membrane could compromise the fertilizing capacity of sperm. The finding of a higher degree of peroxidation of sperm with X chromosome could negatively influence reproduction programs with sexed semen aimed at obtaining females. **Conclusion:** There are differences in the

levels of lipid peroxidation and membrane integrity of porcine sperm populations X and Y, subjected to flow cytometry for sexing purposes.

Key words: Cytometry, semen, sexing, vitality
Palabras clave: Citometría, semen, sexaje, vitalidad

Evaluation of reproductive parameters between different groups of female sows of a pig farm, high colombian tropic

Evaluación de parámetros reproductivos entre diferentes grupos de hembras de una granja porcina, trópico alto colombiano

Estefanía Herrera Pasos[1*], David A Hernández Ricaurte[1] and Verónica González Cadavid[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Departamento de Ciencias Animales, Colombia, ORCID 0009-0004-2057-4033, 0009-0000-8458-4346, 233495543.
*Corresponding author: esherrerap@unal.edu.co

Introduction: In general, commercial pig farms require constant evaluation of reproductive parameters associated with each female based on the information contained in her record and timely observations by farm technicians regarding the conditions influencing the reproductive performance of the herd, thus aiming to comply with schedules and expected production levels according to each farm's sufficiency. **Objective**: To compare reproductive parameters of females originating from a commercial la genetic line (L1), females obtained through artificial insemination of L1 females with liquid genetics (grandfather semen) (L2), and females obtained through artificial insemination of L1 females with semen from farm-owned males (L3). **Methods**: Records of 101 individuals from a single farm were used to evaluate, through descriptive statistics, the parameters of average total piglets born (TPB), average liveborn piglets (LBP), average weight of liveborn piglets (WLBP), average weaned piglets (WP), as well as the average weight of weaned piglets (WWP)**. Results and Discussion**: The results obtained for the different evaluated variables for groups L1, L2, and L3 were as follows: mean of variable TPB (14,84±1,72; 14,56±1,07; 11,61±1,18) respectively; mean of variable LBP (12,31±1,53; 12,28±0,98; 10,25±1,02) respectively; mean of variable WLBP (1,37±0,20 kg; 1,45±0,05 kg; 1,43±0,08 kg) respectively; mean of WP (10,65±1,30; 11±0,75; 9,32±0,82) respectively. Finally, mean of variable WWP (7,86±0,63 kg; 8,20±1,09 kg; 7,90±1,69 kg). Thus, for the particular case of this farm, the datasets derived using descriptive statistics allow for the analysis of the main reproductive characteristics of interest in the three groups of evaluated females. **Conclusion**: It is evident that females belonging to group L2 retain genetic potential for the reproductive variables evaluated compared to females belonging to group L1. On the other hand, females belonging to group L3 show a reproductive potential that is less outstanding compared to groups L1 and L2, given that, even though they have the capacity to reproduce, their genetic potential is directed towards meat production characteristics and not necessarily towards the maximum express

Keywords: Performance, pigfarms, reproductive parameters
Palabras clave: Desempeño, granjas porcinas, parámetros reproductivos

Relationship between sperm kinetics parameters and protein electrophoretic profiles of seminal plasma in "Casco de Mula" boars

Relación entre parámetros de cinética espermática y los perfiles electroforéticos de proteínas del plasma seminal en machos porcinos "Casco de Mula"

Fabián L Rueda Alfonso[1*], Eliana Neira Rivera[1], María C Rozo Florez[1], Wilson D Rangel García[2] and Martha Y Gutiérrez Ibáñez[2]

[1]Corporación Colombiana de Investigación Agropecuaria AGROSAVIA. Centro de Investigación Tibaitatá, Cundinamarca, Colombia, ORCID 0000-0002-5502-2544, ORCID 0000-0002-8940-5885, ORCID 0000-0003-2275-5167. [2]Corporación Colombiana de Investigación Agropecuaria AGROSAVIA. Centro de Investigación La Libertad, Meta, Colombia, ORCID 0000-0002-9072-8518, ORCID 0000-0002-8180-9797.
*Corresponding author: frueda@agrosavia.co

Introduction: The Casco de Mula creole porcine breed (S. scrofa) has exhibited promising perspectives and attributes when crossbred with specialized races, particularly regarding productivity and prolificity. The assessment of sperm motility plays a pivotal role in devising strategies for germplasm conservation and the dissemination of genetic material. This assessment should also encompass seminal plasma proteins (SPP), integral to processes safeguarding sperm cells against oxidative and thermal stress, as well as facilitating oocyte fertilization. **Objective:** To delineate the relationship between SPP electrophoretic profiles and kinetic sperm parameters in cooled semen of Casco de Mula boars. **Methods:** Semen from 12 Casco de Mula boars aged 2-4 years, housed at La Libertad research center (Villavicencio, Meta), was utilized. Semen samples were manually extracted using an adjustable dummy. Seminal plasma was isolated by centrifugation at 3500 g, 4 °C for 15 minutes, followed by filtration with 0.22 µm nitrocellulose filters. After extraction of seminal plasma, semen was diluted in BTS medium and cooled to 17 °C for 16 hours. Motility parameters of cooled semen were evaluated using a Computer Assisted Sperm Analyzer (CASA) System. SDS-PAGE was performed on seminal plasma following the Laemmli method, and resulting gels were analyzed using Image Lab Software (Bio Rad). The relationship between the relative quantity of each band in electrophoretic profiles and

CASA motility parameters was established through a Pearson correlation test. **Results and Discussion:** A protein band around 130 KDa exhibited significant and negative correlation coefficients with massal motility (r=-0.63; P<0.05) and fast sperm cells averages (r=-0.69; P<0.05). Conversely, the same band demonstrated significant and positive correlation with linear movement (r=0.63; P<0.05) and flagellar shake (r=0.60; *P*<0.05). These findings suggest that this 130 KDa band may exert a distinct influence on kinetic features in Casco de Mula sperm cells. **Conclusion:** The investigation of SPP in Casco de Mula boars, particularly the 130 KDa protein band, could yield valuable insights for the development of conservation techniques aimed at preserving porcine germplasm and sustainably utilizing Colombian genetic resources.

Keywords: Animal reproduction, biotechnology, porcine semen, proteomics, seminal quality
Palabras clave: Reproducción animal, biotecnología, semen porcino, proteómica, calidad seminal

Association of sperm mitochondrial activity and viability with the distribution of X/Y porcine sperm populations

Asociación de la actividad mitocondrial y la viabilidad espermática con la distribución de poblaciones de espermatozoides porcinos X/Y

Kelly V Zapata Carmona[1], Juan D Montoya Páez[2], Mauricio Rojas López[3], Alexandra Úsuga Suárez[4] and Giovanni Restrepo Betancur[1]*

[1]Universidad Nacional de Colombia sede Medellín, Colombia, ORCID ORCID 0000-0002-3559-5783, ORCID 0000-0002-8427-4433. [2] Politécnico Colombiano Jaime Isaza Cadavid. Facultad de Ciencias Agrarias, Medellín, Colombia, ORCID 0000-0002-9677-0426. [3]Universidad de Antioquia. Facultad de Medicina, Medellín, Colombia, ORCID 0000-0002-7791-9328. [4]Universidad de Antioquia. Facultad de Ciencias Agrarias, Medellín, Colombia, ORCID 0000-0002-0537-0065. *Corresponding author: grestre0@unal.edu.co

Introduction: Sperm sexing allows the production of offspring of a desired sex. **Justification:** Recognizing the characteristics of porcine sperm with X and Y chromosomes could favor the generation of strategies aimed at improving sperm sexing. **Objective:** To evaluate the association of mitochondrial activity and sperm viability (VE) with the distribution of boar sperm populations with X and Y chromosomes. **Methods:** Ten ejaculates from three male boars were used to perform 100 sessions of detection of the sperm populations X and Y, by flow cytometry with the Hoechst-33342 probe. The mitochondrial membrane potential ($\Delta\Psi M$) and VE of spermatozoa X and Y were evaluated by flow cytometry with the JC-1 and SYBR14/Propidium iodide probes, respectively. Linear models, correlation analysis and comparison of means by Tukey test were performed. **Results and Discussion:** The proportion of sperm with high-$\Delta\Psi M$ (dimers) was 76.2 ± 1.0 % for X, and 45.0 ± 2.0 % for Y. VE was 84.1 ± 1.6 % for X, and 38.8 ± 2.8 % for Y ($p<0.05$). A positive correlation was found between high-$\Delta\Psi M$ and VE for X of 0.38 ($P<0.001$), and for Y of 0.54 ($P<0.0001$). The difference found between the vitality and mitochondrial activity of porcine sperm with X and Y chromosomes could be explained by particular characteristics of the sperm, as well as by a differentiated sensitivity between both to the conditions of flow cytometry. **Conclusion:** Porcine sperm populations X and Y may differ in their levels of mitochondrial activity and viability, as well as in the degree of association between both parameters.

Key words: Cytometry, mitochondria, sexing, vitality
Palabras clave: Citometría, mitocondria, sexaje, vitalidad

SALUD PREVENTIVA Y BIOSEGURIDAD

Identification of digestive pathogens in lactating and weaning piglets in pig farms in Colombia

Identificación de patógenos digestivos en lechones lactantes y precebos en granjas porcinas tecnificadas de Colombia

José F Naranjo Rativa[1], **María del P Pineda Ortíz[1]*,** Carolina Mendoza Hortúa[1], Kristina Osbjer[2], Mabel J Ortiz de Leo[2], Gilma Hernández Herrera[1] and Alejandro L Soraci[1]

[1]Asociación Colombiana de Porcicultores -Porkcolombia, ORCID 0009-0006-8460-6107, ORCID 0000-0001-9752-3438, ORCID 0009-0007-8646-7101, ORCID 0000-0001-6725-162X, ORCID 0000-0002-6098-6452. [2]International Centre for Antimicrobial Resistance Solutions – ICARS ORCID 0000-0002-0902-8232, ORCID 0000-0002-7813-3802. *Corresponding autor: mpineda@porkcolombia.co

Introduction: Neonatal and post-weaning diarrhea are among the main causes of morbidity and mortality in piglets in Colombia, representing an important challenge due to their impact on productive profitability. The prevention of diarrhea requires adequate immunization of sows prior to farrowing to ensure colostrum quality and optimal protection of piglets. To maximize the effectiveness of vaccination, it is strategic to identify digestive pathogens on the farm. **Objective:** Identify digestive pathogens in lactating and weaning piglets to reinforce the vaccination schedule in sows and increase colostrum quality. **Methods:** To identify *Salmonella* spp, *Escherichia coli* (virulence factors F4,F5,F6,F18,F41 and Stx2e), *Clostridium perfringens* and *difficile*, *Lawsonia intracellularis*, PED, *Rotavirus* A-C and *Cystoisospora suis*, rectal swab and fecal matter from lactating and weaning piglets were collected in 5 technified farms in Colombia. The calculated sample was 30% of 280 litters of suckling and weaning piglets (84 litters for each stage distributed proportionally according to the census of sows of each farm. The samples were processed by bacteriology, parasitology and RT PCR techniques at Porkcolombia's laboratory in Bogota. **Results and Discussion:** A total of 146 pooled samples (62 lactating piglets and 84 weaning piglets) were collected. In suckling piglets, the most frequently found pathogens were *Clostridium difficile* (57.5%), *E.coli*-F5 (35.6%), *Clostridium perfringens* (18.5%), *Cystoisospora suis* (18.4%), *Salmonella* spp (16.4%), *Rotavirus*-A (15.7%) and *E. coli*-F18 (3.4%). In weaning piglets, the following were mainly identified: *E.coli*-F5 (40.4%), *Clostridium perfringens* (33.3%), *Cystoisospora suis* (16.6%), *Salmonella* spp and *Rotavirus*-C (14.2% each) and Rotavirus-A (13%). All samples were negative for *Lawsonia intracellularis* and PED. These findings were used to guide the implementation of vaccination targeting the presence of the pathogens and the physiological changes that the mammary gland undergoes during gestation. The vaccination was carried out on day 73 and 93 of the gestational period. **Conclusion:** The identification of digestive pathogens that cause diarrhea in piglets is essential for the establishment of a correct on-farm vaccination program, which leads to improving colostrum quality and piglet immunity.

Keywords: Colostrum, diarrhoea neonatal piglet, immunity, vaccination

Palabras clave: Calostro, diarrea neonatal, inmunidad, vacunación

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Influence of deep litter in breeding sows on the number of piglets per farrowing in a humid temperate climate

Influencia de la cama profunda en cerdas de cría sobre la cantidad de lechones por parto en clima templado húmedo

Jaime A Durán Prada[1]*

[1]Universidad Francisco de Paula Santander seccional Ocaña, Colombia, ORCID 0000-0001-6890-3132.
*Corresponding author: jaimealbertod@hotmail.com

Introduction: This study conducted an analysis of the number of piglets produced by sows housed in deep litter in warm humid climates**. Objective**: Analyze the influence of deep litter in warm climate conditions with high humidity on the number of piglets produced per litter**. Methods:** The study was carried out from January 1, 2023 to December 31 of the same year at Finca El Peral, municipality of San Alberto, Cesar with 18 breeding sows housed in rice husk beds**. Results and Discussion:** The results of the work allow us to infer that there is no negative influence on the number of piglets per litter in this system. **Conclusion:** The adaptation and development of deep bedding systems in breeding sows in warm climates with high humidity allow producers to achieve litters of over 12 live births, being a profitable housing system with less environmental impact.

Keywords: Breeding sows, deep bedding, live births, warm humid climate
Palabras clave: Cerdas de cría, cama profunda, nacidos vivos, clima cálido húmedo

Tasting analysis results between commercial samples and mule helmet pork ham

Resultados análisis de degustación entre muestras comerciales y jamón de cerdo casco de mula

Sandra J Castañeda[1], Martha Y Gutiérrez Ibáñez[2]* and José L Escudero[3]

[1]Agrosavia, Villavicencio, Meta. ORCID 0009-0001-5300-5126**.** [2]Agrosavia, Villavicencio, Meta, ORCID 0000-0002-8180-9797**.** [3]SENA, Villavicencio, Meta. ORCID 0009-0004-4497-7013.
*Corresponding author: mygutierrez@agrosavia.co

Introduction: The processing of meat by-products is an alternative for the integral use of pigs, income diversification, food security and giving added value to the production of Creole pigs in the rural population. **Justification:** The comparative tasting analysis will provide information on the sensory differences between standard commercial samples and mule hoof Creole pork ham, which will help determine its quality and market acceptance **Objective:** To provide sensory evidence on the qualities and consumer preference between standard commercial samples and mule hoof Creole pork ham, in order to support its valuation in the market and promote its consumption. **Methods:** At SENA Meta, a mule-hulled ham was prepared by maturing it for 72 hours in brine and cooking at 90°C. At the La Libertad Research Centre, a comparison was made between the degree of acceptance of different brands of commercial ham and ham made from Mule Hind Pig, with the participation of mixed panelists aged between 22 and 65 years. **Results and Discussion**: For the Casco de Mula ham, 59% liked the colour very much, 22% liked it, 11% neither liked nor disliked it and 7% disliked it; there were no people who indicated that they disliked this variable very much; 50% of the participants liked the smell very much and none of the panellists disliked it. Texture 41% of panel participants liked it very much, 52% liked it, 7% neither liked nor disliked it. For the taste variable, 44% indicated that they liked it very much, 33% liked it, 19% neither liked nor disliked it, 4% indicated that they disliked it and no one indicated that they disliked it very much. **Conclusion:** These preparations, which seek to add value to the production of Criollo pork and aim to produce a product with a designation of origin, should continue to be carried out.

Key words: Color, mulefoot, smell, taste, textura
Palabras clave: Color, casco de mula, olor, sabor, texture

RESUMENES

MÓDULO 3

EQUINOS

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Abuse in farm animals in Antioquia (Colombia), 2023

Maltrato en animales de producción en Antioquia (Colombia), 2023

Santiago Henao Villegas[1*], María J Hernández Ruiz[2] and Isabel C Guerrero Naudín[2]

[1]Universidad CES. Facultad de Medicina Veterinaria y Zootecnia, Medellín, Colombia, ORCID 0000-0003-0519-7001, ORCID 0009-0005-5151-396X, ORCID 0009-0009-8470-8631.
*Corresponding author: shenao@ces.edu.co

Introduction: Reports of abuse across various animal species are gaining greater prominence in newspapers and social media, and the Department of Antioquia (Colombia) is no exception, often accompanied by concurrent acts of interpersonal violence. **Justification:** Presenting objective assessments of the problem of violence in production animals serves to strengthen public policies and raise awareness among society at large about direct impacts on the welfare of these individuals and their effects on the production chain. **Objective:** To determine the typology and frequency of abuse in production animals, and to characterize the individual or individuals reported for such phenomena. **Methods:** Descriptive observational research was conducted with an observation period spanning the year 2023. The primary variables studied included intrinsic characteristics of maltreated production animals, as well as the type, frequency, and location of abuse within the nine subregions of Antioquia (Colombia). The profile of alleged abusers was also delineated. A structured interview was administered to 70 municipal inspectors or government secretaries. The project received endorsement from the ESC Ethics Committee. **Results and Discussion:** Officials from various subregions of Antioquia participated in the study. Based on absolute values provided by public servants, the subregions with the highest frequency of formal complaints were Southwest (24%) and East (18%). The equid species was the most commonly mistreated according to complaints. Men were predominantly reported as perpetrators of abuse, with women being the primary reporters (ratio of 5:1). The most prevalent types of abuse were physical abuse or neglect by owners. **Conclusion:** There is a rising trend in complaints of animal abuse across various forms (negligence, reckless interaction, sexual abuse, among others). Equids (including bottlenose horses, donkeys, and horses) are the most impacted species in Antioquia based on formal complaints. There appears to be a lower level of empathy toward the pain and suffering of farm animals among men compared to women. Awareness campaigns focusing on sentience, ethics, and animal welfare should be promoted.

Keywords: Animal abuse, animal ethics, animal welfare, violence
Palabras clave: Abuso en animales, ética animal, bienestar animal, violencia

Colic in working equids in four Colombia´s communities: a One Welfare vision

Cólico en équidos de trabajo en cuatro comunidades de Colombia: visión One Welfare

Santiago Henao Villegas[1*], Hellen G Díaz Perea[1], Francisco R Ramírez García[1], Sergio A Pizarro Cano[2] and Carolina Jaramillo Gómez[2]

[1]Universidad CES. Facultad de Medicina Veterinaria y Zootecnia, Medellín, Colombia, ORCID 0000-0003-0519-7001, ORCID 0009-0006-7431-6827, ORCID 0000-0002-8026-174X. [2]Fundación Arrieros Colombia, World Horse Welfare, ORCID 0009-0001-3492-5365, ORCID 0000-0002-5434-6643.
*Corresponding author: shenao@ces.edu.co

Introduction: In countries with low development indicators, working equines play an important role in the socioeconomic sector, since they promote the food security of communities. The Acute Abdominal Syndrome (colic) affect family's incomes, considering the interconnection between animal welfare, human wellbeing, and their physical and social environment. **Justification:** In Colombia, the welfare of working equids is an issue with few reports, therefore, it is necessary to identify and solve the problems that prevent these animals to have the established welfare parameters. Welfare makes the animals free of disease, but the AAS (Acute Abdominal Syndrome - colic) in working equids is one of the most common pathologies of the species and the most frequent problem; it is treatable, but it can also be prevented. **Objective:** The general aim of this study was to determine the level of knowledge and importance of AAS in working equids in four communities in Colombia. **Methods:** Qualitative research, using statistical analysis with percentage calculations with structured interviews in 40 equid's owners from Cocorná, Andes, Apartadó y Santa Marta, with different types of work. Descriptive statistics were performed for all variables representing the frequency of response in each category in each question, for each geographic area where the information was collected. The study had ethics committee approval (CICUA-CES). **Results and Discussion:** The results showed that the communities were concerned about the presence of AAS in their equids (95%), the study population

had basic knowledge that allowed them to identify the disease, regarding the treatment of colic what most concerned them was the lack of veterinary care in each geographical area. The most familiar signs associated with the pathology was rolling (72.5%) and lie down (62.5%), associated with inappropriate feeding and nutritional practices (70%). **Conclusion:** While these communities were concerned about the presence of colic, preventing it is certainly the priority. Empirical treatments for colic are those that predominate in the communities visited, with a clear absence of professional support, with a negative impact in sustainable development since the one welfare vision.

Keywords: Acute abdominal syndrome, animal welfare, preventive medicine, sustainable development
Palabras clave: Síndrome abdominal agudo, bienestar animal, medicina preventiva, desarrollo sostenible

REPRODUCCIÓN

Effect of Quercetin, L-Ergothionein and H89 on the oxidative stability of cryopreserved equine semen

Efecto de Quercetina, L-Ergotioneína y H89 sobre la estabilidad oxidativa de semen equino criopreservado

Mariano E Acosta Lobo[1]*, Benjamín A Rojano[2] and Giovanni Restrepo Betancur[2]

[1]Institución Universitaria Visión de las Américas. Facultad de Medicina Veterinaria y Zootecnia, Medellín, Colombia, ORCID 0000-0002-3043-9319. [2]Universidad Nacional de Colombia sede Medellín, Colombia, ORCID 0000-0003-3590-8046, ORCID 0000-0002-8427-4433.
*Corresponding author: mariano.acosta@uam.edu.co

Introduction: Seminal cryopreservation increases the production of reactive oxygen species (ROS) and nitrogen (RNS), leading to oxidative stress, which results in reduced sperm motility, and loss of plasma membrane viability and integrity. **Justification**: To find new supplements for cryopreservation diluents that improve the quantity and quality of post-thawed equine spermatozoa. Thus, the antioxidants quercetin, L-ergothionein and the sperm capacitation inhibitor H89 were chosen for this study due to antioxidant protection and hyperactivity reduction respectively, observed in previous studies in semen from other species. **Objective**: To evaluate the post-thaw oxidative stability of cryopreserved equine semen. **Methods**: Semen samples from colombian criole horses were cryopreserved in an extender supplemented according to these six experimental groups: control, quercetin (Q) 100 µM, L-ergothionein (E) 150 µM, H89 20 µM, H89 + quercetin (H89Q) and H89 + L-ergothionein (H89E). Post-thawing, EROS/ERNS, and lipid peroxidation were measured spectrofluorometrically using dichlorodihydrofluorescein diacetate (DCFH-DA) and C11 - BODIPY 581/591 respectively. The normality of the data was evaluated by the Shapiro-Wilk test, and the comparison of means between treatments was performed by Tukey's test with a alfa value of $p<0.05$. **Results and Discussion**: Relative units of fluorescence/sec (RFU/sec) of ROS/RNS were as follows: Quercetin (0.031±0.011)>H89Q (0.033±0.012) =H89E (0.033±0.014)>E (0.035±0.014)>Control (0.039±0.018) =H89(0.040±0.018). On the other hand, the BODIPY ratio between red and green fluorescences showed that all treatments except E reduced lipid peroxidation with respect to the control as follows: H89Q (9.60 ± 3.03)>H89(8.6±2.97) = H89E (8.25±2.71)>Q (7.82±2.33)>E (7.55±2.44) =Control (7.38±2.06). The results are consistent with other studies where the antioxidant effect of Q and E have been observed in cryopreserved semen from males of other species, such as bulls and rams. Regards to H89, probably because of its chemical structure, it seems that it could work in conjunction with other antioxidants such as Q, providing a protective effect against oxidative stress. **Conclusion**: Q and E are good additives as antioxidants for equine semen freezing diluents, and a synergistic activity of Q with H89 in decreasing lipid peroxidation in cryopreserved equine spermatozoa is suggested.

Keywords: Antioxidants, cryopreservation, lipid peroxidation, EROS, sperm
Palabras claves: Antioxidantes, criopreservación, peroxidación lipídica, EROS, espermatozoides

RESUMENES

MÓDULO 4

AVICULTURA

EXTENSIÓN RURAL

Strengthening the organizational capacities of Rural women, Vereda Caño Claro, El Castillo, Meta

Fortalecimiento de las capacidades organizativas de mujeres rurales, Vereda Caño Claro, El Castillo, Meta

Luis C Ramírez Villa[1]*, Edgar A Martínez[1], Dayra García[1] and Deilen P Sotelo Moreno[1]

[1]Universidad de los Llanos. Facultad de Ciencias Agropecuarias y Recursos Naturales, Colombia, ORCID 0000-0003-1498-9932, ORCID 0000-0003-4719-2479, ORCID 0000-0002-2501-4842, ORCID 0000-0002-4282-8864.

*Corresponding author: lcramirez@unillanos.edu.co

Introduction: Rural women in the Ariari subregion have been relegated to the role of housewife, ignoring their role within agricultural production systems and their valuable contribution to the family economy and regional development. Awareness is required within community processes and strengthening of their livelihoods through the generation of business plans in poultry farming to achieve empowerment. **Objective:** Strengthen the organizational capacities of rural women in the Caño Claro village, El Castillo through group processes of rural extension as a strategy for developing business plans in poultry farming. **Methods:** Qualitative research from a community approach, where people interacted with each other to generate political, economic and social processes in their community. Firstly, a characterization of the population was carried out through a visit to the farm, where the productive potentialities were determined, and through the dialogue of knowledge, confidence began to be generated for the exercise of empowerment, then workshops on the Plan of Action were held. Life, Empowerment, Bioinputs, structuring business plans in bird feeding. **Results and Discussion:** A process of land restitution was carried out to women heads of family, with an average allocation of 5.5 ha. In the Caño Claro village, 90% of the women still remain in the area and develop agricultural production processes in crops. Regarding animal production, laying hens depend on the use of commercial concentrates, increasing the costs of the activity, which is why a series of workshops were held on topics related to animal nutrition, empowerment and project management, with the establishment of a community business plan on concentrated foods, reducing dependence on external inputs by 70% through a own brand called Productos Caño Claro. **Conclusion:** The rural women of Vereda Caño Claro are moving towards empowerment, generating economic, social and environmental development with their own brand for the marketing of their products; However, an investment in equipment and technical assistance is required.

Keywords: Animal feeding, poultry farming, rural extension, rural women

Palabras clave: Alimentación animal, avicultura, extensión rural, mujer rural

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Nocturnal activity of hens (*Gallus gallus domesticus*)
Actividad nocturna de las gallinas (*Gallus gallus domesticus*)

Mateo Itza-Ortiz[1]*, José Carrera-Chávez[1], Ernesto Orozco-Lucero[1], Marcela Beristaín-Ruíz[1] and Edgar Aguilar-Urquizo[2]

[1]Universidad Autónoma de Ciudad Juárez. Departamento de Ciencias Veterinarias. Juárez, Chihuahua, México, ORCID 0000-0003-0313-586X, ORCID 0000-0002-6899-9485, ORCID 0000-0003-3238-2341, ORCID 0000-0002-9189-3750. [2]Tecnológico Nacional de México. División de Estudios de Posgrado e Investigación/I.T. de Conkal, Yucatán, México. ORCID 0000-0003-4727-7894.
*Corresponding author: mateo.itza@uacj.mx

Introduction: The ancestor of the domestic chicken (*Gallus gallus silvestre*) perched on tree branches to rest or find shelter at night. In nature it can be observed that wild birds and commercial hens during the day and night. Various studies on well-being suggest that the lack of perches to rest or feel safe is a cause of "frustration" or "stress" that can have a negative impact on their behavior, health, production, and the deterioration of their well-being. Currently, commercial hens in technical houses lack these structures to rest or feel safe at night due to the type of housing where they are raised. **Objective:** Document the nocturnal activity of a group of hens based on the time they spend in the different nocturnal substates. **Methods:** Seven 20-week-old hens were used, which were observed for three consecutive nights using a video surveillance camera with infrared light. Monitoring began 30 minutes before the group of birds entered the room and continued throughout the night until 15 minutes after the birds left the room at sunrise. The activities evaluated were standing awake, lying awake, standing sleeping, lying prone sleeping, grooming standing, and grooming prostrate. The data were analyzed using descriptive statistics and expressed as a percentage. **Results and Discussion:** 8% were observed grooming standing, 2% grooming prostrate, 5% standing awake, 4% prostrate awake, 4% standing sleeping, 77% prostrate sleeping. All the hens perched and the different substates are observed that in nature birds seek refuge at heights to rest or sleep "safely" with a lower probability of being predated. **Conclusion:** Activity during the night is varied and 77% of the time they sleep, it could be classified as deep "sleep" since they are prostrate.

Keywords: Birds, cyclic sleep, habit, welfare
Palabras clave: Aves, sueño cíclico, hábito, bienestar

IMPACTO AMBIENTAL

Dietary fibre source influence ammonia emission of broiler excreta

La fuente de fibra dietética influye en la emisión de amoniaco de excrementos de pollos de engorde

Miranda E Smith[1], Stephen C Mansbridge[1], Isobel M Whiting[1], Stephen P Rose[1] and **Vasil R Pirgozliev**[1]*

[1]Harper Adams University, The National Institute of Poultry Husbandry, Shropshire, UK, ORCID 0000-0003-4246-9782, ORCID 0000-0003-2160-3583, ORCID 0000-0001-6459-597X, ORCID 0000-0002-4213-7609.

*Corresponding author: vpirgozliev@harper-adams.ac.uk

Introduction: Feeding high fibre diets to pigs and laying hens decreased ammonia emissions from manure. However, the use of high fibre diets in broilers is limited by a potential reduction in growth performance. Thus, research into the effects of high fibre on broiler ammonia emissions is a considerably under researched area. **Objective**: The objective of this study was to assess the impact of dietary fibres on ammonium concentration (AM) in excreta of broilers. **Methods**: Alfalfa (AA), grass (GR) or stinging nettle (SN) meals were incorporated at 12%, into the finisher diet (used as control) of indoor reared Ross 308 broiler, with or without a fibre-degrading enzyme (RONOZYME® MultiGrain, DSM Switzerland), resulting in 8 treatments. Each diet was fed to 6 pens following randomisation. The content of neutral detergent fibres (NDF) was 40.2% DM in AA, 67.5% DM in GR and 47.0% DM in SN, respectively. The ammonium content of the excreta was approximated as ammonia determined using a Kjeltec™ 8400 analyser (FOSS, Denmark) at the end of the study. Data were analysed as a 2x4 factorial two-way ANOVA. **Results and Discussion**: Diet containing SN reduced excreta AM by 17.6% compared to control and by 36.2% compared to GR supplemented diets ($P<0.001$) and did not differ ($P>0.05$) from the AA diet. Grass supplemented diet had the highest NDF level, corresponding to higher AM in excreta compared to all other diets ($P<0.001$). Dietary enzyme did not change AM in excreta ($P>0.05$) and there was no enzyme by fibre source interaction ($P>0.05$). The NDF content in SN was intermediate but resulted in a significant reduction in AM of excreta, although the reduction due to AA was numerical only ($P>0.05$). Thus, suggesting that either the fibre content of SN was the optimal in this study, or the structure of SN fibres may be the reason for the reduced AM. **Conclusion**: Supplementing 12% SN in the broiler finisher diet reduced AM in excreta. The impact of level and structure of dietary fibre on AM of excreta warrant further investigation.

Keywords: Alfalfa, broilers, environmental impact, grass, stinging nettle

Palabras clave: Alfalfa, pollos de engorde, impacto ambiental, pasto, ortiga

NUTRICIÓN Y ALIMENTACIÓN

Alternative raw materials from the Colombian Orinoco region are used in the formulation of concentrate feed for broilers

Uso de materias primas alternativas de la Orinoquía Colombiana en la formulación de alimentos concentrados para pollos de Engorde

Angely G Garzón Torres[1]*, Luz E Castillo Pabón[1], Angelica Santos Escobar[1], Daniela Velandia Benito[1], Yeraldine Melo Pedroza[2], Alexander Moreno[2] and Jesús A Berdugo[1]

[1]Universidad Nacional de Colombia sede Orinoquia. Arauca, Colombia, ORCID 0009-0004-5630-7068, ORCID 0009-0006-8017-559X, ORCID 0009-003-8458-9958, ORCID 0000-0002-1556-6387. [2]Semillero Germinando Curiosidades.
*Corresponding author: agarzonto@unal.edu.co

Introduction: In Colombia, the most consumed meat is chicken, which has become fundamental for food security. In this production, food is the most crucial item; consequently, the search for economical and environmentally friendly raw materials is a reason for research. In the Colombian Orinoco region, some species can be a source of protein: bore (*Alocasia macrorrhiza)*, matarratón (*Gliricidia sepium),* and buttercup (*Tithonia diversifolia*) and energy: corn (*Zea mays)*, plantain (*Musa paradisiaca*) and yucca (*Manihot esculenta*) for the production of concentrated foods. **Objective:** To evaluate the effect on broiler growth of a feed formulation supplemented with the above-mentioned raw materials in the region (MOBMPY). **Methods**: It was carried out between October and November 2023; 15 COOBS broilers were fed from day 14 to 31 of life. They were distributed in three groups: MOBMPY experimental, experimental with soybean, and commercial concentrate. The animals were weighed weekly, and the information generated was recorded in a specially designed format. The groups were compared using the Student's t-test. **Results and Discussion:** At the end of the experiment, the average weight of the animals was 530, 565, and 915 g, with weight gains of 374, 370, and 689 g for MOBMPY, soybean, and commercial, respectively. The commercial concentrate showed significant differences (P=0.0002) compared to MOBMPY and soybean. The two previous ones had no significant differences. The MOBMPY feed consumed 65% of the expected consumption, and its cost was $ 503 vs $ 2625 for the commercial concentrate. The value per kg of meat produced with the MOBMPY supplement was $2,622 compared to $18,150 for the commercial concentrate. **Conclusion:** The use of local raw materials allows animal protein production at a cost 6.9 times lower than that of commercial concentrates, facilitating food sovereignty. The low growth rate and palatability obtained with local raw materials should be analyzed to improve formulations or to adopt policies for the management of the production system.

Key words: Broilers, growing, raw matherials, supplement
Palabras clave: Pollos, crecimiento, materias primas, suplemento

Effect of passion fruit oil on the quality of eggs from light laying hens

Efeito do óleo de maracujá na qualidade dos ovos de galinhas poedeiras leves

Laís G Cordeiro[1]*, Byron A Hernández Ortíz[2], Vinícius Fardin[1], Elis O Figueroa Castillo[1], Gabrieli A de Lima[1], Paola A Damázio Rodrigues[1], Joyce A da Silva[1], Luane B Gonçalves Andrade[1] and José R Sartori[1]

[1]Universidade Estadual Paulista - UNESP, Faculdade de Medicina Veterinária e Zootecnia - FMVZ, Botucatu, Brasil, ORCID 0000-0002-2545-8902, ORCID 0009-0002-6871-4336, ORCID 0000-0003-4679-3002, ORCID 0000-0003-2719-0425, ORCID 0000-0001-7975-4531, ORCID 0000-0002-6833-9903, ORCID 0000-0002-4221-3827, ORCID 0000-0003-2691-8250. [2]Agrosavia, Colombia, ORCID 0000-0002-2390-4323.
*Corresponding author: lais.cordeiro@unesp.br

Introduction: Eggs are a complete, versatile, and low-cost food, justifying the growing worldwide consumption of this protein. The use of additives in the diet of laying hens seeks to improve productivity and egg quality. Passion fruit seeds have vegetable oil rich in antioxidant components, such as tocopherol, carotenoids, phenolic compounds, and unsaturated fatty acids, which can improve the quality of the eggs produced and allow the use of agro-industrial residues, adding value to the passion fruit seed. **Objective:** Evaluate the effect of passion fruit seed oil in the diet of Lohmann White laying hens on egg quality. **Methods:** A total of 192 25-week-old laying hens were housed, distributed in a completely randomized design with three treatments (0.00%, 0.45% and 0.90% passion fruit seed oil) and eight replicates. At the end of 28 days, two eggs per replicate were analyzed. The data were evaluated for normality and analyzed by the REG procedure for linear and quadratic regression, with a significance of 5%. **Results and Discussion:** The results showed that egg, albumen, yolk and eggshell weight, yolk color, yolk index, Haugh unit, albumen diameter, eggshell strength and eggshell thickness were not influenced (P>0.05) by the inclusion of passion fruit seed oil in the diet. The non-difference between treatments may be a consequence of the insufficient amount of bioactive compounds in passion fruit

seed oil or the short period of the product supply. Considering that this cycle represents the beginning of the productive period of these layers, the monitoring of egg quality according to the aging of the hens would allow a better evaluation of the mitigation of the age negative effects. **Conclusion:** The use of up to 0.90% passion fruit seed oil in the diet of light commercial laying hens between 25 and 29 weeks of age does not affect the egg quality. However, these bioactive compounds have the potential to improve hens' health, increase nutrient absorption, reduce tissue oxidation, and increase albumen secretion and yolk stability, and it is necessary to deepen this research line.

Keywords: Additive, antioxidant, *Passiflora edulis*, phytogenic, poultry farming
Palavras-chave: Aditivo, antioxidante, *Passiflora edulis,* fitogênico, avicultura

Effect of botanical extracts inclusion on nutrient digestibility in broiler chickens

Efecto de inclusión de extractos botánicos sobre la digestibilidad de nutrientes en pollos de engorde

Camila A Villalobos Gutiérrez[1*], Cruz E Enríquez Valencia[1], Mayra Díaz Vargas[1], Carlos F Duque Ramírez[1], Lina M Peñuela Sierra[2] and Juan Javierre[3]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0002-8179-998X, ORCID 0000-0002-9442-8395, ORCID 0000-0002-5598-6335. [2]Universidad del Tolima. Facultad de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0002-0483-2176; [3]Layn. USA, ORCID 0000-0003-2514-6981.
*Corresponding author: camvillalobos@udca.edu.co

Introduction: Antibiotic growth promoters (APC) are widely and continuously used in the poultry industry. Botanical extracts are presented as an alternative for the prevention of bacterial resistance caused by APC, however, it is important to evaluate their application. **Objective:** To evaluate the effect of botanical extracts inclusion on nutrients digestibility in broiler chicken diets. **Methods:** 704 one-day-old chickens were used, distributed in a completely randomized design with 4 treatments: Positive control diet with APC (PCD); negative control diet without APC (DCN), diet with 200 ppm grape extract (DEU) and diet with 200 ppm green tea extract (TEV). For nutrient digestibility analysis, ileal digesta was collected from chickens at 21 and 42 days of age. Subsequently, nutrient analysis was carried out and the digestibility coefficients of dry matter (CDMS), crude protein (CDPB), ethereal extract (CDEE) and gross metabolizable energy (CDEM) were estimated according to AOAC. The data were subjected to analysis of variance and the comparison of means was performed by the Tukey test ($p<0.05$). **Results and Discussion:** On day 21, significantly higher values ($p<0.05$) of CDMS were observed in the DCP (96.57±0.01%) and DCN (96.54±0.01%) diets. For the CDPB, higher values ($P<0.05$) were observed in the DEU (78.18±0.04%) and DCP (77.83±0.1%) diets, while for the CDEE (88, 46±0.04%) and CDEM (80.62±0.09%) were better ($P<0.05$) in the TEV diet. At 42 days the CDMS were higher ($p<0.05$) in the DCP (96.28±0.01%) and DEU (95.92±0.01%) diets and the CDPB were higher ($P<0.05$) in the DCP (80.74±0.10%) and DCN (79.59±0.32) diets. As at 21 days, for the CDEE (95.80±0.04%) and CDEM (80.69±0.36%) the diet with the best response ($P<0.05$) was TEV. Some studies suggest that natural extracts increase the digestibility and absorption of nutrients, by stimulating digestive enzymes. **Conclusion:** The inclusion of natural extracts in broiler chicken diets have a positive effect on nutrient digestibility.

Key words: Crude protein, dry matter, ethereal extract, grape seed, green tea, metabolizable energy
Palabras clave: Proteína bruta, materia seca, extracto etéreo, semilla de uva, té verde, energía metabolizable

Antimicrobial additives and their effect on intestinal morphology and microbiota in broilers

Aditivos antimicrobianos y su efecto en la morfología intestinal y microbiota en pollos de engorde

Carlos A Maya Ortega[1], Tomás Madrid Garcés[1] and **Jaime E Parra Suescún**[1*]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0002-5094-7716, ORCID 0000-0002-4191-2343, ORCID 0000-0003-4472-1326.
*Corresponding author: jeparrasu@unal.edu.co

Introduction: The inclusion of growth promoters antibiotic (GPA) in the food of productive species has counteracted the adverse effects caused by the imbalance of microbial ecosystems on the different cellular structures of the intestine. However, international regulation on GPA addition has promoted the search and development of new natural, efficient and biologically safe alternatives. Probiotics and essential oils have shown promising results at the intestinal level, since under different modes of action they increase histomorphological, immunological response and productive performance. **Objective:** To evaluate the addition of different antimicrobial compounds on histomorphology and microbiota of duodenum in broilers. **Methods:** 192 single day Ross308 chickens were randomized and assigned to 4 diets: Control Diet 1 (D-Ctrl): no GPA; Diet 2 (D2-GPA): Ctrl+GPA (avilamycin, 10 ppm); Diet 3: Ctrl+oregano essential oil (D3-OEO, 150 ppm); Diet 4 (D4-PROB): Ctrl+*Bacillus subtilis* (50 ppm) for 42 days. Days 21 and 42 were measured productive variables (weight gain-WG and food conversion-FC); in addition, 8 birds were sacrificed by treatment to evaluate pH, histomorphology and microbiota in the duodenum. The different variables were evaluated under an experimental design of random complete blocks with 8 replicates. **Results and Discussion:** The addition of *Bacillus subtilis* (D4-PROB) and AEO (D3-OEO) had a positive impact ($p<0.05$) on WG and FC. In addition, AEO and *Bacillus*

subtilis in the feeding of weaned piglets improved the height and width of the villi (P<0.05) and the production of mucoproteins; likewise, the depth of crypts decreased (P<0.05). The addition of D4-PROB significantly acidified pH (P<0.05) and improved microbiome diversity and growth of beneficial genera (P<0.05), compared to the addition of GPA. **Conclusion:** The inclusion of AEO and *Bacillus subtilis* as functional additives in the food, favor productive performance and intestinal health (integrity and microbiome stability) of broiler.

Keywords: *Bacillus subtilis*, gut health, *Lippia origanoides*, microbiome, mucines, poultry
Palabras clave: *Bacillus subtilis,* salud intestinal, *Lippia origanoides*, microbiome, mucinas, avicultura

Fructooligosaccharides: An opportunity for modern poultry farming

Fructooligosacáridos: una oportunidad para la avicultura moderna

Loufrantz J Parra Méndez[1], Katerin Luna[1], Blanca C Martínez Morales[1], Álvaro J Uribe Serrano[1] and **Jaime A Ángel-Isaza**[1]*

[1]Unidad de Investigación Desarrollo e Innovación de Promitec, ORCID 0000-0003-0702-3953, ORCID 0000-0003-0028-3058, ORCID 0000-0002-8417-8687, ORCID 0000-0001-8870-6793, ORCID 0000-0003-1612-6938.
*Corresponding author: Nutricionanimal@promitec.com.co

Introduction: Short-chain fructooligosaccharides (FOSsc), such as kestose, nystose, and fructofuranosylnystose, are oligosaccharides composed of fructose units with a terminal glucose that presents non-hydrolyzable β-type linkages by the animal. This leads to their availability as selective substrates for the intestinal microbiota, stimulating the proliferation of beneficial bacterial genera such as *Bifidobacterium* spp, *Lactobacillus* spp, *Akkermansia* spp, *Butyrivibrio* spp, *Butyricicoccus* spp, and *Coprococcus* spp, while competitively inhibiting others like Escherichia coli. This eubiotic property has turned FOSsc into a biotechnological tool of great necessity in current diets based on corn and soybean cake used in broiler chickens and commercial hens. **Objective**: To provide an introduction to the studies and experiences of Promitec Santander regarding the use of short-chain fructooligosaccharides as a biotechnological additive generated through enzymatic hydrolysis, on the intestinal health of broiler chickens. **Methods**: For this work, a process of collection, tabulation, and analysis of results from experimental and field trials conducted by Promitec Santander on the effect of FOSsc on different variables of intestinal health and their relationship with intestinal microbial communities was carried out. **Results and Discussion**: The use of FOSsc positively impacts intestinal health by improving the expression of brush border enzymes in different segments of the small intestine. Additionally, at the microbial community level, stimulation of lactic acid bacteria evaluated by culture techniques is observed. At the microbiota level, these compounds increase the abundance of taxa associated with short-chain fatty acid production. This has been reflected in the improvement of productive parameters such as weight gain and feed conversion in broiler chickens. **Conclusion**: The use of FOSsc in broiler chicken diets is proposed as a necessary tool to stimulate the development of intestinal microbial communities to stages that promote intestinal health and broiler chicken productivity.

Keywords: Intestine, gut health, poultry, prebiotic
Palabras clave: Intestino, salud intestinal, aves de corral, prebiótico

Modulation of broiler cecal microbiota fed with botanical extracts

Modulación del microbiota cecal de pollos de engorde alimentados con extractos botánicos

Cruz E Enríquez Valencia[1*], Mayra Díaz Vargas[1], Carlos F Duque Ramírez[1], Wilmar A Botello[2], Lina M Peñuela Sierra[3] and Juan Javierre[4]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0002-8179-998X, ORCID 0000-0002-9442-8395, ORCID 0000-0002-5598-6335; [2]Universidad El Bosque. Facultad de Ingeniería, Colombia, ORCID 0000-0003-1442-3066. [3]Universidad del Tolima, Facultad de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0002-0483-2176. [4]Layn USA, ORCID 0000-0003-2514-6981.
*Corresponding author: cenriquez@udca.edu.co

Introduction: The productivity of chickens depends, among other factors, on the functionality of the intestine, which is associated with the role of the microbiome. Botanical extracts may be able to modulate the composition of the gut microbiome. **Objective:** To determine the effects of botanical extracts inclusion in the diet of broiler on the cecal microbiota. **Methods:** Seven hundred and four one-day-old chickens were distributed into 3 experimental groups: commercial diet (CD), diet with 200 ppm grape seed extract (DSU) and diet with 200 ppm green tea extract (DTV). For DNA extraction, cecal samples were taken from chickens at 21 and 42 days of age. Sequencing of the V3/V4 regions of the bacterial 16S rRNA was done using the Illumina platform. In the identification of the Taxonomic Units (OTUs), reference databases of the 16S rRNA marker were used. Taxonomic classification at the phylum level was done using MEGAN. The relative frequencies of the OTUs were analyzed and compared through analysis of variance and Tukey test (p<0.05). **Results and Discussion:** The main phyla found were Firmicutes, Bacteroidetes, Actinobacteria and Proteobacteria. At 21 days, no differences (P>0.05) in Bacteroidetes were observed between groups. However, Firmicutes abundance was lower (P<0.05) in chickens fed DTV (67±7.9%) than chickens fed DSU (88.3±3.8%) and DC (88.2±7.8%). On the other

hand, chickens fed with DTV (1.24±0.18%; 0.7±0.02%) and DSU (2.32±0.16%; 0.8±0.04%) presented higher abundance of Actinobacteria and Proteobacteria compared to chickens fed DC (0.30±0.08%; 0.5±0.01%). At 42 days, no difference (*P*>0.05) was observed in the abundance of the OTUs of the bacterial phyla. The bacterial microbiome can be regulated by diet, which can lead to positive effects on the productivity and health of broilers. **Conclusion:** Grape seed and green tea extracts induced differential changes in the cecal microbiota of broiler chickens.

Keywords: Grape seed, green tea, phylum, RNAr16S, sequencing
Palabras clave: Semilla de uva, té verde, filo, ARNr16S, secuenciación

Characterization of nutritional management of backyard poultry in three rural areas of Antioquia

Caracterización del manejo nutricional de aves de corral en tres zonas rurales de Antioquia

Diana M Valencia-Echavarría[1]*, Yury T Granja-Salcedo[1], Piedad Y Martínez-Oquendo[1], Gonzalo J Restrepo-Castañeda[1], Felipe A Diaz Trujillo[1], Gilberto Tovar Claros[1] and Jorge G Noriega Márquez[1]

[1]Corporación Colombiana de Investigación Agropecuaria – Agrosavia. Centro de Investigación el Nus, Antioquia, Colombia, ORCID 0000-0001-8321-1353, ORCID 0000-0003-4783-999X, ORCID 0000-0002-9607-245X, ORCID 0000-0003-3496-2817, ORCID 0000-0003-4651-9353, ORCID 0000-0002-4838-6200, ORCID 0000-0002-9101-6424.
*Corresponding author: dmvalencia@agrosavia.co

Introduction: The backyard poultry farming contributes to the development of rural communities by preserving species, culture, and tradition, thus promoting food security. The sustainability of these systems is contingent upon overcoming productivity issues associated with traditional management practices. However, the characterization of nutritional management remains limited, constraining opportunities for improvement. **Objective**: To characterize the nutritional management of backyard poultry in three rural areas of the Antioquia department. **Methods**: Thirty backyard poultry farms in rural areas of San Roque (17), Maceo (7), and Caracolí (6) municipalities were characterized. Data were collected through a systematic survey including bird species, number of birds, feeding frequency, and types of feed. Data were compared between municipalities using the Kruskal-Wallis test and presented as median ± interquartile range. Thus, the frequencies of feed types are presented as the percentage of occurrence in the total identified feeds. **Results and Discussion**: Caracolí had the highest number of backyard birds per farm (44±24), compared to Maceo (24±13) and San Roque (16±21) (*P*=0.02). San Roque had a higher number of hens per farm (14±14; *P*=0.02). The fattening of chickens showed a similar number of birds per farm in all three municipalities (9±9; *P*=0.23). These systems had a similar number (*P*=0.19) of other livestock (7±5.5) and similar feeding frequency (1.5±1 times/day; *P*=0.32). Three farms provided *ad libitum* feeding, while the remaining offered 88.9±60 g/bird/day of feed (*P*=0.84). The types of feed identified were whole corn (54.1%), concentrates (21.3%), mixtures of concentrates + by-products (10.45%), corn meal (6.55%), forages (2.27%), cooked kitchen residues (1.63%), and cheese whey (1.63%). **Conclusion**: The variety of identified feeds reflects producers' adaptation to locally available resources. However, *ad libitum* feeding in some characterized farms may influence the sustainability of these systems. Acknowledgments: Ministry of Agriculture and Rural Development - MADR and the Colombian Agricultural Research Corporation - Agrosavia for their technical and financial support through the project: MADR Agreement 334– 2023.

Keywords: Area, feeds, frequencies, hens
Palabras clave: Área, Alimentos, frecuencias, gallinas

Nutrient digestibility in broiler chickens fed diets with lipase inclusión

Digestibilidad de los nutrientes en pollos de engorde alimentados con dietas con inclusión de lipasa

Edy S Acosta Calderón[1]*, Mayra Díaz Vargas[1] and Juan Javiere[2]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Facultad de Ciencias Agropecuarias, Colombia, ORCID 0009-0002-4781-5349, ORCID 0000-0002-9442-8395. [2]Layn, USA, ORCID 0000-0003-2514-6981.
*Corresponding author: edacosta@udca.edu.co

Introduction: Improving fat digestion in animal feed can reduce production costs and enhance chicken performance by decreasing the energy content of the diet. **Justification:** Energy is one of the most costly components in formulating diets for animals. **Objective:** To evaluate the digestibility of nutrients in broiler chickens from 1 to 42 days old fed diets that include lipase. **Methods:** The study was conducted at the Avian Experimentation Unit located in Palmira, Colombia. 560 one-day-old Cobb 500 broiler chickens were used, grouped into 5 Treatments**:** positive control diets according to animal requirements (CP), one negative control diet with a 35 kcal reduction (CN) from bird requirements, and three CN diets with lipase inclusion (100, 200, 300 ppm), each with 7 replicates of 16 animals per replicate. The digestibility of dry matter, ether extract, total protein, and energy was evaluated in the nutrition laboratory of the University of Applied and Environmental Sciences U.D.C.A according to AOAC methodologies. **Results and Discussion:** It was observed that the inclusion of 300 ppm of lipase improves the digestibility of dry matter and ether extract. Regarding energy metabolizability, the best treatment was 100 ppm of lipase. Studies have shown that lipase supplementation increases the digestibility of nutrients

such as dry matter, ether extract, and gross energy in broiler chickens and can lead to better feed conversion. **Conclusion:** The use of 100 ppm of lipase in diets with a 35 kcal reduction in 1 to 42-day-old broiler chickens improves energy digestibility, which is higher than that of birds receiving diets with the total required energy.

Keywords: Costs, energy, formulation, lipase
Palabras clave: Costos, energía, formulación, lipasa

Yolk quality of eggs produced by brown hens raised in cage-free system

Qualidade de gema de ovos de poedeiras marrons criadas em sistema livre de gaiolas

Ligia S Pereira[1], **José H Stringhini**[1]*, Fabyola Barros de Carvalho[1] and Carla D Suguimoto Leite[1]

Departamento de Zootecnia, Escola de Veterinária e Zootecnia, Universidade Federal de Goiás, Goiânia, GO, Brasil, ORCID 0000-0002-5204-1213, ORCID 0000-0002-3710-6963, ORCID 0000-0001-5900-5437, ORCID 0000-0002-6838-7761.
*Corresponding author: henrique@ufg.br

Introduction: Eggs are extremely perishable and start losing their internal quality immediately after being laid. It is an inevitable phenomenon that can be worsened by different factors. **Justification**: Several parameters can influence egg quality, such as bird age, housing system (conventional cage, cage-free, and free range), and storage (period and temperature). **Objective**: This study aimed to evaluate the influence of the storage environment, bird age, and storage period on the yolk characteristics of eggs from commercial laying hens housed in a cage-free system. **Methods**: The experiment involved 243 eggs of Hy-Line Brown® hens, which were distributed in a completely randomized design with a triple 3 x 2 x 3 factorial arrangement represented by three ages (36, 53, and 69 weeks), two storage temperatures (ambient and refrigerated), and three storage periods (10, 20, and 30 days), totaling 18 treatments. Yolk weight (g), yolk pH, yolk index, and yolk dry matter (%) were measured. Data were analyzed using R-project®. **Results and Discussion**: differences were observed in the average yolk weight of eggs from young hens (36 weeks), which gradually increased with the storage period, regardless of the storage environment. In ambient temperature, yolk pH was significantly different for all bird ages. Furthermore, advanced-age hens (69 weeks), were the only ones to present eggs with a difference in yolk pH regarding the storage environment, which was lower in ambient temperature. Eggs from hens at 53 weeks of age presented the lowest yolk pH, regardless of the storage environment. The yolk index presented a clear drop over the storage period at ambient temperature, whereas there was no such decrease under refrigeration. Moreover, this index was higher in eggs stored in refrigeration, regardless of the storage period. Eggs from advanced-age hens (69 weeks), lost more yolk dry matter in percentage as compared to the others at the end of the study, even under refrigeration. **Conclusion**: eggs stored in the refrigerator presented better yolk quality, regardless of the storage period. Finally, storage environment, period, and bird age influence the quality of eggs stored for 30 days.

Keywords: Ambient temperature, laying hens, refrigeration, storage, yolk quality
Palabras clave: Temperatura ambiente, gallinas ponedoras, refrigeración, almacenamiento, calidad de la yema

Characterization of the cecal microbiota of broilers fed with botanical extracts

Caracterización de la microbiota cecal de pollos de engorde alimentados con extractos botánicos

Katerin Silva Portela[1]*, Cruz E Enríquez Valencia[1], Mayra Díaz Vargas[1], Carlos F Duque Ramírez[1], Wilmar Botello[2], Lina M Peñuela Sierra[3] and Juan Javierre[4]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0002-8179-998X, ORCID 0000-0002-9442-8395, ORCID 0000-0002-5598-6335. [2]Universidad El Bosque. Facultad de Ingeniería, Colombia, ORCID 0000-0003-1442-3066. [3]Universidad del Tolima. Facultad de Medicina Veterinaria y Zootecnia, Colombia, ORCID 0000-0002-0483-2176. [4]Layn USA, ORCID 0000-0003-2514-6981.
*Corresponding author: katesilva@udca.edu.co

Introduction: The gastrointestinal microbiota of chickens is considered crucial for their welfare, growth and productive performance. Different bioactive plant compounds are being considered as potential alternatives to antibiotic growth promoters. **Objective:** To characterize the taxonomic structure of the cecal microbiota of broiler fed with the inclusion of botanical extracts. **Methods:** The experiment was carried out in Armero-Tolima with 704 one-day-old birds, distributed in 3 experimental groups, commercial diet (CP), diet including 200 ppm of grape seed extract (CNU) and diet with 200 ppm of green tea extract (CNT). At 21 days of age, 8 chickens per treatment were sacrificed. Cecum samples were taken from each individual and used for the extraction of microbial DNA. Sequencing of the 16S rRNA regions was done using the Illumina platform. The identification of the Operational Taxonomic Units (OTUs) was carried out using non-redundant databases as a reference from the 16S rRNA ribosomal marker. Taxonomic classification was performed by subsampling using MEGAN. **Results and Discussion:** The most representative bacterial phyla were Firmicutes and Bacteroidetes with approximate relative abundances of 84% and 3%, respectively. Other phyla such as Actinobacteria, Proteobacteria, Spirochaetes, Cyanobacteria, Tenericutes and Verrucomicrobia presented relative abundance around 1%. At the genus level, the most predominant OTUs in the cecal microbiota of chickens corresponded to *Alistipes*, *Bacillus*, *Blautia*, *Clostridium*, *Eubacterium*, *Faecalibacterium*,

Lactobacillus and *Ruminococcus*, within which *Lactobacillus* and *Clostridium* presented a relative abundance of 16.8% and 11.5%, respectively. As observed in this study, it is known that Firmicutes, Bacteroidetes and Proteobacteria represent the majority (>90%) of cecal bacteria in chickens and that this bacterial community has important interactions between diet and the host. **Conclusion:** The main OTUs found in 21-day-old broiler chickens fed with botanical extracts correspond mainly to the phyla Firmicutes and Bacteroidetes and the genera *Clostriduim* and *Lactilobacillus*.

Keywords: Bacteroidetes, Firmicutes, grape, RNAr16S, sequencing
Palabras clave: Bacteroidetes Firmicutes, uva, ARNr16S, secuenciación

Effect of aspartyl protease in broiler chicken diets
Efecto de aspartil proteasa en dietas de pollos de engorde

Katty G Bernal González[1]*, Carlos Duque Ramírez[1] and Mayra Díaz Vargas[1]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA), ORCID 0009-0009-8560-1182, ORCID 0000-0002-5598-6335, ORCID 0000-0002-9442-8395.
*Corresponding author: kbernal@udca.edu.co

Introduction: Protein is one of the most expensive nutrients in balanced feed for production animals. Therefore, research on this topic seeks to reduce the economic impact on poultry farming. **Objective:** To evaluate the inclusion of protease produced by fermentation with *Aspergillus niger* in the feed of broiler chickens from 1 to 42 days, focusing on productive performance. **Methods:** The study was carried out at the Experimentation Unit in Palmira-Colombia, located in a thermally warm region at 1,000 meters above sea level. 960 one-day-old Cobb 500 chickens were used, grouped into 5 treatments: two control diets with a reduction in protein content by 3% (LP3) and 6% (LP6) of the birds' requirements and three diets with inclusion of protease (50, 100, 150 ppm) based on LP6, each with 8 repetitions of 24 animals per replicate, the productive performance of the birds was evaluated by analyzing live weight, feed consumption and conversion rate. **Result and Discussion:** When evaluating weight gain, it was observed that the birds that received the diets with 50 and 100 ppm of protease had a weight gain equal to the birds that received the diet with -3% protein, and greater than the birds that received the diet with -6% protein and those that received the diet with 150 ppm of protease. Regarding food consumption and weight gain, no differences were observed between treatments. The use of up to 100 ppm of protease in diets with 6% protein reduction can increase weight gain in broilers from 1 to 42 days, because proteases play an important role in physiological processes such as protein degradation, cell division and turnover, promoting intestinal health and reducing the colonization of pathogenic bacteria. **Conclusion:** Supplementing with serine protease at up to 100 ppm in diets with less than 6% protein improves weight gain of birds and can reduce production costs.

Keywords: Feeding, poultry, performance, protease, production, weight
Palabras clave: Alimentación, aves, rendimiento, proteasa, producción, peso

Immunomodulatory effect of β-glucans in broiler chickens challenged with *E. coli*
Efecto inmunomodulador de los β-glucanos en pollos de engorde desafiados con *E. coli*

Luisa F García Ospina[1]*, Carlos F Duque Ramírez[1] and Mayra Díaz Vargas[1]

[1]Universidad de Ciencias Aplicadas y Ambientales. Facultad de Ciencias Agropecuarias, Colombia, ORCID 0009-0004-7502-4872, ORCID 0000-0002-5598-6335, ORCID 0000-0002-9442-8395.
*Corresponding author: luisagarcia@udca.edu.co

Introduction: In Colombia, poultry farming is one of the main livestock activities in the country and with this it becomes fundamental to perform a correct antibiotic management in production, since antimicrobial resistance is considered an emerging problem. Understanding this, β-glucans have been considered an alternative to antibiotics. **Objective**: An experiment was carried out to evaluate: How do β-glucans generate an immunomodulatory effect in broilers, since studies show that they can promote bird growth, provide immunomodulatory effects and prevent antimicrobial resistance. **Methods**: 150 one-day-old Broiler Ross line birds challenged at 7 days of age with oral inoculation of *E. coli* (1·107 CFU) via gavage were used. The β-glucan additive was supplied in drinking water, and the treatments were T1: 0.1% saline, T2: β-glucan 0.25%, and T3: β-glucan 0.5%. Eight birds from each treatment were randomly selected on days 17, 21 and 43 of age, and blood samples were collected to determine the levels of immunoglobulins (IgG, IgA, IgM). Subsequently, they were sacrificed and organs were collected: thymus, spleen and bursa of Fabricius - to determine the relative weight of the thymus and the size of the bursa and spleen. **Results and Discussion**: After determining globulins on day 17 of life (10 days post-infection: DPI) no significant differences were obtained; on day 21 (14 DPI) (P=0.0008) and day 43 (35 DPI) (P= <0.0001) the highest IgG value was obtained with T2. Likewise, measurement of lymphoid organ size at 10 DPI showed significant increases in bursa (P=0.003) and spleen (P=0.03) with T2; at 14 DPI, T2 increased bursal size (P= 0.015); and finally, at 35 DPI, bursal size (P=0.007) and relative thymus weight (P=<0.0001) increased with T1, while spleen increased in size with T2. Delivery of β-glucan at 0.25% (T2) influences the immune response by increasing the

amount of IgG in the late phase of infection, and the increase in the size of the bursa and spleen influences the immune response against infection. Conclusion: The use of β-glucans at 0.25% is a viable alternative to improve the immune response in *E. coli* positive birds.

Keywords: Colibacillosis, immunostimulants, immune response
Palabras clave: Colibacilosis, inmunoestimulantes, inmunorespuesta

Validation of an *in vitro* technique for the estimation of nutrient digestibility in poultry diets

Validación de una técnica in vitro para estimar digestibilidad de nutrientes en dietas para aves

Marina Fernández-García[1*], Juan P Uzcátegui-Varela[2], Alejandro Britos[3] and Sebastián Brambillasca[4]

[1]Facultad de Veterinaria, Universidad de la República, UdelaR, Uruguay, ORCID ORCID 000-0001-5208-9893, ORCID 0000-0003-1091-5346, ORCID 0000-0001-5728-8517.. [2] Universidad Nacional Experimental Sur del Lago "Jesús María Semprum" (UNESUR). Núcleo La Victoria, Mérida, Venezuela, ORCID 0000-0001-7602-1332.

*Corresponding author: fdezgarcia.marina@gmail.com

Introduction: The evaluation of complete diets is crucial for efficient and sustainable animal production. **Justification:** The development of repeatable and reliable *in vitro* techniques minimizes the need for *in vivo* experiments, thereby reducing animal testing while offering economical and time-saving benefits. **Objective**: Optimization of an *in vitro* technique to predict apparent digestibility in complete diets for poultry nutrition. **Methods:** An *in vivo* study of dry matter and organic matter total tract apparent retention (DMTTAR, OMTTAR) was performed. Sixty Ross female broilers were housed in battery cages and in a randomized block design, with 5 animals per cage and 6 cages per treatment. Excreta were collected for 3 days and DMTTAR and OMTTAR were determined using acid insoluble ash as an indigestible marker. In addition, dry matter and organic matter *in vitro* digestibility (DMIVD and OMIVD) was determined using an Ankom-DaisyII incubator. Filter bags were incubated at 39 °C in two phases: 1) pepsin-HCl digestion for 0.5 or 1 h; 2) pancreatin digestion for 1.5, 3, 4.5, 6, or 7.5 h. DMIVD and OMIVD results were compared for different incubation times. Furthermore, *in vivo* and *in vitro* results were compared and prediction equations for DMIVD and OMIVD were developed from *in vitro* data. **Results and Discussion:** There were no difference for DMIVD and OMIVD at both incubation times in step 1 (P=0.175), however, in step 2, DMIVD and OMIVD increased linearly with longer incubation times (P<0.0001). *In vitro* and *in vivo* results were equivalent when *in vitro* analysis was conducted using pepsin digestion for 0.5 h followed by pancreatin digestion for 3, 4.5, or 6 h, or alternatively, pepsin digestion for 1.5 h followed by pancreatin digestion for 3, 4.5, or 6 h (*P*>0.05). Prediction equations for DMTTAR and OMTTAR performed from the *in vitro* method had high coefficients of determination (R^2>0.97) and low standard errors (SE<0.110) for these incubation times. **Conclusion:** The method is consistent with *in vivo* determinations, and in practice, incubation with pepsin solution for 0.5 h followed by pancreatin solution for 3 h would be sufficient to obtain adequate predictions.

Keywords: Ankom-DaisyII incubator, animal nutrition, prediction equations
Palabras clave: Ankom-DaisyII, nutrición animal, ecuaciones de predicción

Efecto de la inclusión de muramidasa en dietas para pollos de engorde

Muramidase inclusión effects in broiler diets

Mateo Sepúlveda Rodríguez[1*] and Mayra Díaz Vargas[1]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Bogotá, Colombia, ORCID 0009-0003-0462-0194, ORCID 0000-0002-9442-8395.

*Corresponding author: ansepulveda@uda.edu.co

Introduction: Lysozyme, a natural enzyme with antibacterial properties, has shown promise as a dietary supplement in poultry, improving feed conversion, reducing the presence of pathogenic bacteria in the intestines, and decreasing intestinal lesions. This highlights its potential as a growth promoter in poultry farming. **Objective:** To evaluate the effects of muramidase on productive parameters in broiler chickens. **Methods:** 448 animals were used, divided into 4 treatments: diet with -60 kcal/kg ME and 1% CP (T1); T1 diet with 0.005% muramidase (T2); T1 diet with 0.01% muramidase (T3); and T1 diet with 0.02% muramidase (T4), each with 7 repetitions of 16 animals. Performance parameters (weight gain, consumption, feed conversion) and nutrient digestibility coefficients (dry matter, protein, ether extract) were evaluated, as well as the metabolizability coefficient of energy. **Results and Discussion:** At 21 days (*P*=0.002) and 42 days (*P*=0.0007), females receiving T4 showed higher protein digestibility; regarding the energy metabolizability coefficient (P=0.008), it was higher in females receiving T1 and at 42 days (*P*=0.003) in those receiving T2; in males, higher protein (*P*=0.0003) and ether extract (*P*=0.001) digestibility were observed for birds receiving the T1 and T2 diets, and the energy metabolizability coefficient (*P*=<0.001) was better for the T3 diet, as well as at 42 days (*P*=0.01); however, there were no differences in productive parameters for females and males. The inclusion of muramidase increases the digestibility of protein, ether extract, and energy. **Conclusion:** The inclusion of 0.02% muramidase in females improves protein digestibility, and the inclusion of 0.01% improves energy digestibility without changes in productive parameters.

Keywords: Conversion, digestibility, energy, protein, weight gain
Palabras clave: Conversión, digestibilidad, energía, proteína, ganancia de peso

Meat quality in chicken breast fed with diets containing natural extracts

Calidad de carne en pechuga de pollos alimentados con dietas con extractos naturales

Nina Y Sepúlveda Monroy[1*], Mayra Díaz Vargas[1], Juan A Javierre[2] and Carlos F Duque[1]

[1]Universidad de Ciencias Aplicadas y Ambientales (UDCA). Facultad de Ciencias Agropecuarias, Colombia, ORCID 0009-0003-1172-6472, 0000-0002-9442-8395, 0000-0003-2514-6981. [2] Layn USA, ORCID 0000-0002-5598-6335.
*Corresponding author: ninsepulveda@udca.edu.co

Introduction: As a strategy to be implemented in poultry feeding, photogenic additives emerge, which have positive impacts on meat quality. **Objective:** To evaluate the effect of natural extracts (grape and green tea) on breast meat quality. **Methods:** 408 one-day-old broiler chickens of the Cobb 500 line were used. The animals were randomly distributed into 3 treatments: T1: Balanced control diet according to animal requirements (BC); T2: BC + 400 ppm grape extract; T3: BC + 400 ppm green tea extract; each treatment had 8 replicates of 16 animals. To evaluate meat quality at 42 days, one bird from each replicate was selected, slaughtered, and breast samples were stored in expanded polystyrene trays covered with cling film and stored in a refrigerated showcase for 15 days. pH, texture, and lipid oxidation were evaluated using the TBARS methodology, and the data obtained were analyzed using the SAS 9.4 statistical program. **Results and Discussion**: When evaluating the pH evolution of the breast, a progressive increase in pH was observed (P=0.009), with birds fed grape showing greater pH stability, as well as lower texture observed in the samples of birds that received grape (P=<0.001) and green tea (P=0.008) at 15 days, indicating that the texture of these samples was softer. When evaluating oxidation, it was observed that at day zero, the lowest values were found in samples from birds fed the green tea diet (P=<0.0001), and at 15 days of storage, the lowest TBARS values were observed in samples from birds fed grape and green tea (P=<0.001), while samples from birds fed the control diet showed the highest TBARS values, indicating greater lipid peroxidation. **Conclusion**: The breast meat of birds fed grape and green tea extracts has better texture and lower lipid oxidation, indicating better quality.

Keywords: Lipid oxidation, photogenic additives, pH, texture
Palabras claves: Oxidación lipídica, aditivos fitogénicos, pH, textura

Short-chain fructooligosaccharides as enhancers of productivity and intestinal development in broiler chickens

Fructooligosacáridos de cadena corta como mejoradores de la productividad y el desarrollo intestinal en pollo de engorde

Jaime A Ángel-Isaza[1*], Viviana Parada Roa[1], Loufrantz J Parra Méndez[1], Blanca C Martínez Morales[1] and Álvaro J Uribe Serrano[1]

[1]Unidad de Investigación Desarrollo e Innovación de Promitec. ORCID 0000-0003-1612-6938, ORCID 0000-0003-0702-3953, ORCID 0000-0002-8417-8687, ORCID 0000-0001-8870-6793.
*Corresponding author: Nutricionanimal@promitec.com.co

Introduction: Short-chain fructooligosaccharides (scFOS) are oligosaccharides composed of fructose units with a terminal glucose, featuring β linkages that are resistant to animal hydrolysis, resulting in their availability as selective substrates for the intestinal microbiota. scFOS have become highly valuable biotechnological compounds for the animal nutrition industry, aiming to modulate intestinal microbial populations to enhance intestinal health and productivity. **Objective.** Evaluate the use of increasing doses of scFOS supplementation on the productivity and morphological development of the intestine in broiler chickens. **Methods:** Two hundred one-day-old Ross AP chickens were homogenized and randomized following a completely random design with five repetitions of five treatments: D1: basal diet (BD) without scFOS inclusion, D2: BD + 700 g/ton of scFOS, D3: BD + 1050 g/ton of scFOS, D4: BD + 1400 g/ton of scFOS, and D5: BD + 1750 g/ton of scFOS. The experimental period lasted for 42 days, during which the animals received the treatments consistently. At the end of the experimental period, productive parameters were evaluated, and jejunal samples were taken to assess morphometric variables. Statistical analysis was conducted using generalized linear models and ANOVA with Tukey's mean comparison in the Rstudio program. **Results and Discussion:** Productive variables such as live weight and productivity index showed a significant linear effect (P<0.05) of the scFOS dose. The 1400 g/ton dose (D4) presenting the best productivity results. Regarding jejunal morphological development, treatment D5 significantly (P<0.05) exhibited the longest intestinal villi, while the villus-to-crypt ratio was mostly increased (P<0.05) by the 1050 g/ton dose (D3) of scFOS. **Conclusion:** The inclusion of scFOS in broiler chicken feed at doses ranging from 700 to 1750 g/ton improves productivity and morphological development, with a greater beneficial impact on productive outcomes at the 1400 g/ton dose.

Key Words: Health, intestine, prebiotic, poultry
Palabras clave: Salud, intestino, prebiótico, avicultura

Gene expression of proinflammatory and anti-inflammatory cytokines in a chicken intestinal inflammation model

Expresión génica de citoquinas proinflamatorias y antiinflamatorias en un modelo de inflamación intestinal en pollos

Sandra P Rodríguez González[1*], Albeiro Lopez Herrera[2] and Jaime E Parra Suescún[2]

[1]Universidad Pedagogica y Tecnológica de Colombia UPTC, ORCID 0000-0002-1037-7843. [2]Universidad Nacional de Colombia sede Medellin. Facultad de Ciencias Agrarias, ORCID 0000-0003-1444-3470, ORCID 0000-0003-4772-1326.
*Corresponding author: sprodriguezg@unal.edu.co

Introduction: Enteritis is associated with an increase in the population of gram-negative bacteria such as *Escherichia coli*, which when replicated and eliminated release Lipopolysaccharides (LPS), which have the ability to activate the intestinal immune system and increase the expression of cytokines presenting structural and functional alterations in the intestine, appearance of diarrhea and mortality. **Objective:** to evaluate the addition of *B. subtilis* on the duodenal gene expression of pro- and anti-inflammatory cytokines in chickens exposed to *E. coli* LPS. **Methods:** RNA extraction and quantification of cytokine expression by real-time PCR, from duodenum samples collected in conventional necropsy, a completely randomized design was carried out in an arrangement of divided plots. Each animal was assigned to one of six experimental diets, the differences between the means of the treatments were determined by least squares and analyzed by ANOVA and the comparison of the means between each treatment with Duncan. **Results and Discussion:** in diets containing *B. subtilis,* the expression of proinflammatory cytokines (IL-8, IL-18, TNF-α, INF-γ) was decreased, the decrease in these as the age of the bird increased and The increase in IL-10 suggests that *B. subtilis* has a role in maintaining immune homeostasis, preventing the triggering of a strong inflammatory response. **Conclusion:** The use of *B. subtillis* has a beneficial effect similar to APCs as a modulator of the inflammatory response, decreasing the expression of proinflammatory cytokines (IL-8, IL-18, TNF-α, INF-γ) and increasing the IL-10 (anti-inflammatory), to maintain a balance of the inflammatory response in bacterial infection.

Keywords: *B. subtilis,* cytokines, duodenum, *E. coli*, LPS, PCR
Palabras clave: *B. subtilis*, citoquinas, duodeno, *E. coli*, LPS, PCR

Metabolizable energy of insect meal for broiler chickens

Energía metabolizable de harina de insectos para pollos de engorde

Sashka Chobanova[1], Nikolay Karkelanov[1], Stephen C Mansbridge[2], Isobel M Whiting[2], Stephen P Rose[2] and **Vasil R Pirgozliev**[2*]

[1]Trakia University. Faculty of Agriculture, 6000, Stara Zagora, Bulgaria. [2]Harper Adams University. The National Institute of Poultry Husbandry, TF10 8NB, Shropshire, UK, ORCID 0000-0003-4246-9782, ORCID 0000-0003-2160-3583, ORCID 0000-0001-6459-597X, ORCID 0000-0002-4213-7609.
*Corresponding author: vpirgozliev@harper-adams.ac.uk

Introduction: Insect based feed materials are increasing in availability for poultry diets due to legislative changes and advances in production methods. However, there is limited information on the N-corrected apparent metabolizable energy (AMEn) of those products. The AMEn of feeds is required to formulate diets accurately, thus research has practical importance. **Objective**: The objective of this study was to assess the AMEn of defatted insect meal (IM; 459 g/kg CP, 171 g/kg fat, 963 g/kg DM) and whole larvae meal (WLM; 399 g/kg CP, 240 g/kg fat, 997 g/kg DM) for broiler chickens. **Methods**: Three diets, in meal form, were used in this study: a basal diet (B; 181 g/kg CP, 66 g/kg fat, 920 g/kg DM), B diluted with 100 g/kg of IM and B diluted with 100 g/kg of LM. Each diet was fed to 6 pens (two female Ross 308 chicks each) from 14 to 21d age, following randomisation. Total excreta collection technique was used. The AMEn in diets was calculated as described by Hill and Anderson (1958). The AMEn in the IM and WLM was determined via substitution technique. Data were analysed by one-way ANOVA. **Results and Discussion**: Dietary AMEn was 12.49, 12.98 and 12.89 MJ/kg DM (SEM=0.220, *P*>0.05), for diets B, IM and WLM, respectively. The AMEn for IM was 17.40 and for WLM was16.50 MJ/kg DM (SEM=2.150, *P*>0.05). The AMEn obtained for insect products was within expected values (Schiavone et al. 2017; Mahmoud et al. 2023). However, the available energy content may depend on production process and chemical composition of the product. Thus, standardising the methods for insect product manufacturing would improve predictability of their feeding value. **Conclusion**: The present experiment shows that the studied insect meal products contain relatively high AMEn, which makes them suitable components for poultry diet formulation. However, research into standardising insect rendering and production methods should be prioritised by the industry.

Keywords: Broilers, insect meal, metabolizable energy, poultry
Palabras clave: Pollos de engorde, harina de insectos, energía metabolizable, aves de corral

The addition of antimicrobials modulates microbial diversity, the gene expression of intestinal enzymes-transporters and the production performance of chickens

La adición de antimicrobianos modula la diversidad microbiana, la expresión génica de los transportadores de enzimas intestinales y el rendimiento productivo de los pollos

Tomás Madrid Garcés[1*], Carlos A Maya[1], Jaime Ángel Isaza[1], Albeiro López Herrera[1] and Jaime E Parra Suescún[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, ORCID 0000-0002-4191-2343, ORCID 0002-5094-7716, ORCID 0000-0003-4472-1326, ORCID 0000-0003-1612-6938, ORCID 0000-0003-1444-3470, ORCID 0000-0003-4472-1326.
*Corresponding author: jeparrasu@unal.edu.co

Introduction: The intestinal microbiota plays an important role in the health and well-being of birds, so the establishment of beneficial microorganisms and an adequate bacterial balance from the early days of the bird, is crucial for optimal intestinal development, good health and better productive performance. Therefore, research has been promoted on food alternatives that

are natural, efficient and biologically safe to partially/totally reduce the use of grow promoters antibiotics (GPA). **Objective:** To evaluate the productive yield, the genetic abundance of digestion/transport proteins and the intestinal microbiota of chickens fed with natural antimicrobial products. **Methodology:** 192 day-old Ross308 male chickens were randomized and assigned to 4 diets: Control Diet 1 (D1-Ctrl): no antimicrobials; Diet 2 (D2-GPA): Ctrl+GPA (avilamycin, 10 ppm); Diet 3: Ctrl+oregano essential oil (D3-OEO, 150 ppm); Diet 4 (D4-PROB): Ctrl+*Bacillus subtilis* (50 ppm) for 42 days. Days 21 and 42 were measured productive variables (weight gain-WG and food conversion-FC); in addition, 8 birds were sacrificed for treatment for extraction of metagenomic DNA from intestinal content (jejunum), and to evaluate the gene expression of enzymes-transporters (MgA, SI and SGLT-1, GLUT-2 and GLUT-5) and microbiota (diversity and composition). The different variables were evaluated under an experimental design of random complete blocks with 8 replicates. **Results and discussion:** the addition of *Bacillus subtilis* and OEO had a positive impact (P<0.05) on WG and FC; in addition, the expression of enzymes-carriers increased (P<0.05). The use of *Bacillus subtilis* promoted more diverse intestinal microbiomes compared to D2-GPA, while the addition of OEO preserved the equilibrium of the microbiome. **Conclusion:** OEO and *Bacillus subtilis* modulate the jejunum microbiome differently compared to GPA (avilamycin), promoting the diversity of the microbiome; improving function (molecular expression of enzymes-transporters in enterocyte) and yield in poultry. Moreover, these products could partially replace the use of GPA´s.

Keywords: *Bacillus subtilis*, digestion/transport, gut health, *Lippia origanoides*, microbiome, mucines, poultry
Palabras clave: Aves de corral, *Bacillus subtilis*, digestión/transporte, *Lippia origanoides*, microbioma, mucinas, salud intestinal

SALUD PREVENTIVA Y BIOSEGURIDAD

Microorganisms causing diseases in beds of chicken houses in Valledupar, Colombia

Microorganismos causantes de enfermedades en camas de galpones de pollos en Valledupar, Colombia

Camila A Ruiz Jiménez[1*], Abid S Cañate González[1], Daniel M Echeverri De la Hoz[2], Estefanía Jaimes Hernández[1], Patricia Herrera Demares[1] and Yerelis K Anaya Bustos[1]

[1]Universidad Popular del Cesar. Programa de Microbiología, Colombia, ORCID 0009-0002-2660-7444, ORCID 0000-0003-0496-2971, ORCID 0009-0003-8180-5723, ORCID 0000-0002-46269449, ORCID 0009-0002-2411-1218. [2]Universidad de Córdoba. Colombia, ORCID 0000-0002-7953-2661.

*Corresponding author: Candrearuiz@unicesar.edu.co

Introduction: Inadequate litter management can be considered an important factor in the proliferation of agents, putting the productivity of birds at risk. Among the causal microorganisms that can be found in poultry litter are *Salmonella* spp., *Campylobacter* spp., *Escherichia coli*, *Clostridium perfringens*, and fungi; responsible for symptoms such as watery, bloody diarrhea, anorexia, high mortality and high economic losses. **Objective:** Determine pathogenic microorganisms present in broiler chicken shed bedding in Valledupar, Colombia. **Methods:** Floor bed sampling was carried out in nine farms located in Valledupar, Cesar, one week before completing the 45 days of production. Sampling was carried out by initially marking five specific points on the shed bed. From each indicated point, 100 g of the sample were taken for a total of 500g. They were collected in Ziploc bags, packed and transported to be analyzed in the laboratory of the Popular University of Cesar. Specific culture media for bacteria were implemented EMB Agar, XLD, Salt Mannitol, and rappaport broth, Ziehl Neelsen stain for *Clostridium* spp and Sabouraud for fungi. A descriptive analysis of the results was performed in RStudio. **Results and Discussion:** *Escherichia coli* and *Staphylococcus aureus* were the most prevalent microorganisms, found in 77% of the sampled farms, followed by *Salmonella* spp, with 66%, *Aspergillus niger* (44%) and *Clostridium* spp (33%). Fungi of the genus *Fusarium* (22%) spp, and *Mucor* spp (11%), were the least prevalent in all the farms under study. **Conclusion:** The identified microorganisms represent a risk for poultry health. It is important to determine the origin and route of entry of these pathogens into the poultry houses; in many cases, overcrowding and the high load of fecal matter in the beds makes it possible for birds to contract diseases, becoming a risk for operators and the final consumer. It is recommended to implement appropriate management practices such as regulated cleaning and disinfection of the area where the beds are located, to minimize risks and maintain the health of the birds.

Keywords: Broiler chickens, litter, microorganisms, pathogens, public health

Palabras clave: Pollos de engorde, Cama, microorganismos, patógenos, salud pública

Systematic review of the prevalence of avian Hepatitis E Virus in poultry worldwide, 2000-2023

Revisión sistemática de la prevalencia del Virus Hepatitis E aviar en aves de producción en el ámbito mundial, 2000-2023

Jorge E Forero Duarte[1*], Leonardo Alzate Mejía[2] and Jaiberth A Cardona-Arias[2]

[1]Universidad de Antioquia. Escuela de Microbiología, Colombia, Grupo de Microbiología Ambiental, Colombia, ORCID 0000-0001-7345-9590. [2]Universidad de Antioquia.Escuela de Microbiología, Colombia, ORCID 0000-0002-7101-929X.

Corresponding author: jorge.forero@udea.edu.co

Introduction: Infection with avian Hepatitis E Virus (aHEV) constitutes an animal health problem and is involved in significant losses in poultry production. **Objective:** To analyze the prevalence of aHEV infection in production birds based on global scientific publications between 2000 and 2023. **Methods:** Systematic review applying the Johanna Briggs Institute guidelines and the PRISMA guide. Exhaustiveness, reproducibility and evaluation of methodological quality were guaranteed. Two random effects meta-analyses were performed estimating the prevalence of aHEV using ELISA and RT-PCR; homogeneity was evaluated with I^2, publication bias with the Begg statistic, and sensitivity using the graphical method of influences. **Results and Discussion:** 193 publications were identified, and only 24 complied with the protocol, 17 used ELISA and 12 RT-PCR (five studies used both tests). 54.1% of studies were carried out in Asian countries (mainly in China), 20.1% were done in European countries, in America, only three studies were found in the United States. Poland was the country with higher diversity of genotypes (isolating genotypes 2, 3 and 4), while in Europe and America the more common genotype is genotype 2, in Asia genotype 3 was the most isolated. The meta-analysis found high heterogeneity within studies, no publication bias was found, and no statistically significant differences were

found in the sensitivity analysis. Seroprevalence in studies using ELISA ranged from 8.1% to 100%, with a pooled measure of 32.1% (95% CI 32.1-33.8) in 11,719 birds. The molecular prevalence fluctuated between 0% and 74%, the combined measurement in 3165 birds was 15.7% (95% CI 11.6-14.0). **Conclusion:** A high molecular prevalence of aHEV and distribution of multiple genotypes in European countries was found, which is worrying given the effects that this infection generates in birds and its implications for poultry production. The absence of studies in regions like Latin America, despite the demonstration of the circulation of aHEV in countries like the United States, makes it imperative to develop epidemiological studies in this kind of region.

Keywords: aHEV, *Hepevirus*, meta-analysis, poultry, seroprevalence
Palabras clave: aHEV*, Hepevirus,* metaanálisis, avicultura, seroprevalencia

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Eggshell quality of eggs produced by brown hens raised in cage-free system

Qualidade da casca de ovos de pedeiras marrons provenientes de sistema livre de gaiolas

Ligia Sarneiro Pereira[1], **José H Stringhini**[1]*, Fabyola Barros de Carvalho[1], and Carla D Suguimoto Leite[1]

[1]Universidade Federal de Goiás. Departamento de Zootecnia, Escola de Veterinária e Zootecnia, Goiânia, GO, Brasil, ORCID. 0000-0002-5204-1213, ORCID 0000-0002-3710-6963, ORCID 0000-0001-5900-5437, ORCID 0000-0002-6838-7761.
*Corresponding author: henrique@ufg.br

Introduction: Egg production is essential to human consumption due to its low cost and nutritional aspects since they are rich in proteins, carbohydrates, lipids, vitamins, minerals, and fatty acids. **Justification**: Several parameters can influence egg quality, such as bird age, housing system (conventional cage, cage-free, and, free range), and storage (period and temperature). **Objective**: This study aimed to evaluate the influence of the storage environment, bird age, and storage period on the physical characteristics of the shell of eggs from commercial laying hens housed in a cage-free system. **Methods**: The experiment involved 243 eggs of Hy-Line Brown® hens, which were distributed in a completely randomized design with a triple 3x2x3 factorial arrangement represented by three ages (36, 53, and 69 weeks), two storage temperatures (ambient and refrigerated), and three storage periods (10, 20, and 30 days), totaling 18 treatments. Eggshell weight (g), eggshell strength (kgf), and specific gravity (g/cm^3) were measured and the eggshell percentage was calculated in relation to egg weight. Data were analyzed using R-project®. **Results and Discussion**: differences were observed on the eggs from advanced-age hens (69 weeks), which presented higher eggshell weight as compared to the other ages on day 10th, regardless of the storage environment. On the same day, eggs from 36 and 53 weeks presented their lower eggshell weight. Because of their size, the eggs from advanced-aged hens (69 weeks), presented lower eggshell strength as compared to the other ages. The specific gravity presented a sharper decline in eggs in ambient temperature. Eggs from advanced age laying hens (69 weeks) presented the lowest specific gravity, regardless of the storage environment. **Conclusion**: the advancing age of the laying hens reduced the eggshell quality due to less proportional calcium deposit in eggshells, regardless of the storage environment and period. Finally, storage environment, period, and bird age influence the quality of eggs stored for 30 days.

Keywords: Ambient temperature, eggshell quality, laying hens, refrigeration, storage

Palabras clave: Temperatura ambiente, calidad de la cáscara de huevo, gallinas ponedoras, refrigeración, almacenamiento

Productive characteristics of the "miniature" hen (*Gallus gallus domesticus*)

Características productivas de la gallina "miniatura" (*Gallus gallus domesticus*)

Mateo Itza-Ortíz[1]*, Marcela Beristaín-Ruiz[1] and Edgar Aguilar-Urquizo[2]

[1]Universidad Autónoma de Ciudad Juárez. Departamento de Ciencias Veterinarias. Cd. Juárez, Chihuahua, México, ORCID 0000-0003-0313-586X, ORCID 0000-0002-9189-3750. [2]Tecnológico Nacional de México. Yucatán, México, ORCID 0000-0003-4727-7894.
* Corresponding author: mateo.itza@uacj.mx

Introduction: "Miniature" hens and roosters, also known as Kikiriki, Arlequines, Habanero, Azteca, Currito, Filipino, are birds of the *Phasianidae* family considered as companion or ornamental birds. They are known as "miniature" hens due to their size, which resembles a pullet in the growth phase with the morphological characteristics of an adult hen. It has been considered that "miniature" hens have an approximate measurement of 25% of the size of a *Gallus gallus domesticus* "normal" since they can weigh between 300 to 450 g and measure between 20 to 30 cm in height with an average lifespan of 5 to 6 years. **Objective:** To announce, some morphological and productive aspects of the miniature hen. **Methods:** Seven miniature hens of approximately 6 months of age were housed individually in individual scratching posts of 90 x 90 cm and were fed with commercial hens feed of 17% protein and 2800 kcal/kg and freshwater *ad libitum*. The study variables were oviposition frequency (d), egg weight (g), yolk color, DMS fan was used, shell thickness (mm) and albumen height (mm). The data were captured and analyzed with Microsoft Excel using a descriptive statistics of frequency table, mean, standard deviation. **Results and Discussion:** 45.45% of the hens had an oviposition frequency between 1 to 2 days, 34.09% between 2 to 3 days, 15.91% between 3 to 4 days. The maximum average egg weight found was 27.36±4.42 g (CV= 19.38); the minimum was 21.81±1.52 g and the heaviest was 36.10±1.22 g and in neither case was a double yolk observed. The yolk color was 8.50±2.71, the shell thickness was 0.32 ±0.05 and the albumen height was 3.89±1.22. **Conclusion:** The "miniature" *Gallus gallus domesticus* has productive characteristics like a "normal" hen and in addition to being an exhibition or companion hen, it can be considered acceptable as a production hen.

Keywords: Egg production, miniature hen, morphology
Palabras clave: Producción de huevo, gallina miniatura, morfología

RESUMENES

MÓDULO 5

PEQUEÑOS RUMIANTES

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Effect of heat stress on the behavior of plasma proteins in Katahdin sheep

Efecto del estrés calórico sobre el comportamiento de las proteínas plasmáticas en ovejas de raza Katahdin

Ricci Terraza-Martínez[1]*, Lisbeth Campos-Arenas[1], Elkin Romero-Cárdenas[1], Rodolfo Ruiz Posada[1], Darwin A García[1], Jorge H Contreras[1] and Jorge E Franco Rodríguez[1]

Instituto Universitario de la Paz - UNIPAZ. Escuela de Medicina Veterinaria y Zootecnia, Bucaramanga, Colombia, ORCID 186931276, ORCID 207671259, ORCID 210623354, ORCID 94221556, ORCID 297490055, ORCID 331258541, ORCID 235734421.
*Corresponding author: ricci.terraza@unipaz.edu.co

Introduction: Heat stress in sheep is the main physical risk factor for the animal's physiological imbalance. The requirements for water, energy, proteins, minerals, and vitamins are essential for growth, production, reproduction, and thermodynamic maintenance between the animal and environmental conditions. **Objective**: To study the effect of heat stress on plasma protein concentration in Katahdin sheep. **Methods**: The research was carried out at the Santa Lucia Research Center's Ovine Academic Research Unit. It was an experimental study with a unifactorial design. Sixteen adult Katahdin sheep with an average weight of 50 kg were used, which were managed under a semi-stabling system. Temperature samples were taken three times a week (Monday, Wednesday, and Friday), in the morning at 10 am and in the afternoon at 4 pm, using a thermo-hygrometer to measure ambient temperature. Blood samples were collected on days 30, 45, and 60, at 7 am and 4 pm. Blood chemistry tests were performed by colorimetry using a semi-automated BA-88A Mindray analyzer. Data analysis was carried out using descriptive and inferential statistics. **Results and Discussion**: Regarding ambient temperature, a significant difference was observed (AM=28.3 °C and PM=34.8 °C), with p=<0.0001. For total proteins, the t-student test showed p=0.0011, with plasma protein levels (AM=5.8 mg/dl and PM=6.3 mg/dl). For Albumin, the t-student test showed *P*=0.0011, (Albumin AM=3.2 mg/dl and PM=3.4 mg/dl). In the afternoon hours, the sheep were under heat stress, as hair breeds begin to experience signs of hyperthermia at temperatures $\geq$30 °C. It can be inferred that the activation of physiological adjustments in haired sheep to maintain normothermia in warm climates is closely related to changes in blood analyte levels. **Conclusion**: Although there were significant differences between plasma protein concentrations throughout the day, all values are within the normal reference ranges for haired sheep.

Key words: Ambient temperature, blood biochemistry, Katahdin, subtropics, thermoregulation
Palabras clave: Temperatura ambiente, bioquímica sanguínea, Katahdin, trópico bajo, termoregulación

Response to the male effect on fertility in Katahdin sheep

Respuesta al efecto masculino sobre la fertilidad en ovejas Katahdin

Rodolfo Ruiz Posada[1]*, Elkin O Romero Cárdenas[1], Emiro R Canchila Asencio[1], Jorge E Franco Rodríguez[1], Jorge H Contreras Castro[1], Ricci Terraza Martínez[1]

[1]Instituto Universitario de la Paz - UNIPAZ. Escuela de Medicina Veterinaria y Zootecnia, Bucaramanga, Colombia, ORCID 4-2215-565, ORCID 2-1062-3354, ORCID 3-2299-1565, ORCID 235734421, ORCID 3-3125-854, ORCID 186931276.
*Corresponding author: rodolfo.ruiz@unipaz.edu.co

Introduction: The stimulating effect of the male has been used to synchronize and induce estrus and ovulation in ewes through pheromones secreted by the male, an effective method without the use of expensive commercial hormonal products. **Objective:** The objective of this study was to evaluate the conception rate, fertility and number of offspring per lambing of a group of 20 ewes and an adult Katahdin breeder with biostimulation by male effect, as well as other indicators such as birth weight and pre-weaning weight gain. **Methods:** it was an experimental and longitudinal study. The work was carried out in the sheepfold of the Instituto Universitario de la Paz in Barrancabermeja, located in a tropical rainforest region. Synchronization was carried out with the introduction of a 7-year-old breeding stock to the herd and the variation in calf weight was determined every 15 days. Follow-up of gestation was performed by ultrasound check-up every 30 days. Descriptive and inferential statistics were used for data analysis with the Stata 14.0 program. **Results and Discussion:** 93% of calvings were grouped within 25 days, 19 females were pregnant, 17 calved and 2 had embryo loss, the conception rate was 95%, fertility 85% and the number of offspring per calving was 1.35. The average birth weight of calves was 3.8 kg, single and multiple birth calves had a birth weight and preweaning day weight gain respectively of 3.9 kg,

273 g and 3.67 kg, 193 g. Both characteristics showed significant statistical differences (P<0.05). In Katahdin ewes, similar results were reported in one breeding season of evaluation. **Conclusion:** the male effect allowed to agglutinate calving in a short time, proving its effectiveness as a natural synchronization method. Reproductive results demonstrate the good adaptation of Katahdin ewes to the environmental conditions of the low tropics. Birth weight and preweaning weight gain variables were within the normal range for the breed.

Keywords: Behavior, births, gestation, pheromones, ram, small ruminants
Palabras clave: Comportamiento, nacimientos, gestación, feromonas, carnero, pequeños rumiantes

Roof type and its effect on physiological constants in lactating ewes and their offspring

Tipo de techo y su efecto en las constantes fisiológicas en ovejas lactantes y sus crías

Santiago J. Torreblanca Zárate[1], Alejandro Montiel Flores[1], Abel E. Villa Mancera[1], José M. Robles Robles[1], Fernando Utrera Quintana[1] and **José del C. Rodríguez Castillo**[1]*

[1]Facultad de Medicina Veterinaria y Zootecnia, Benemérita Universidad Autónoma de Puebla, México, ORCICD 9000451510403; ORCID 9000093388865, ORCID 5997564, ORCID 18541850X, ORCID 25203066, ORCID 277551623
*Corresponding autor: jose.rodriguez@correo.buap.mx

Introduction. Sheep farming is essential for those who practice family livestock farming. Some families have shifted from the pasture system to the stall system, using greenhouse-type roofs. **Justification**. It is possible that sheep housed in greenhouse-type roofs may present stress that could limit their productive performance. **Objective**. To evaluate physiological constants of sheep housed in galvanized sheet or greenhouse roofs. **Methods**. Physiological constants were taken in two groups of lactating ewes with their respective lambs at similar ages; each group consisted of ten ewes and ten lambs. Four treatments were obtained, T1, Lactating ewes with sheet type roof; T2, Lactating ewes in greenhouse type roof; T3, Lactating lambs in sheet type roof and T4, Lactating lambs in greenhouse type roof. The physiological constants taken and compared were: heart rate (HR), respiratory rate (RF), rectal temperature (T), capillary filling time (CFT) and rumen movements (RM). The periodicity of the measurement of physiological constants to both females and lambs was weekly until completing five measurements between January and February 2023. **Results and Discussion**. There was a generalized increase (P<0.05) in the HR of T2 over T1; on the contrary, T3 and T4 showed similar results (P>0.05), behavior that was maintained in the measurements of the five physiological constants tested. T2 presented higher respiratory frequency (P<0.05) with respect to T1, being notorious the increase in weeks 4 and 5 of the experimental evaluation. The T °C of T2 remained higher than T1 (P<0.05). The TLLC did not show any difference between treatments (P>0.05). RM were not different between treatments (P>0.05), highlighting the rumen activity of lambs (T3 and T4) that started in the third week of measurements. **Conclusions**. The greenhouse roof caused an increase in heart rate, respiratory rate and rectal temperature of lactating ewes; with no change in their lambs. Capillary filling time and ruminal movements showed no differences between lactating ewes and their lambs in both types of housing.

Key words: Animal welfare, heart rate, physiological constants, respiratory rate.
Palabras clave: Bienestar animal, frecuencia cardiaca, constantes fisiológicas, frecuencia respiratoria.

GENÉTICA Y MEJORAMIENTO

Inbreeding and runs of homozygosity in creole sheep breeds

Endogamia y series de homocigosidad en razas criollas de ovinos

Johanna Ramírez-Díaz[1]*, Arianna Manunza[1]*, Filippo Biscarini[1]; Paolo Cozzi[1], Luz A Álvarez[2], Gerson Barreto Mourao[3], Gabriel Ciappesoni[4], Pablo Peraza[4], José Arranz[5], Fernando Freire[5], Juan C Rincón[2] and Alessandra Stella[1]

[1]Institute of Agricultural Biology and Biotechnology – Italian National Research Council – CNR, Milan, Italy, ORCID 0009-0006-4995-7665, ORCID 0000-0001-8812-8962, ORCID 0000-0002-3901-2354, ORCID 0000-0003-0388-6874, ORCID 0000-0003-2850-3964. [2]Universidad Nacional de Colombia sede Palmira. Departamento de Ciencia Animal, Palmira, Colombia, ORCID 0000-0001-9483-3158, ORCID 0000-0002-6769-6407. [3]Universidade de Sao Paulo. Animal Science Departament, ESALQ - Piracicaba, Sao Paulo, Brazil, ORCID 0000-0002-0990-4108. [4]Instituto Nacional de Investigación Agropecuaria. Canelones, Uruguay, ORCID 0000-0002-0091-3956, ORCID 0000-0001-6822-0307. [5]Universidad de Leon. Department of Animal Production, Leon, Spain, ORCID 0000-0001-9058-131X.

*Corresponding author: johanna.ramirezdiaz@ibba.cnr.it; arianna.manunza@ibba.cnr.it

Introduction: In livestock, the advancement of genotyping technology has introduced new methods for assessing inbreeding based on single nucleotide polymorphism. Homozygosity runs (ROH) provide a more accurate method for estimating past and recent inbreeding rates at the individual/population level compared to traditional pedigree-based estimations or in the absence of pedigree records. Furthermore, ROH metrics can be used for the identification of regions under strong selection and provide insights into evolutionary trends over time. **Objective:** This work aimed to estimate the genomic inbreeding coefficient (FROH) and ROH patterns in fifteen local sheep breeds from Africa (NQA: Namaqua, RMA: Red Maasai, RDA: Ronderib) Barbados (BBB: Barbados BlackBerry), Brazil (STI: Santa Ines; BMN: Morada Nova), Colombia (OPCE: Ethiopian, OPCP: Peliguey, OPCS: Sudan, OPCW: Wayúu); Ecuador (ECU: Creole), Spain (CAS: Castellana, LXT: Latxa, CHU: Churra) and Uruguay (CRL: Creole). **Methods:** SNPs on the sheep autosomes from the OvineSNP50 BeadChip (Illumina Inc) were used. After quality control (MAF<0.01, sample and SNP callrate >0.95), 359 sheep and 36,613 SNPs were used for further analysis. The Consecutive Runs method within the R package detectRUNS was used to detect ROH and estimate FROH, ROH descriptive statistics per breed, chromosome, SNP, and length classes were calculated. **Results and Discussion:** The average FROH ranged from 0.08 (CAS) to 0.44 (BBB). BMN, RDA, CRL, and STI showed FROH values above 0.33, while in the Colombian and Ecuadorian populations, FROH was lower than 0.26. The total number of ROH varied among populations. BBB, BMN, and CRL showed a large number of homozygous segments compared to the other breeds; the lowest number of ROH was found in CAS. In contrast, the longest ROH in CHU, and the shortest ROH were found in ECU, OPCE, OPCP, OPCS, and OPCW. The majority of ROH were detected in lengthier size classes (>6Mbp) across almost all breeds. **Conclusion:** Our findings indicate high genomic inbreeding in most populations, which could be related to their breeding history, demographic changes, or husbandry practices, and also underline the importance of developing more sustainable breeding programs that take into account the conservation of local sheep breeds.

Keywords: AGnR, autozygosity, genomic relationships, local breeds, ROH

Palabras clave: AGnR, autocigosis, genómicas, relaciones, razas locales, ROH

NUTRICIÓN Y ALIMENTACIÓN

Evaluation of the selectivity of high montane forest tree species in sheep and goats

Evaluación de la selectividad de especies arbóreas de bosque montano alto en ovinos y caprinos

Eliana M Ruiz Bayona[1]*

[1]Servicio Nacional de Aprendizaje - SENA. Centro de Desarrollo Agropecuario y Agroindustrial; Zemucansuca, Colombia, ORCID 0000-0002-8092-6609.
*Corresponding author: emruizb@sena.edu.co

Introduction: Boyacá in its geography of Andean mountains, presents a great variety of shrubs that are produced natively or in nurseries, consumed by sheep and goats in the central area of the department. Objective**:** To evaluate the selectivity of high montane forest tree species in sheep and goats. **Methods:** The study was carried out at the CEDEAGRO headquarters, located in the municipality of Duitama, Boyacá. Forage was taken from 5 tree species Tilo T1 (*Sambucus peruvianna*), Ciro T2 (*Baccharis bogotensis benth*), Hayuelo T3 (*Dodonaea viscosa*), buttercup T4 (*Tithonia diversifolia*) and Holly smooth T5 (*Cotoneaster panosos*). 2 kg of fresh tree material per animal was supplied directly to the pasture for consumption. The study lasted 15 days (5 for habituation and 10 for measurements); It was supplied for 120 minutes and a maximum of 24 hours. Voluntary consumption and the number of visits per species were evaluated by the Kruskall-Wallis test. A forage sample of 500 g of each species was taken to determine crude protein (CP), ethereal extract (E.E), humidity, ash, and saponin levels by qualitative foam method, and its analysis was carried out completely in blocks. random. **Results and Discussion:** The highest consumption and in the shortest time (P>0.001) was found in both sheep and goats in T1 followed by T4, T5; T2 and T3 were only consumed up to 24 hours in goats; In sheep finished 24 hours only 60% of the T2 offered and 30% of the T3 were consumed. Nutritional quality showed highly significant differences (P>0.01) T1 was the species with the highest CP content (21.1%) and T3 the lowest (11.06%). Medium saponin levels are found at T1, followed by T5; high levels of saponins in T4 and very high levels of saponins in T2 and T3. **Conclusion**: Highly significant differences were found in the consumption of tree species evaluated in sheep and goats; The nutritional quality and the very high presence of saponins directly influenced the selectivity process and consumption times by these two species of small ruminants.

Keywords: Anti-nutritional factors, nutritional quality, palatability, voluntary consumption
Palabras clave: Factores antinutricionales, calidad nutricional, palatabilidad, consumo voluntario

Effect of supplementation with mountain microorganisms on productive behavior in lambs

Efecto de la suplementación con microorganismos de montaña sobre el comportamiento productivo en corderos

Sara Guerrero Chávez[1]*, Sara I Rendón Pineda[1], Simón E Zuleta Zuleta[1] and Raúl A Velásquez Vélez[2]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0007-3181-7354, ORCID 0009-0006-0371-2419, ORCID 0009-0008-9223-044X. [2]Politécnico Colombiano Jaime Isaza Cadavid. Medellín, Colombia, ORCID 0000-0001-7614-8560.
*Corresponding author: saguerreroch@unal.edu.co

Introduction: Price fluctuations in the global market significantly impact the price of balanced feed; this vulnerability to the influence of foreign currency and inputs prevents adequate food sovereignty and security. **Objective:** The present study aims to evaluate the effect of mountain microorganisms on the productive behavior and carcass yield of growing lambs. **Methods**: Ten crossbred meat-type lambs were used; a Completely Randomized Design (CRD) with two treatments was employed, where T0 is the control group and T1 is the experimental group. Animals in T0 were fed ad libitum forage and 250 g of commercial feed, while animals in T1 were fed 175 g of commercial feed with 75 g of mountain microorganisms (MM). **Results and Discussion:** Group T0 recorded an average daily gain of 120 g, whereas T1 gained 100 g (P>0,05), resulting in total weight gains of 7.17 kg and 5.79 kg for T0 and T1 respectively. Additionally, the daily feed cost per animal in T0 was $593.3 compared to $449 in T1, representing a saving of $144.3. **Conclusion:** Lambs in group T0 reached a weight of 27.22 kg, while lambs in group T1 achieved 25.82 kg; therefore, group T0 had a significantly higher daily and total weight gain compared to T1. However, the feed cost for T1 was lower, saving 24.3% compared to T0.

Keywords: Average daily gain, balanced feed, feeding costs, ovines
Palabras clave: Ganancia de peso diaria, alimento balanceado, costos de alimentación, ovinos

Replacement of soybean cake (*Glycine max*) with chia seed cake (*Salvia hispanica*) in the diet of lambs in feedlot

Sustitución del expeller de soya (*Glycine max*) por expeller de chia (*Salvia hispanica*) en la dieta de corderos confinados

Jorge D Caballero Mascheroni[1]*, Javier F González Cabañas[1], Luis A Alonzo Griffith[1], Guido A Portillo[1] and Julio Salas Mayeregger[1]

[1]Universidad Nacional de Asunción. Facultad de Ciencias Agrarias, San Lorenzo, Paraguay, ORCID 0000-0002-1722-8883, ORCID 0000-0003-1716-6501, ORCID 0000-0002-0542-1774, ORCID 0000-0003-0749-0826, ORCID 0000-0001-5630-5215.
*Corresponding author: daniel.caballero@agr.una.py

Introduction: Sheep farming in Paraguay is experiencing significant growth and serves as an alternative as farm diversification. Feedlot systems have emerged as a solution to shorten finishing times, however it comes with certain limitations, such as high feeding costs. This has prompted the need to explore agricultural industry by-products as alternative feed sources to reduce costs while maintaining productivity. Among these, Chia seed cake (an oil extraction by-products) is an option available in the market, offering high nutritional value at a low cost. **Objective:** This study aimed to evaluate the effects of replacing soybean cake with chia cake on productive parameters; carcass, and meat quality of lambs under feedlot conditions. **Methods:** The experiment took place in the Presidente Hayes department over a period of 60 days. A completely randomized design with three treatments and four replications, totaling 12 experimental units, was employed. Male crossbred Dorper and Santa Inés lambs with an average initial body weight of 27±1 kg were used. The basal diet (T1) consisted of Pangola grass hay *Digitaria eriantha* (20%), corn (42%), soybean cake (34%), calcium carbonate (1%), and mineral salt (3%). The applied treatments involved replacing soybean cake with chia seed cake at levels of 0%, 50%, and 100% for T1, T2, and T3, respectively. The variables analyzed included daily weight gain (DWG), total weight gain (TWG), voluntary intake, feed conversion ratio (FCR), hot carcass yield (HCY), cooling loss (CL), fat thickness (FT), ribeye area (REA), marbling, cooking loss (CL), and tenderness. Statistical analysis was conducted using ANOVA followed by Duncan's test at a significance level of 5%. **Results and Discussion:** Results showed no significant differences between treatments. The average DWG was 242 g/day, voluntary intake was 4.72% of body weight, FCR was 6.42, and HCY was 41.4%. **Conclusion:** Thus, it is inferred that the use of chia seed cake as a protein component in the diet of sheep is feasible without altering the evaluated productive parameters.

Keywords: Byproducts, productivity, sheep
Palabras clave: Subproductos, productividad, oveja

Inclusion of *Crescentia cujete* silage in sheep: consumption, digestibility and ingestive behavior

Inclusión de ensilado de *Crescentia cujete* en ovinos: consumo, digestibilidad y conductas de ingestión

René M Patiño Pardo[1], Jhonatan Sencio López[1], and **Ana Peralta Vega**[1*]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0000-0001-6137-6384, ORCID 0009-0005-1318-4464, ORCID 0009-0009-2320-8705.
*Corresponding author: ana.peralta@unisucre.edu.co

Introduction: *Crescentia cujete* is a plant with multiple known uses, including forage. **Justification:** There is evidence of the use of ensiled fruit in feeding ruminants, but little is known about its effect on the intake and digestibility of the base diet in sheep. **Objective:** To evaluate the effect of the inclusion of increasing levels of *Crescentia cujete* fruit pulp silage on intake, digestibility and eating behaviors in growing colombian hair sheep (OPC). **Methods:** Four sheep (19.5±0.57 kg) were used, housed in metabolism study cages, for 28 days. Four diets based on *Panicum hispidifolium* Swallen hay, mineral mixture and different levels of inclusion of fruit pulp silage added with urea were evaluated: 35% (T35), 50% (T50) and 60% (T60) and the treatment control (T0), without silage, on a dry basis. A crossover design with four periods was used. Dry matter intake (DMI), NDF intake (NDFI), dry matter (DMD) and NDF (NDFD) digestibility, and time dedicated to feed and water intake, rumination and rest were evaluated. **Results and Discussion:** The highest (P<0.05) DM (3.41% PV) and NDF (1.7% PV) intake were observed in T50, while the lowest intake of both fractions (P<0.05) occurred at T60 (DMI=1.71% PV; NDFI=0.59% PV). Similarly, at T50 the highest DMD were observed (87.9%) and at T60 the lowest (72.4%). The lowest NDFD (P<0.05) occurred at T60 (40.5%), with no differences between the other treatments, which were above 73.7%. The longest feed intake time and the shortest rumination and rest time were observed in T50, in accordance with what was observed for the CMS and DMS. **Conclusion:** The inclusion of *Crescentia cujete* fruit pulp silage added with urea in a proportion of up to 50% of the diet improves the consumption and digestibility of the DM and the NDF fraction in OPC sheep.

Keywords: Fermentation, forage, intake, ruminants
Palabras clave: Fermentación, forrajes, consumo, rumiantes

Effect of different additions and drying time in cassava bagasse silages

Efecto de diferentes adiciones y del oreo en ensilados de bagazo de yuca

René M Patiño Pardo[1*], Mayra A Cervera Ricardo[1], Aramy J Vásquez Hermosilla[1] and Diego A Moya Martínez[1]

[1]Universidad de Sucre. Facultad de Ciencias Agropecuarias, Sincelejo, Colombia, ORCID 0000-0001-6137-6384, ORCID 0009-0005-0506-4964, ORCID 0009-0006-1643-0381, ORCID 0009-0003-7161-1087.
*Corresponding author: rene.patino@unisucre.edu.co

Introduction: After extracting cassava starch, bagasse is obtained, a waste that contains remaining starch and fiber, but the moisture makes its handling difficult, compromising the environmental impact of the process. **Justification:** Feeding ruminants with bagasse is possible, but management methods must be sought that make its use viable. **Objective:** To evaluate the ensilability of cassava bagasse subjected to two times of drying in the sun (0 or 5 hours) and the addition of different

products. **Methods:** Twenty-four PVC microsilos (55×11 cm; ± 3 kg) were used to evaluate the treatments: T1: 100% bagasse; T2: 99.5% bagasse + 0.5% NaCl; T3: 69% bagasse + 30% rice bran + 1% urea; T4: 69% bagasse + 30% hay (*Panicum hispidifolium*) + 1% urea (T4), in factorial arrangement (addition × drying). The variables were: dry matter, effluents, titratable acidity, pH and microbial populations. The silos were opened after 65 days. **Results and Discussion:** The addition of hay and bran increased (*P*=0.0076) the DM content, going from 17.5 (T1) to 33.3% (T3), without effect of drying. For the titratable acidity and pH variables, an interaction (*P*<0.05) was present between the factors. Titratable acidity increased (*P*<0.05) with the addition of hay and bran, in that order, and with airing. The pH ranged between 2.97 and 4.43, with the highest values (*P*<0.05) corresponding to T4, and the lowest to T1, with no effect of the addition of salt (*P*>0.05). Drying caused a lower pH value (P<0.05) and lower effluent production in T4, while in T3 there was a greater amount. The additions evaluated did not affect the presence of fungi and yeasts (*P*>0.05), however, the 5 h flashing meant a greater presence of fungi (*P*<0.05), but not yeasts (*P*>0.05). The treatments did not affect the proportion of gram-positive or negative bacteria. **Conclusion:** The evaluated additions reduced the silage moisture, without affecting ensilability; Sun exposure of the bagasse for five hours reduced effluent losses, but favored, to a certain extent, the presence of fungi in the silage material.

Keywords: Byproducts, fermentation, industry, livestock
Palabras clave: Subproductos, fermentación, industria, ganado

Effects of supplementation with natural extracts on bacterial microbiota in hair lambs

Efectos de la suplementación con extractos naturales sobre la microbiota bacteriana en ovinos de pelo

Saira Romero Sánchez[1]*, Román D Castañeda Serrano[1], Diana C Mogollón Vergara[1], Jairo A Pardo Guzmán[1], Vladimir Tovar Urrea[1], María J Muñoz Ramírez[1] and Carlos F Prada Quiroga[1]

[1]Universidad del Tolima. Facultad de Ciencias, Colombia, ORCID 0009-0007-5050-2972, ORCID 0000- 0002-6935-3918, ORCID 0000-0003-2968-3397, ORCID 0000-0002-4746-5978, ORCID 0000-0002-9643-3059, ORCID 0009-0009-6929-6341, ORCID 0000-0001-5201-9502.
*Corresponding autor: sromerosan@ut.edu.co

Introduction: Plants produce a wide variety of bioactive compounds and secondary metabolites. For many years, these compounds have been primarily used in food manufacturing and preservation. However, they have also been shown to be useful in manipulating metabolic processes in ruminants and selectively modulating rumen microbial populations, allowing for improved digestibility, increased intake, and enhanced animal performance. **Objective:** To determine the effect of *Senna spectabilis* and *Tithonia diversifolia* extracts on ruminal bacterial population in haired sheep. **Methods:** The experimental phase was conducted at Las Brisas farm, with 32 sheep feed lot system, in individual cages. The animals were fed a diet composed of 75% concentrate and 25% corn silage, and were distributed into four treatments: T1. Control group, without any additives; T2. Sodium monensin group (33 mg/kg dry matter; T3. *Senna spectabilis* extract (25 mL daily); T4. *Tithonia diversifolia* extract (25 mL/d). The experimental period lasted 42 days. At the time of animal slaughter, a rumen fluid sample was taken from each animal, deposited in 50 mL Falcon tubes, placed in liquid nitrogen, and then frozen. The samples were sent to the Genomic Sequencing Research Laboratory at the University of Antioquia, where bacterial diversity was determined using 16S gene sequencing (V3-V4) and bioinformatic analysis. **Results and Discussion:** Taxa associated with weight gain/loss were identified, and significant differences (*P*<0.05) were observed between treatments for *Prevotella* taxa. It can be inferred that bioactive compounds positively modulate microbial populations that contribute to the growth of communities that may favor weight gain. **Conclusion:** It is concluded that the use of natural extracts such as *Senna spectabilis* and *Tithonia diversifolia* modifies the composition of the microbiota in hair lambs.

Keywords: Ionophores, metabolites, rumen, ruminants, sequencing
Palabras clave: Ionóforos, metabolitos, rumen, rumiantes, secuenciación

REPRODUCCIÓN

Type of feeding and time of year on follicle stimulant hormone secretion in goats

Tipo de alimentación y época del año en la secreción de hormona folículo estimulante en cabras

José del C Rodríguez Castillo[1*], Abel E Villa Mancera[1], José M Robles Robles[1], Fernando Utrera Quintana[1], José L Ponce Covarrubias[2], Ethel Caterina García y González[2] and Addy Anchondo Aguilar[3]

[1]Facultad de Medicina Veterinaria y Zootecnia, Benemérita Universidad Autónoma de Puebla; México. [2]Universidad Autónoma de Guerrero, Escuela Superior de Medicina Veterinaria y Zootecnia No.3 Tecpan de Galeana, Guerrero, México. [3]Facultad de Ciencias agrotecnológicas, Universidad Autónoma de Chihuahua, México. JCRC, ORCID 277551623; AEVM, ORCID 5997564; JMRR, ORCID 18541850X; FUQ, ORCID 25203066; JLPC, ORCID 201826846; ECGG, ORCID 223063122; AAA, ORCID, 2-4112-403X

*Corresponding autor: jose.rodriguez@correo.buap.mx

Introduction. Grazing goats during the dry season show an absence or delay of reproductive activity, which may be associated with the type of feeding and/or time of the year. The secretion of follicle stimulating hormone (FSH) is influenced by photoperiod and type of feeding. **Justification**. It is important to know the changes that occur in FSH concentration at different times of the year (anestrus and reproductive season) and different feeding patterns for a better understanding of folliculogenesis. **Objectives**. To know the effect of nutritional restriction (65%) and hyperfeeding (120%) for 15 d after 15 d with and without nutritional restriction on FSH secretion, as well as its response to the presence of fluorogestone acetate (FGA). **Methods**. Daily FSH concentration was measured throughout the experiment, fasted goats, at 7:00 a.m. FSH was quantified by ovine RIA of 120 hours incubation at 4°C, using as tracer (NIDDK-oFSH-1-SIAFP-19) labeled with Iodine-125, according to the IODO-GEN technique. Four types of feeding (TA) were evaluated:TA1, balanced feeding (100%); TA2, feeding increment from 100 to 120%; TA3, restricted feeding (65%); TA4, feeding increment from 65 to 120%. **Results and Discussión**. Nutritional restriction in goats in a constant or partial manner causes an increase in FSH concentration ($P<0.05$), both in the anestrus and reproductive periods. The application of FGA in anestrus and reproductive allows the appearance of the preovulatory FSH pulse, the FSH concentration before FGA does not differ ($P>0.05$) to when the progestogen is present, however the FSH concentration after the withdrawal of FGA is higher ($P<0.05$) with respect to the moment of FGA presence. The latter difference is given by the preovulatory FSH pulse. Even when nutritional restriction is constant in goats, it does not allow the appearance of the mentioned pulse. **Conclusion**. Constant or partial nutritional restriction increases FSH concentration, but does not allow the preovulatory FSH pulse. Withdrawal of allows the occurrence of the preovulatory FSH pulse.

Keywords: Fluorogestone acetate, follicle stimulating hormone, nutritional restriction

Palabras clave: Acetato de fluorogestona, hormona folículo estimulante, restricción nutricional

SALUD PREVENTIVA Y BIOSEGURIDAD

Potential of plant extracts to inhibit egg hatching and migration of *Haemonchus contortus* larvae

Potencial de extractos arbóreos en la inhibición de la eclosión y migración larval de *Haemonchus contortus*

Edgar Aguilar-Urquizo[1], Erika M Marcín-Marrufo[1], Miguel Á Magaña-Magaña[1], Ángel T Piñeiro-Vázquez[1], Juan F de J Torres-Acosta[2] and **Mateo Itza-Ortiz[3]***

[1]Tecnológico Nacional de México. División de Estudio de Posgrado e Investigación/I. T. de Conkal. Yucatán, México, ORCID 0000-0003-4727-7894, ORCID 0000-0002-5809-0710, ORCID 0000-0002-8379-9756, ORCID 0000-0002-8400-4046. [2]Universidad Autónoma de Yucatán. Facultad de Medicina Veterinaria y Zootecnia, CCBA. Mérida, Yucatán, México, ORCID 0000-0003-3724-3391. [3]Universidad Autónoma de Ciudad Juárez. Departamento de Ciencias Veterinarias, Ciudad Juárez, Chihuahua, México, ORCID 0000-0003-0313-586x.
* Corresponding author: mateo.itza@uacj.mx

Introduction: One of the main problems that affects sheep production based on the grazing system has been the infestation by gastrointestinal nematodes, not only in Mexico, but throughout the world, they constitute important animal health problems that worsen over years due to the inappropriate use of medications to control it and cause resistance to anthelmintics. The use of plants with anthelmintic potential offers biological control without anthelmintic resistance. **Objective:** To evaluate the potential of *Azadirachta indica* (AZA) and *Moringa oleifera* (MOR) extracts to inhibit egg hatching and *in vitro* displacement (migration) or tropism of *Haemonchus contortus* larvae. **Methods:** A completely randomized experimental design was carried out, where 15 treatments and a negative control of dimethyl sulfoxide were evaluated: MOR-75, MOR-50, MOR-25, MOR-12.5 and MOR-6.25 mg/mL; AZA-75, AZA-50, AZA-25, AZA-12.5 and AZA-6.25 mg/mL; and thiabendazole (TBZ) TBZ-200, TBZ-100, TBZ-40, TBZ-20, TBZ-10 µg/mL. **Results and Discussion:** The extracts did not inhibit the hatching capacity of the eggs; however, a decrease in motility of up to 100% was observed in L1 larvae. The extracts affected larval migration ($P<0.0020$) compared to controls (dimethyl sulfoxide and TBZ), with an inhibition of the migration rate greater than 65%. Probit analysis showed that the median effective concentrations were 60.41 and 65.69 mg/mL for *M. oleifera* and *A. indica*, respectively. **Conclusion:** The *in vitro* results suggest that the aqueous extract of both plants has anthelmintic action against gastrointestinal nematode larvae.

Keywords: Anthelmintic, *Azadirachta indica*, *Haemonchus contortus*, *Moringa oleífera*, ovine
Palabras clave: Antihelmíntico, *Azadirachta indica*, *Haemonchus contortus*, *Moringa oleífera*, Ovino

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Characterization of the meat quality of the *longissimus thoracis* muscle in Colombian hair sheep

Caracterización de la calidad de carne del músculo *longissimus thoracis* en ovinos de pelo colombianos

Matheus S Da Silva Ferreira[1]*, Darwin Y Hernández Herrera[1] and Juan C Rincón Flórez[1]

[1]Universidad Nacional de Colombia sede Palmira. Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0002-7550-6829, ORCID 0000-0002-1758-604X, ORCID 0000-0002-6769-6407.
*Corresponding author: mda@unal.edu.co

Introduction: The basal breed for sheep production in Colombia is the Colombian creole hair sheep (OPC, from Spanish Ovino de Pelo Colombiano), this is due to its great adaptability. However, several productive aspects still unknown, this is the case of traits regarding meat quality. **Objective:** To quantify meat quality parameters pH, texture (Warner-Bratzler share force - WBSF) and cooking loss (CL) of *longissimus thoracis et lumborum* (LTL) muscle from OPC lamb. **Methods:** One hundred sixty-eight animals were slaughtered at 320±20 days and 31.21±8.78 kg of live weight in a commercial slaughterhouse. After 24 hours two 2.5 cm steaks were collected from LTL muscle and pH was measured. Forty-eight hours *post-mortem* texture was assessed through WBSF and cooking loss was estimated according the American Meat Science Association procedures. Data were submitted to descriptive statistics and Pearson correlation analysis. **Results and Discussion:** pH was found at 5.75±0.12 units (Min: 5.37; Max: 6.18). This value is considered high, and that suggests that the lambs arrived at the slaughterhouse with low muscle glycogen reserves or that they were submitted to stress during the slaughter. The WBSF was 49.46±17.64N (Min: 15.20N; Max: 94.54N). This value classifies the meat from OPC as acceptably soft (42.87N <WBSF<52.68N). The CL was 32.02±13.28% (Min: 13.29%; Max: 133.31%). The CL depends most importantly on pH, even though also on sex, marbling and maturation time. All correlations estimated between variables were positive and significative, with higher values between pH *vs* WBSF (R=0.28; P<0.005) and between pH *vs* CL (R=0.26; P<0.005). **Conclusion:** The pH found suggests slaughter stress on the lamb with negative effects over WBSF and CL, what represents lower meat quality of these OPC lambs.

Keywords: Cooking loss, Colombian creole sheep, Warner-Bratzler shear force

Palabras clave: Cocina pérdida, oveja criolla colombiana, fuerza de corte Warner-Bratzler

Frequency of use of homeopathic medicines in agribusinesses in Jamundí Valle del Cauca

Frecuencia de uso de medicamentos homeopáticos en agronegocios de Jamundí Valle del Cauca

Ximena M Guzmán Perlaza[1], Janeth Dehaquitz[1] and Sandra P Rodríguez[1]

[1]Universidad Nacional Abierta y a Distancia, Colombia, ORCID 0009-0006-5888-1746, ORCID 0000-0002-2039-8891, ORCID 0000-0002-1037-7843.
*Corresponding author: perguzveterinaria@gmail.com

Introduction: Veterinary homeopathy is a therapy that seeks to improve the health of animals in a holistic way, preventing and treating diseases from a comprehensive perspective, and optimizing conditions with adequate nutrition. As an alternative, the use of homeopathic medicines, which are more natural and less polluting than allopathic ones, was proposed. To explore this option, diversified production systems were selected in the municipality of Jamundí, in the department of Valle del Cauca, which aspired to be green businesses. These systems had in common small ruminants, among other species. **Objective:** To estimate the frequency of use of homeopathic medicines in agribusiness, compared to allopathic medicines in the municipality of Jamundí. **Methods:** The use of a quantitative approach to carry out a survey in the production systems of Jamundí was described, a questionnaire based on the Likert model was used. The criteria used to choose the production systems are that they had in common the species of small ruminants, that they were registered with the ICA, that they complied with the health regulations, among others, 6 production systems were identified in Jamundí that met all the established requirements. **Results and Discussion:** Veterinary homeopathy is a therapy that seeks to improve the health of animals in a holistic way, preventing and treating diseases from a comprehensive perspective, and optimizing conditions with adequate nutrition, it was found that 83% valued the benefits of homeopathic medicines for the economy, the environment and society. showing a strong consensus of more than 75% of the respondents with the effective option to improve production systems, since they contributed to reducing costs

and increasing profitability and where more than 79% accepted this therapy by offering a preventive and/or curative medicine for animals with a safer protein production. **Conclusion**: This study highlighted the importance of homeopathy in production systems. Homeopathic medicine improved animal health, ensured food safety, and promoted environmental sustainability. Although it was environmentally friendly and safe, proper training and compliance with standards were required to maximize its benefits in production systems.

Keywords: Allelopathy, health, homeopathy, immunity, sustainability
Palabras clave: Alelopatía, sanidad, homeopatía, inmunidad, sostenibilidad

RESUMENES

MÓDULO 6

PISCICULTURA

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Evaluation of productive variables of fingerlings of *Oreochromis sp.* under two fish production systems

Evaluación de variables productivas de alevinos de *Oreochromis* sp. bajo dos sistemas de producción piscícola

Hernán A Alzate Díaz[1*] and Sandra C Pardo Carrasco[1]

[1]Universidad Nacional de Colombia sede Medellín. Departamento de Producción Animal, Colombia, ORCID 0000-0002-1245-1154, ORCID 0000-0001-5796-9419.
*Corresponding author: haalzated@unal.edu.co

Introduction: In Colombia, the production of the red tilapia Oreochromis sp. it had a growth of 13% by 2021 and with 45% it has become the largest exporter of fish fillet to the United States (MADR, 2020). To meet the increase in demand and the intensification of production, it is necessary to improve production practices that generate crops with quality and safety in the fingerlings and in the other productive stages. **Objective:** To evaluate the productive performance of red tilapia fingerlings in two types of systems in the municipality of Arauca, Colombia. **Methods:** The productive performance of red tilapia fingerlings with an average weight of 0.6g was evaluated in two production systems, one on land (EST) with an animal load of 25 fish/m^3 and a biofloc system (BFT) with a load of 400 fish/m^3. Zootechnical variables such as survival and weight gain of fish during 30 days of culture were evaluated in three periods: T1 (10 days), T2 (20 days) and T3 (at 30 days). **Results and Discussion:** The productive variables total biomass (g), DWG (g), feed consumption (g) and survival (%) were evaluated. The areas per unit of production were 1m^2 for the BFT and 24 m^2 for EST, where the BFT was evaluated under a much higher carrying capacity (1600%) than the load handled in ponds on land EST. Vieira et al., (2019), tested a density of (500–1250/m^3) with acceptable results and Brol et al. 2017 proposed that for improvement in performance in tilapia larviculture, the optimal density is 800/m^3. A very similar productive behavior was found between the two systems evaluated, indicators such as survival, feed consumption and daily weight gain DWG, behaved in a similar way in the time periods evaluated. Assumptions of normality were evaluated with a one-way ANOVA and homogeneity of variances by the Levene and Bonferroni test with a (P<0.05), there were no significant differences between the EST and BFT systems in the parameters analyzed. **Conclusion:** The biofloc system (BFT) has a great capacity for intensification and competitive management in its productive performance with respect to the results obtained in EST, this shows that intensive systems in addition to being efficient in the use of water resources and space; It also allows convenient results to be obtained at the fingerling stage by increasing the carrying capacity.

Keywords: Animal welfare, biofloc, fish
Palabras clave: Bienestar animal, biofloc, peces

Geometric morphometry of the Piro *Schizodon fasciatus* (Characiformes: Anostomidae) in two tributaries of the Catatumbo river-Colombia

Morfometría geométrica del piro *Schizodon fasciatus* (Characiformes: Anostomidae) en dos tributarios del río Catatumbo-Colombia

Luz M Guevara Rincón[1*], Daniela Ahumada Cabarcas[2], Jordán C Hernández Martelo[3], Luis F Escalante Ramírez[4], Carlos A Garcia Bayona[1], Leylis Y Núñez López[1] and Adriana Quintana Canabal[2]

[1]Universidad Francisco de Paula Santander. Ocaña, Colombia, ORCID 0000-0003-0197-2197, ORCID 0009-0006-1879-5974, ORCID 0009-0003-3240-0420. [2]Universidad de Cartagena. Colombia, ORCID 0000-0002-4182-5143, ORCID 0000-0002-8429-9091. [3]Instituto Milenio Biodiversidad de Ecosistemas Antárticos y Subantárticos. Colombia, ORCID 0000-0002-9911-6569. [4]Universidad de Pamplona. Colombia, ORCID 0009-0002-9660-1048.
*Corresponding author: lmguevarar@ufpso.edu.co

Introduction: *Schizodon fasciatus*, known as Piro, is a freshwater fish of the Anostomidae family, characterized by its cylindrical body, small head and protractile mouth. It is distributed in Colombia and Venezuela, in the basins of the Magdalena River, and tributaries of the Catatumbo, and constitutes an important resource in the department of Norte de Santander (Colombia), as it is used as a subsistence food resource by local communities. Justification: It is relevant to achieve an understanding of the factors and mechanisms that drive the morphological variability of *S. fasciatus*, and thus contribute to the development of effective cultivation and management plans for this species, guaranteeing its conservation. **Objective:** The purpose of this research was to analyze the morphological variability of *S. fasciatus* using geometric morphometry in individuals from rivers in two municipalities of Norte de Santander: El Zulia (EZ) and Puerto Santander (PZ). **Methods:** Thirty-six individuals were studied and photographed in anteroposterior position using a scale. Fifteen reference points digitized in TpsDig2 were defined. A Generalized Procrustes Analysis was performed, measurement error was calculated, followed by a Procrustes ANOVA and a principal component analysis (PCA) using the covariance matrix. Subsequently, a PCA of the covariance matrix was used and the combined mean locality classifier was performed, overlaying the body shapes. **Results and Discussion:** The value of the mean squares of the individuals

was greater than the measurement error. The first three PCA axes explained 55.65% of the shape variation (PCA1: 30.53; PCA2: 13.85; PCA3: 11.26). PS individuals had a longer pectoral fin base than EZ individuals. EZ individuals, on the other hand, presented slightly more compact bodies than those of PS. **Conclusions:** There are differences in shape between the populations of *S. fasciatus* under study. This research constitutes a basis of information for future ecomorphological or genetic studies that seek to know the status of the populations of this species.

Keywords: El Zulia, Grita river, landmarks, native fish, populations
Palabras clave: El Zulia, río Grita, hitos, peces nativos, poblaciones

Los avances tecnológicos y sus contribuciones al bienestar animal en peces

Technological advances and their contributions to animal welfare in fish

Sandra C Pardo Carrasco[1]* and Hernán A Alzate Díaz[1]

Universidad Nacional de Colombia sede Medellín. Departamento de Producción Animal, Colombia, ORCID 0000-0001-5796-9419, ORCID 0000-0002-1245-1154.
*Corresponding author: scpardoc@unal.edu.co

Introduction: The need to build tools to determine animal well-fare in each species has been indicated. The intensification and need for biosafe production imply the need for constant surveillance in the systems. Water quality is key to production efficiency, and parameter fluctuations directly affect health, feed conversion, growth rate and carrying capacities. **Objective:** To know the fluctuation of temperature (T°), dissolved oxygen (DO) and pH through wireless sensors placed within two facilities (pond and tank), all in search of greater understanding of the elements that They are part of the well-being of the fish. **Methods:** In a 12 m^2 pond and a 1 m^3 biofloc tank with red tilapia (Oreochromis sp) fry, the physicochemical parameters of the water were monitored with dataloggers (submersible wireless data loggers) to measure pH in real time (HOBO pH MX 2501), temperature and dissolved oxygen (HOBO OD U26-001). The dataloggers were introduced into a pond and a tank, for 24 hours, at three different times, and were programmed to record the parameters every 15 minutes. At the end, the recorded data were downloaded for analysis, obtaining 97 time series observations. of each variable during the three days. With this information, a descriptive analysis was carried out based on graphs, to know the fluctuation of the physicochemical parameters during the day, according to the aquatic installation (tank or pond). **Results and Discussion:** The T° and PH presented lower values in the tank, but with similar fluctuations in the two aquatic facilities. The DO was greater in the tank and with little fluctuation throughout the day, while this parameter presented a lot of fluctuation in the pond. **Conclusion:** Although the parameters do not go beyond the comfort ranges, the variations affect the fish, so measure water quality with greater precision, frequency and low cost, to understand and thoroughly control the agroecosystem, achieving well-being. animal.

Keywords: Animal welfare, fishculture, water quality
Palabras clave: Bienestar animal, cultivo, calidad del agua

NUTRICIÓN Y ALIMENTACIÓN

Digestibility in *Piaractus orinoquensis* of the cowee bean *Vigna unguiculata (L) Walp*

Digestibilidad en *Piaractus orinoquensis* del frijol caupi *Vigna unguiculata* (L) Walp

Diana E Buendía-Lara[1]*, Orleydy Racero Espitia[1], Adriana C Rada[1], Leonardo A Alemán[1], Claudia D De Paula[1] and Martha J Prieto-Guevara[1]

[1]Universidad de Córdoba. Montería, Colombia, ORCID 0000-0003-1036-648X2, ORCID 0009-0003-1076-8638, ORCID 0009-0008-5781-57844, ORCID 0009-0008-5874-321, ORCID 0000-0002-9632-9585, ORCID 0000-0003-3458-4983.
*Corresponding author: dianabuendial@correo.unicordoba.edu.co

Introduction: The cowpea bean is a legume grown by small farmers in the Colombian Caribbean; it stands out for its protein, iron, and zinc content. It is considered an essential raw material in human and animal nutrition (terrestrial and aquatic). Fish favors zootechnical performance and intestinal response. **Objective:** to evaluate the apparent digestibility coefficients (ADC) of dry matter (DM), proteins, and energy of the grain subjected to soaking and thermal treatments in *Piaractus orinoquensis*. **Methods:** under a completely randomized design, an experiment with three treatments for caupicor-50 beans was carried out at the Fish Research Institute of the University of Córdoba (CINPIC) (T1: soaking for 5 hours, cooking for 15 minutes at 90 °C; T2: soaking for 5 hours, cooking for 30 minutes at 120 °C in a pressure cooker; T3: soaking for 5 hours, roasting the grain at 70 °C for 5 hours in an air circulation oven); A Commercial Reference Diet (CRD) (24% CP) was used in a proportion of 69% in the determination of digestibility, with 30% of the ingredient and 1% of the inert marker chromium oxide (Cr_3O_2), determined by the method acid digestion. 36 juveniles of 190 g were distributed in 12 (60 L) plastic conical tanks (modified Guelph system); Feces were collected for ten nights, and the CDA was considered with the formulas of CHU-KOO et al. (2016). **Results and Discussion:** highly significant differences (P<0.01) in ADC of DM, protein, and energy between treatments; the best was recorded in T1 (59.13±1.18 MS, 62.07±2.6 proteins, and 52.95±2.6% energy, respectively), in T2 and T3 (8.98±1.18 and 4.42±1.18 for MS; 55.75±2.6 and 48.75±2.6% energy respectively). This marked difference is possibly related to the presence of the grain shell, the cooking method, and the temperature, which affects digestibility, increases nutrient loss, and reduces nutritional quality. **Conclusion:** Cowpea is a protein raw material that could be used in the formulation of diets for cachama, with prior soaking for 5 hours and cooking for 15 minutes at 90 °C.

Keywords: Chromium oxide, cooking, feces, food, juveniles, proteins
Palabras clave: óxido de cromo, cocción, heces, alimentación, juveniles, proteína

Spore-forming bacilli with enzymatic activity isolated from the intestine of *Panaque cochliodon* (blue-eyed pleco)

Bacilos esporulados con actividad enzimática aislados del intestino del *Panaque cochliodon* (cucha de ojos azules)

Juan D Cano Gil[1]*, Sandra C Pardo Carrasco[2], Luz A Gutiérrez Ramírez[1] and Carlos A David Ruales[1]

[1]Corporación Universitaria Lasallista. Facultad de Ciencias Agropecuarias, Programa de Zootecnia, Caldas, Colombia, ORCID 0000-0002-4574-7509, ORCID 0000-0003-1174-555, ORCID 0000-0002-3071-9919. [2]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0001-5796-9419.
*Corresponding author: jucanog@unal.edu.co

Introduction: *Bacillus* sp is a genus of Gram-positive microorganisms that are part of the Bacilliaceae family, they form endospores that can become thermo-resistant, and survive pH variations. They are aerobes and facultative anaerobes, they occupy different environments, being capable of using a great diversity of organic substrates. They are widely used in agribusiness due to their ability to degrade xylose, starch, proteins and cellulose. *Panaque cochliodon* is an endemic species of the Cauca and Magdalena basins, and is classified as vulnerable (A2d), it has xylivorous habits, that is, it consumes wood as the main food source for its nutrition, being a species of great value biological for the ecosystem. There is some knowledge about its basic behavior, adaptation to captivity and other characteristics related to its feeding and reproduction, however, its digestive physiology is completely unknown. **Objective**: To identify, by conventional biochemical tests, sporulated bacilli with enzymatic activity isolated from the intestine of *Panaque cochliodon*. **Methods**: in the present study, a series of conventional biochemical tests were applied to determine the metabolic behavior of the sporulated bacilli, which were isolated from the intestine of *Panaque cochliodon*, known in Colombia as blue-eyed cucha. Three adult specimens from the Magdalena River were captured and used, which were transported and sacrificed following animal welfare standards by the ethics committee of the Lasallian university corporation. Dissection of the intestinal tract was performed, obtaining samples for microbiological isolation and molecular identification

of culturable microorganisms. **Results and Discussion**: From the methodological process, six species of Gram-positive sporulated bacilli with enzymatic activity were isolated and identified by commercial API biochemical tests and conventional biochemical tests. These species are classified as: *Bacillus paramycoides, Bacillus velezensis, Bacillus amyloliquefaciens, Bacillus thuringiensis, Bacillus nitratireducens* and *Bacillus atrophaeus*. These microorganisms have a high capacity for intestinal colonization, easy reproduction and mass production. **Conclusion**: specific biochemical tests allow establishing specific communities of bacilli. It is known that these species are used in the bio-industry with different applications, including as biofertilizers, as probiotics in animal nutrition and in commercial formulations due to their high enzymatic activity and are recognized for their potential to improve animal production.

Keywords: *Bacillus*, enzymes, intestinal microbiota, *Panaque cochliodon*
Palabras clave: *Bacillus*, enzimas, microbiota intestinal, *Panaque cochliodon*

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Volume of suspended and sedimentable solids in the culture of *Mugil cephalus* with biofloc technology

Volumen de sólidos suspendidos y sedimentables en el cultivo de *Mugil cephalus* con tecnología biofloc

Julia E Ayazo Genes[1]*, Mariana H Paes Barboza[1], Sara C Chaverra Garcés[1], Zuhelen C Valencia Núñez[1] and Gabriele Rodrigues de Lara[1]

[1]Pontificia Universidad Católica de Valparaíso (Campus Curauma). Escuela de Ciencias del Mar,Valparaíso, Chile, ORCID 0000-0003-4869-223X, ORCID 0000-0002-9242-0648, ORCID 0000-0002-7273-1203, ORCID 0009-0002-3034-0105, ORCID 0000-0002-6726-8824. *Corresponding author: juliaevaayazogenes@gmail.com

Introduction: The profile of solids in a biofloc culture system is one of the quality indicators of the system; their concentration and variation are influenced by both the carbon source used and the utilization of bioflocs by the cultured species. **Objective:** Evaluate the volumes of total suspended solids (TSS) and sedimentable solids (SS) in the culture of *Mugil cephalus* juveniles using different organic carbon sources. **Methods:** Three organic carbon sources were evaluated for biofloc system management: Chancaca, Sugar, and Beet Molasses, over a 45 day experimental period. SS were monitored using Imhoff cones (Kartell®/1000 mL, Italy) expressed in terms of mL/L. TSS evaluation was done using the APA-160.2-Gravimetric dried at 103°C Method and estimated by the formula: TSS (mg/L) = (Weight of filter with residue – weight of filter) *1000/Volume of the sample. Repeated measures analysis of variance was conducted to detect the significance of test time effects on each variable; followed by Shapiro-Wilk and Levene tests, and Tukey's test (P<0.05) for multiple comparisons and determination of significant differences among reatments, using R version 4.2.2 (R Core Team, 2022). **Results and Discussion:** The level of SS in the treatments, chancaca (1.4±1.4 mL/L), sugar (1.2±1.3 mL/L), and beet molasses (1.0±2.0 mL/L) did not show statistically significant differences (P>0.05), as well as TSS, with mean values of 60.0WW±107.5 mg/L (beet molasses) and 100±90.0 mg/L (chancaca and sugar) (P>0.05). Biofloc systems typically operate with TSS concentrations of less than 1000 mg/L and an average of 500 mg/L, along with SS values between 25 and 50 mL/L; the SS and TSS values recorded were lower than those reported for other culture fish species. **Conclusion:** The three sources of carbon used provided functional values of SS and TSS for system management and stability; however, beet molasses could lead to lower solid profile volumes, offering better control of them.

Keywords: Bioflocs, chancaca, Imhoff cones, *Mugil cephalus,* organic carbon, volume

Palabras clave: Bioflóculos, chancaca, conos Imhoff, *Mugil cephalus*, carbono orgánico, volumen

RESUMENES

MÓDULO 7

ESPECIES PRODUCTIVAS NO TRADICIONALES

EXTENSIÓN RURAL

Experiences in the social appropriation of knowledge of the guinea pig chain in Alto Putumayo

Experiencias en la apropiación social del conocimiento de la cadena cuyícola en Alto Putumayo

Álvaro M Cadena Pastrana[1]*, Edwin Castro Rincón[1], Pedro P Bacca Acosta[1], Jhon J Borja Tintinago[1], Erika Meneses Estrada[1] and Henry C Arana Chico[1]

[1]Corporación Colombiana de Investigación Agropecuaria (Agrosavia), Colombia, ORCID 0003-3836-5171, ORCID 0001-9841-8242, ORCID 0002-0590-0396, ORCID 0002-5576-028, ORCID 0001-8492-7492.
Corresponding author:* amcadena@agrosavia.co

Introduction: The guinea pig chain represents one of the socio-productive pillars in the life strategies of small peasant and indigenous producers in southwestern Colombia; however, its technological level is still low, in part, due to gaps in the research, transfer and technological adoption processes. In this context, the proposals for social appropriation of knowledge and technologies may be relevant to the greater dynamization and development of the chain. **Objective:** Systematize the experience of the process of social appropriation of knowledge and technologies with small guinea pig producers in Alto Putumayo. **Methods:** A systematization of the experience was carried out from the moments of reconstruction of historical memory of the process, critical analysis and identification of lessons learned, through focus group techniques, semi-structured interviews with key actors and case studies to estimate the adoptability of possible technologies to implement. **Results and Discussion:** It was evident that there are different perceptions of knowledge gaps in the chain, mainly in the nutritional and health components (78% and 63% of correspondence, respectively), mainly due to the scarce research processes and health regulations; One of the factors for the greatest perception of positive impact has been the processes of knowledge management from farmer to farmer as agents of change and facilitators in the generation, adjustment, validation and dissemination of technologies in a context. The analysis of technology adaptability indicates that although the superiority of technologies (understood from economic profitability) influences as a key factor in decision-making to adopt technologies and guides a vision of the chain from agribusiness and not as a subsistence or self-consumption strategy; the compatibility with local resources and the simplicity of communicating and replicating knowledge suggest the importance of consolidating and strengthening social capital. **Conclusion:** During the process, an attitudinal and cultural change in the communities has been evident, oriented towards a more business vision of the chain; however, social innovation processes are necessary that consolidate knowledge societies and lead to the management and scaling of new knowledge, especially in animal nutrition and health.

Keywords: Change management, innovation, Social appropriation of knowledge, social reproduction strategies, sustainable livestock farming

Palabras clave: Gestión del cambio, innovación, apropiación social de conocimiento, estrategias de reproducción social, ganadería sostenible

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Use of thermo-conductive environmental enrichers in breeding female rabbits located in dry tropical climate conditions

Uso de enriquecedores ambientales termoconductores en conejas reproductoras ubicadas en condiciones de clima seco tropical

Adrián F Medina Montes[1], Yasser Y Lenis[2], and **Diego F Carrillo González**[1]*

[1]Universidad de Sucre. Sincelejo, Sucre, Colombia, ORCID 0009-0004-3698-4619, ORCID 0000-0002-0326-0815. [2]Universidad de Antioquia. Facultad de Ciencias Agrarias, Escuela de Medicina Veterinaria, Medellín, Colombia. ORCID: 0000-0002-4976-9916.
Corresponding author: diego.carrillo@unisucre.edu.co

Introduction: Global warming is a challenge for animal production systems that must guarantee thermal comfort and thus the productivity of animals. Thermo-conductive environmental enrichers (TC-EE) turn into an interesting strategy to mitigate thermal stress and promote animal welfare and natural behaviors in confined animals. **Objective:** To evaluate the effect of TC-EE on the temperature of the external ear (EE) as an indicator of body temperature in breeding female rabbits. **Methods:** Overall, 12 adult rabbits selected randomly and kept in individual cages were divided into two groups: control (Ctrl) and experimental (Exp). The cages of the Ctrl group were maintained without the presence of TC-EE, while, in the Exp group, a TC-EE consisting of 250ml of solid-state water was included per cage. EE temperature was recorded in both groups (Ctrl and Exp) before adding the TC-EE using the FLIR TG267 thermal imaging camera. Subsequently, the TC-EE was located daily at 10:00 a.m. for 14 days in the Exp group, and EE temperature was measured again at 12:00 p.m. and 4:00 p.m. each day. Additionally, the environment temperature was recorded at the same hours as the EE temperature. GLM analysis and repeated measures analysis of variance were performed using Jamovi version 2.3 software. **Results and Discussion:** No statistical difference ($P>0.05$) was found in the EE temperature of the does in the Ctrl and Exp groups from 10:00 a.m. and 12:00 p.m. (1.57±1.73 °C and 0.82±4.37 °C respectively) and between 4:00 p.m., and 10:00 a.m. (1.57±2.35 °C in the Ctrl group and 1.10±2.38 °C in the Exp group). However, a relationship ($P<0.05$) was found between the environment temperature and the EE temperature in both groups, where, at 10:00 a.m., the values were 5.30±7.96 °C and 5.70±8.00 °C for Ctrl and Exp respectively. While, between 12:00 p.m. and 4:00 p.m. were 2.12±1.14 °C, 2.33±1.71 °C for the Ctrl, and 1.77±3.97 °C, 2.26±1.43 in the experimental group. **Conclusion:** The use of TC-EE under the conditions of the current production system did not affect the EE temperature in adult rabbits, suggesting no effect on the body temperature of rabbit females.

Keywords: Animal welfare, infrared thermography, rabbit, stress, temperature
Palabras clave: Bienestar animal, termografía infrarroja, conejos, estrés, temperatura

GENÉTICA Y MEJORAMIENTO

Diversity and genomic relationships of some buffalo breeds from the coffee-growing region, Colombia

Diversidad y relaciones genómicas de algunas razas de búfalos de la región cafetera, Colombia

Juan C Rincón Flórez[1]* and Sorany M Barrientos Grajales[1]

[1]Universidad Nacional de Colombia sede Palmira, Colombia, ORCID 0000-0002-6769-6407, ORCID 0000-0001-6790-4934.
*Corresponding author: jcrincon@unal.edu.co

Introduction: The river buffalo was introduced to Colombia in 1967 initially to provide traction services, but from which the meat, milk and leather are exploited. Buffaloes are capable of producing in difficult environmental conditions where cattle cannot, which makes them an important genetic resource for Colombia. The first breed introduced was the Buffalypso and later Murrah, Mediterranean and others. It is believed that the Colombian population is mixed, but there are no studies to prove it. **Objective**: The objective was to develop a genomic analysis of the patterns of genetic diversity and admixture of the buffalo population of the coffee-growing region. **Methods:** information from the Buffalypso (n=11), Murrah (n=19) and Mediterranean (n=16) genetic groups was used. DNA was extracted from blood and genotyped with the IIlumina 777K Bovine HD chip, which contains SNPs that segregate in buffaloes. It was separated by breed and a quality control (call rate >0.90 per SNP per individual, MAF<0.05) was applied for the evaluation of LD decay. Subsequently, LD pruning (R^2<0.2) was performed and heterozygosities, Fis index, PCA analysis and population structuring by Fst were estimated with Plink v1.9. Finally, individual ancestry analysis was performed by Admixture (k=2 to 5). **Results and Discussion:** For the initial analysis, there were 735923 SNPs (n=46), after the first quality control (QC) filter, there were 11342 SNPs and 45 individuals, with an average MAF of 0.18. After the second QC by LD, there were 421 SNPs. The observed (Ho) and expected (He) heterozygosity for buffalypso was 0.41 and 0.40 on average, respectively. For Murrah and Mediterranean He was 0.47 and Ho 0.40, with Fis Negative. The structuring considering all breeds according to wFst was 0.051 (*P*<0.001), and the PCA and admixture analysis shows a population separation in two groups, with a significant mixing between breeds. **Conclusion:** greater diversity was found in the Murrah and Mediterranean breeds, with respect to Buffalypso, with very probable interbreeding processes between the breeds.

Keywords: Water buffalo, admixture, zoogenetic resources, SNPs
Palabras clave: Búfalo de agua, mezcla, recursos zoogenéticos, SNPs

Genetic and phenotypic parameters for some productive traits in buffalo from the coffee-growing region, Colombia

Parámetros genéticos y fenotípicos para algunas características productivas en búfalos del eje cafetero, Colombia

Sorany M Barrientos Grajales[1*], Juan C Rincón Flórez[1]

[1]Universidad Nacional de Colombia sede Palmira, Colombia, ORCID 0000-0001-6790-4934, ORCID 0000-0002-6769-6407.
*Corresponding author: smbarrie@unal.edu.co

Introduction: Buffalo farming has gained significant relevance in recent years, emerging as an economically important activity in several regions of Colombia, as buffaloes have found favorable environmental conditions for their development. **Justification:** genetic parameters studies in the buffalo populations are essential to drive sustainable and competitive development in the sector. These studies not only enable the improvement of genetic quality and productivity of buffalo herds but also contribute to promoting animal welfare and conserving the genetic biodiversity of this species in the country. **Objective:** To estimate some genetic and phenotypic parameters for economically important traits in a population of buffaloes in the coffee growing region of Colombia. **Methods:** Information from 660 animals distributed across 10 herds located in different municipalities was used. These herds were classified into 8 different lineages composed of the Murrah, Mediterranean, Jafarabadi breeds, and their various F1 and F2 crosses. A descriptive statistical analysis was conducted to characterize the production systems, followed by a Generalized Linear Model (GLM) using R software to assess the significance of fixed effects such as breed component, seasson, and year of birth on the traits at birth weight (BW), weaning weight (WW), average daily gain to weaning (ADG), and Two teats adjusted milk production (AMP). Variance components were estimated based on a uni and bivariate animal model using the restricted maximum likelihood method (REML) and from these components the genetic parameters were estimated, as well as the genetic and phenotypic correlations.

Results and Discussion: Productive parameters showed average values of 34 kg for BW, 280 kg for WW, 672 kg/lactation for AMP, and 225 g/day for ADG. WW had a phenotypic correlation of 0.22 with BW and 0.59 with ADG. Heritabilities for the evaluated traits showed moderate values, with the highest value for ADG (0.43) and the lowest for BW (0.26). Phenotypic correlations showed moderate values, with a value of 0.59 between WW and ADG. **Conclusion:** The estimated genetic parameters for ADG indicate the potential for a good response to selection, leading to a simultaneous improvement in WW due to the correlation found between these two traits.

Keywords: Animal breeding, genetic correlations, heritability, production systems
Palabras clave: Cría de animales, correlaciones genéticas, heredabilidad, sistemas de producción

NUTRICIÓN Y ALIMENTACIÓN

Molecular analysis of the interaction of two insecticides with oxidative stress enzymes in *Apis mellifera*

Análisis molecular de la interacción de dos insecticidas con enzimas de estrés oxidativo en *Apis mellifera*

Edwin D Correa Rojas[1]*, Carlos A Maya[2], Fredy G Galindo Morales[3], Luz M Salazar[4], Nelson E Arenas[5]

[1]Universidad de Cundinamarca. Facultad de Ciencias Agropecuarias, Colombia, ORCID 0000-0001-9246-6008. [2]Fundación Universitaria de Ciencias de la Salud-FUCS. Instituto de Ciencias Básicas, Colombia, ORCID 0000-0001-5455-3282. [3]Universidad Antonio Nariño. Facultad de Ciencias, Colombia, ORCID 0000-0001-8352-128. [4]Universidad Nacional de Colombia. Facultad de Ciencias, Colombia, ORCID 0000-0002-7869-0991. [5]Universidad de Cartagena. Facultad de Medicina, Colombia, ORCID 0000-0002-7665-8955.
*Corresponding author: edcorrea@ucundinarmarca.edu.co

Introduction: The excessive use of insecticides affects pollinating insects, such as bees, causing oxidative stress even at sublethal doses, which impacts their health, population, and ecosystem service. In Colombia, Imidacloprid (IMI) and Chlorpyrifos (CPS) are used, so it is important to understand the possible metabolic effect of these compounds on *A. mellifera,* strengthening the discourse for transitioning to environmentally friendly regulators. **Aim:** To evaluate in silico molecular interactions of IMI and CPS with enzymes associated with oxidative stress (Catalase (CAT), Glutathione peroxidase 1 (GPX1), Superoxide dismutase 1 and 2 (SOD1; SOD2)) and to experimentally assess Catalase enzymatic activity in protein extracts of *A. mellifera* treated with insecticides. **Methods:** Peroxidase activity was measured in protein extracts of bees treated with two insecticides using titration. A computational molecular docking analysis was performed between the insecticides and selected enzymes using PyRx and Discovery Studio. **Results and Discussion:** Enzymatic extracts showed inhibition against IMI and CPS: CAT activity decreased in the IMI treatment fractions compared to the control. The substrate amount was higher (4.30±0.14) with 2 ppm of IMI, suggesting enzymatic inhibition. In the CPS treatment, a decrease in CAT was observed at all concentrations, showing a reduction in enzymatic activity (EA). High inhibition of CAT was presented at the highest substrate level of 16 ppm (5.59±0.16). Computational analysis of CAT showed that CPS bound with an affinity of -6.2 kcal/mol occupying the same site, near the active site (AS) of the enzyme. IMI was placed in the region near the AS of CAT, at the tetrameric interface. Modeling with GPX, CPS suggests interaction in the region near the catalytic residue Trp-134, while IMI interacts with residues in the dimeric interface, causing modifications in alterations in the EA of GPX. For SOD1 and SOD2, IMI and CPS occupy the same dimeric interface region. **Conclusions:** Interactions between insecticides and enzymes can cause modifications in binding interfaces between dimers or tetramers, altering their three-dimensional structure and affecting their EA. For CAT and SOD2, insecticides can impact the substrate binding site according to kinetic assays, affecting their affinity for catalytic activity exposed to IMI or CPS, explaining the oxidative stress observed in *A. mellifera.*

Keywords: Bee, enzyme, pesticide, physiological effects, pollination
Palabras clave: Abeja, enzima pesticida efectos fisiológicos, polinización

Use and management of edible beetle larvae as a food alternative in the Colombian Amazon

Uso y manejo de larvas de coleópteros comestibles como alternativa alimenticia en la Amazonia colombiana

Angélica M Torres Bejarano[1] and
Gabriel J. Colorado Zuluaga[1*]

[1]Universidad Nacional de Colombia sede Medellín. Departamento de Ciencias Forestales, Colombia, ORCID 0000-0003-1990-6366, ORCID 0000-0003-3807-3646.
*Corresponding author: gjcoloradoz@unal.edu.co

Introduction: The use of insects as a food source is a frequent activity in multiple indigenous communities in the Amazon. In particular, the larvae of beetles (Order: Coleoptera) in the Colombian Amazon have an ancestral use as a source of protein and medicine. Many of these bettles have a close relationship with some palm trees, as is the case of the mojojoy *Rhynchophorus palmarum* (Coleoptera: curculionidae), which employs the palm *Mauritia flexuosa* in its life cycle. **Justification**: Despite representing a traditional use, the palm is cut down as a strategy to facilitate the arrival of the beetle to lay their eggs and obtain after a while the larvae. In indigenous communities with small territories, such as San Sebastián de los Lagos (the smallest indigenous preserve in the entire Amazon Department), this palm is found in small numbers due to its diverse uses, including the extraction of mojojoy. These plant formations also have different ecological functions, as a source of food and shelter for the fauna during the fruiting seasons. They also ensure the availability of water for the animals and the inhabitants in their vicinity. **Objective**: In this study, we evaluated alternative and sustainable production methods of *R. palmarum* to reduce the impact on *M. flexuosa* populations and thus contribute to the food security of the periurban indigenous communities

of the municipality of Leticia. **Methods**: Adults were raised in the laboratory and fed with three substrates (*Saccharum officinarum*, *Carica papaya* and *Musa paradisiaca*) common in indigenous *chagras*. **Results and Discussion**: All females (n=36) of the three treatments oviposited ($\overline{X}$=13 eggs/day), with *C. papaya* the most successful substrate by showing lower mortality and a higher number of eggs laid ($\overline{X}$=21 eggs / day). Subsequently, the larvae were kept on a substrate of *S. officinarum* which allowed their successful development. **Conclusion**: This research highlighted the possibility of using alternative diets for the production of *R. palmarum* as an important source of animal protein for indigenous communities while at the same time contributing to reducing the pressure on the palm tree.

Keywords: Aguaje, indigenous communities, insects, *Mauritia flexuosa,* mojojoy, *Rhynchophorus palmarum*
Palabras clave: Aguaje, comunidades indígenas, insectos, *Mauritia flexuosa*, mojojoy, *Rhynchophorus palmarum*

REPRODUCCIÓN

Evaluation of growth in New Zealand rabbit's offspring after maternal arginine or progesterone treatment

Evaluación del crecimiento en la descendencia de conejo de Nueva Zelanda después del tratamiento con arginina o progesterona materna

Janny J Cuatindoy Londoño[1], Daniela García González[1], Darwin Y Hernández Herrera[1] and Yasser Y Lenis[2]

[1]Universidad Nacional de Colombia sede Palmira. Colombia, ORCID 0000-0001-5942-7808, ORCID 0000-0003-0898-5724, ORCID 0000-0002-1758-604X. [2]Universidad de Antioquia. Facultad de Ciencias Agrarias. Medellín, Colombia, OCRID 0000-0002-4976-9916.
*Corresponding author: jcuatindoy@unal.edu.co

Introduction: Arginine (Arg) is a precursor for molecules such as polyamines, ornithine, proline, agmatine, among others present in the histotroph, and is responsible for guaranteeing embryonic nutrition during the pre-implantation period. On the other hand, progesterone (P4) secures the maintenance of pregnancy by enhancing the quality of the histotroph and promoting uterine quiescence. **Objective:** to evaluate the effect of the administration of Arg and P4 during the embryonic period on the post-weaning growth of New Zealand rabbits' female offspring. **Methods:** every 24 hours, 99% Arg (50 mg/kgPV, VS) was administrated on 13 nulliparous rabbits, from day 5 post-mating to day 19 of gestation, having a control (Ctrl) of 18 rabbits who received sodium chloride (0.9%). Subsequently, 99% P4 (1.5 mg/kgPV VS) was administrated to 16 nulliparous rabbits 24 hours post-mating until day 5 of gestation, having 20 rabbits as Ctrl that received sesame oil. Total weight, weight/weekly weight gain (GPS) and weight/daily gain (GPD) from weaning to week 12 post-weaning (P12) were assessed only in female kittens. A GLM model was applied that included the treatment effect (Arg or P4), the week of measurement and their interaction. **Results and Discussion:** the administration of Arg significantly affected ($p= 0.040$) the total weight in P12 (Arg: 2257.3±810.8 g; Ctrl: 2208.3±805.5 g), but not in the GPS or GPD variables. The effect of the measurement week affected ($p<0.05$) all variables. On the other hand, the interaction between treatment per week only affected the GPS or GPD variables with the best performance in the rabbits treated with Arg. The administration of P4 significantly affected ($p< 0.001$) the total weight in P12 (P4: 2176.3±833.9 g; Ctrl: 2107.3±833.9 g). As in the first experiment, the effect of the measurement week significantly affected ($P<0.05$) all variables. However, the interaction of treatment per week did not affect GPS or GPD variables. **Conclusion:** the administration of Arg and P4 during the embryonic period for rabbit females positively affects the total weight of their female's kittens.

Keywords: Aminoacid, embryo development, histotroph, maternal effect
Palabras clave: Aminoácido, desarrollo embrionario, histotrófico, efecto materno

SALUD PREVENTIVA Y BIOSEGURIDAD

Prevalence of *Fasciola hepatica* in water buffaloes (*Bubalus bubalis*) in Mexico: climatic and environmental risk factors

Prevalencia de Fasciola hepatica en búfalos de agua (*Bubalus bubalis*) en México: factores de riesgo climáticos y ambientales

Abel Villa Mancera[1]*, Herminio Jiménez Cortez[1], Manuel Robles Robles[1], José Rodríguez Castillo[1], Fernando Utrera Quintana[1], Alejandro Córdova Izquierdo[2], and Noemí Pérez Mendoza[1]

[1]Benemérita Universidad Autónoma de Puebla. Tecamachalco Puebla, México. [2]Universidad Autónoma Metropolitana. Unidad Xochimilco, CDMX, México.
*Corresponding author: abel.villa@gmail.com

Introduction: Fasciolosis is a zoonotic disease caused by Fasciola hepatica that affects both animals and humans worldwide. **Objective:** To assess the prevalence of *F. hepatica* infection in buffalo and to investigate its association with risk factors in two Mexican states with different tropical climate subtypes. **Methods:** Four hundred and ninety samples were used for the state of Veracruz with a tropical monsoon climate (Am) and 235 sera from the state of Tabasco with a rainy climate (Af). A total of 725 serum samples were tested for anti-*F. hepatica* IgG antibodies by ELISA, with excretory-secretory (E/S) products as antigen. Bivariate regression analysis was used with age, sex and climatic/environmental factors (obtained from satellite data) as independent variables. All statistical analyses were performed using the IBM SPSS 25 software package for Windows (SPSS Inc., USA). **Results and Discussion:** The prevalence of the parasite in buffaloes from September 2022 to December 2022 was 10.62%, with 77 out of 725 buffaloes affected. The state of Veracruz had the highest prevalence of parasite infection, with a rate of 9.18%. In addition, the tropical rainforest climate had the highest prevalence among the other climatic regions, with a rate of 13.62%. In the two states studied, the highest prevalence of fasciolosis was found in young animals aged 3 years or less (21.52%) and in male buffaloes (20.00%). Using multivariate logistic regression analysis, four variables: age, normalised difference vegetation index, daytime land surface temperature and rainfall, were identified as strongly correlated with an increased risk of parasitic infection. The study showed that rainfall had the highest correlation with *F. hepatica* infection (odds ratio 3.434; 95% confidence interval 2.181-5.406), followed by daytime land surface temperature (odds ratio 2.832; 95% confidence interval 1.916-4.186). **Conclusions:** The results suggest that many parameters are closely associated with the occurrence of liver flukes and underline the need for continuous surveillance programmes for parasitic infections to prevent economic losses in buffalo farming.

Keywords: Buffaloes, epidemiology, fasciolosis, prevalence, risk factors, trematodes
Palabras clave: Búfalos, epidemiología, fasciolosis prevalencia, actores de riesgo, trematodos

Molecular characterization and immunoproteomic profiling of *Yersinia pseudotuberculosis* strains from guinea pigs of Nariño, Colombia

Caracterización molecular y perfil inmunoproteómico de cepas de *Yersinia pseudotuberculosis* provenientes de cuyes de Nariño, Colombia

Danny Barney Borrero[1]*, Sabrina del C Jiménez Velásquez[1], **María C Renjifo Ibáñez**[1*] and Gabriela Arévalo Pinzón[2]

[1]AGROSAVIA. Colombia, ORCID 0000-0002-5070-0262, ORCID 0000-0001-6707-4491, ORCID 0000-0002-6350-5554. [2]Pontificia Universidad Javeriana. Colombia, ORCID 0000-0002-5331-5693.
*Corresponding author: mrenjifo@agrosavia.co

Introduction: The guinea pig production system is an activity of socioeconomic importance in Nariño, where more than 80% of the national inventory is located. Yersiniosis, caused by *Yersinia pseudotuberculosis*, is one of the diseases with the greatest impact on this production system. Currently, there are no vaccines available in Colombia for the prevention of this disease, so the molecular characterization of virulence factors and immunoproteomic profiles of autochthonous strains are of vital importance for the design of this type of preventive tool. **Objective:** Characterize three virulence genes (chromosomal and plasmidic) and the immunoproteomic profile of 27 strains of Yersinia pseudotuberculosis obtained from clinical isolates of guinea pigs from the department of Nariño (present in the Collection of Microorganisms of Interest in Animal Health of AGROSAVIA). **Methods:** Virulence gene regions of chromosomal (*inv*) and plasmidic (*yadA* and *virF/lcrF*) origin of *Y. pseudotuberculosis* were amplified by conventional PCR and sequenced. The sequences were analyzed with the DNASTAR Ver17.5 software, performing multiple alignments and phylogeny using the genome of reference strain 29833™ and two reported in the NCBI (CP032566.1 and CP032567.1). Total and secreted proteins were extracted from

the bacteria to evaluate the proteomic profile and their reactivity against sera from infected guinea pigs, using SDS-PAGE and Western Blot. **Results and Discussion:** The plasmidic genes were evidenced in 24 strains, as well as a high degree of conservation of the sequences belonging to the genes *inv*, *yadA* and *virF*/*lcrF*. The proteomic profile of proteins was quite homogeneous in the strains evaluated. Bands ranging from 10 to 250kDa for total and 10 to 150kDa for secreted proteins were evidenced. Immunoreactive bands were evidenced between 25kDa and 75kD, which could be related to proteins involved in the virulence of *Yersinia* such as Yop H, E, J D, B and Lcrv. **Conclusions:** A high conservation of genes and proteomic profiles was evidenced, as well as specific reactivity to secreted proteins, which is crucial for the search for a vaccine candidate with cross-reactivity for the different strains present in guinea pig farms.

Keywords: Guinea Pig production, virulence genes, yersiniosis
Palabras clave: Producción cuyícola, genes de virulencia, proteínas yersiniosis

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

Evaluation of the microencapsulation of *Lactobacillus reuteri* and its addition in granulated jaggery

Evaluación de la microencapsulación de *Lactobacillus reuteri* y su adición en panela granulada

Jhon F Cerón Córdoba[1*], Henry Jurado Gámez[2] and José U Sepúlveda Valencia[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0000-0003-4160-5797, ORCID 0000-0001-5660-4514. [2]Universidad de Nariño. Facultad de Ciencias Pecuarias, Colombia, ORCID 0000-0003-2118-7997.
*Corresponding autor: jhceronc@unal.edu.co

Introduction: In recent decades, research has focused on the design of food products with functional potential, driven by the demand for healthy foods and their effects on gastrointestinal health. **Justification**: Jaggery is a nutritious and traditional product derived from sugarcane with great demand in Latin America. Granulated jaggery is a ready-to-eat presentation used in a variety of recipes. A multitude of studies have demonstrated that *Lactobacillus reuteri* is capable of promoting intestinal health and modulating the intestinal microbiota. However, these microorganisms are susceptible to industrial processes, which represents a limiting factor in the design of functional foods. Microencapsulation by spray drying of bioactive compounds is proposed as a means of protecting the microorganism to guarantee the recommended minimum concentration of 10^7 UFC/mL. **Objective:** To evaluate the microencapsulation of *Lactobacillus reuteri* and its addition in granulated jaggery. **Methods**: The *L. reuteri* inoculum was reconstituted, preserved, and adjusted for microencapsulation by spray drying at 130 °C (inlet temperature) with a binary matrix of inulin (10% w/w) and maltodextrin (10% w/w). Structural, morphological, and capsule size characterization was performed by scanning electron microscopy (SEM). Subsequently, efficiency, viability, humidity, water activity (aw), solubility, wettability, and survival were evaluated under *in-vitro* gastrointestinal conditions in three phases: oral, gastric, and intestinal. Finally, microencapsulated *L. reuteri* was incorporated in granulated jaggery and viability of the probiotic was evaluated. **Results and Discussion**: The yield of the microencapsulation process of *L. reuteri* was 47.86%. The microphotographed microcapsules exhibited a smooth, homogeneous, circular external structure with an average diameter of 5.8 µm. The characterization of the microencapsulated material revealed an efficiency of 91.35%, viability of 100%, humidity of 5.54%, aw of 0.306, solubility of 99.01%, and wettability of 90 seconds. The plate count was $2.4x10^9$ CFU/mL following *in-vitro* gastrointestinal tests. Lastly, the viability of the probiotic was 100% when added to granulated jaggery with a count exceeding $1x10^7$ CFU/mL. **Conclusion:** The microencapsulation of *L. reuteri* by spray drying demonstrated the stability of the microorganism following the drying process and when added to granulated bread.

Keywords: Functional food, intestinal health, prebiotics, probiotics, spray drying
Palabras claves: Alimento funcional, salud intestinal, prebióticos, probióticos, secado por aspersión

Microencapsulation of *Lactobacillus plantarum* as a strategy for viability in ice cream incorporation

Microencapsulación de *Lactobacillus plantarum* como estrategia para viabilidad en la incorporación de helado

Luis C Muñoz Domínguez[1*], Henry Jurado Gámez[2] and José U Sepúlveda Valencia[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0006-2287-9310, ORCID 0000-0001-5660-4514. [2]Universidad de Nariño, Facultad de Ciencias Pecuarias, Colombia, ORCID 0000-0003-2118-7997.
*Corresponding autor: lumunozd@unal.edu.co

Introduction: Currently, numerous studies have been conducted related to the inclusion of probiotics in foods intended for human consumption, where the multiple benefits for the gastrointestinal system have been demonstrated. In this regard, the present research determined the need to contribute to the development of a hard ice cream, due to its nutritional characteristics and the importance of consumption within the human population, in addition to this added value was given in its formulation, which involved the addition of *Lactobacillus plantarum* microencapsulated and the inclusion of sweet serum. The specifications mention the use of *L. plantarum*, known for its beneficial characteristics at the level of biomass production, resistance and the positive effect on the gastrointestinal system of the human being and in turn the inclusion of sweet milk whey, as a co-product obtained from agro-industrial processes, with the purpose of mitigating in harmful effect for the environment. **Objective:** Evaluation and development of microencapsulation of *L.plantarum* and determination of viability in ice cream. **Methods:** The spray-drying technique was implemented, to microencapsulate the strain of *L. plantarum* in a maltodextrin matrix of 20%

and inulin of 10%, and physical characterization of the material, obtaining measurements of solubility, moisture, Aw, humectability and viability; on the other hand, tests were carried out for morphological characterisation of the microcapsulated material and survival of the microorganism under gastrointestinal conditions *in vitro*. **Results and Discussion:** Within the results obtained, the following data were collected: 42% performance, 92.47% solubility, 5.24% humidity, Aw 0.298, 75 seconds moisturization. Plaque count was 2.1x109 UFC/mL, after submitting the microencapsulated to gastrointestinal tests *in vitro*. With regard to probiotic viability in the food matrix was 100% with a count of 1x107 UFC/mL. **Conclusion**: The microencapsulation mechanism of *L. plantarum* for matrix addition in ice cream is feasible as it helps to maintain the viability and preservation of the microorganism despite the conditions of low temperatures.

Keywords: Agriculture, dairy, environment, probiotics, health
Palabras clave: Agricultura, lácteos, medio ambiente, probióticos, salud

RESUMENES

MÓDULO 8

ZOOCRÍA

NUTRICIÓN Y ALIMENTACIÓN

Digestive and nutritional physiology of *Megascops choliba* in a wildlife rehabilitation center

Fisiología digestiva y nutricional de *Megascops choliba* en un centro de rehabilitación de fauna silvestre

Sara Guerrero Chávez[1]*, Sara I Rendón Pineda[1] and Mónica Reinartz Estrada[1]

[1]Universidad Nacional de Colombia sede Medellín. Facultad de Ciencias Agrarias, Colombia, ORCID 0009-0007-3181-7354, ORCID 0009-0006-0371-2419, ORCID 0000-0001-7227-448X.
*Corresponding author : saguerreroch@unal.edu.co

Introduction: At the Wildlife Valuation and Rehabilitation Center of the Valle de Aburrá, Barbosa, Antioquia, in which the Currucutú (*Megascops choliba*) belongs to the top 10 of the most admitted animals, this makes necessary a detailed feeding plan for the attention of this population, providing a balanced diet in the process of rehabilitation and subsequent release of the individuals. **Objective**: To evaluate the current diet in terms of species requirements, composition and raw materials, applying zootechnical, physiological and nutritional aspects. **Methods:** Data collection and analysis were carried out, generating daily weight gains and growth curves. In the necropsies performed by the center, stomach contents were obtained from the feeding in the wild of the species. The energetic and nutritional requirements for the different physiological states were elaborated, implementing the use of software and office tools such as Zootrition, Zoodiet Pro and Excel. The compliance with the requirements of the supplied diet was evaluated, as well as its consumption and cost analysis. **Results and Discussion**: An average GDP of 0.98g was obtained. Stomach contents were observed with the presence of hair, feathers and insects of the Gryllidae and Tettigoniidae families. Nutritional requirements of 49.88 Kcal ME/day average, 20% protein, 10% lipids, 2.5% fiber, 1.65% calcium, 0.55% phosphorus were obtained. An alternative diet is proposed including foods that improve the fiber and calcium intake in the ration and encourage the formation of pellets in the individuals. A diet consumption of 81.4% (P>0.05) and a decrease of 21% in the costs associated with feeding were achieved. **Conclusion:** Based on the results, it is considered that the diet should be reformulated since more complete and detailed information is available, being able to meet the nutritional requirements of the species and allowing the creation of pellets to improve the physiology of digestion and food transit.

Keywords: Currucutú, diet, energy, food, requirements

Palabras clave: Currucutú, dieta, energía, alimentación, requerimientos

Nutritional characterization and digestive physiology in opossums (*Didelphis marsupialis*) under *ex-situ* conditions

Fisiología digestiva y caracterización nutricional en zarigüeyas *(Didelphis marsupialis*) en condiciones *ex-situ*

Sara I Rendón Pineda[1]*, Sara Guerrero Chávez[1] and Mónica Reinartz Estrada

[1]Universidad Nacional de Colombia sede Medellín. Colombia, ORCID 0009-0006-0371-2419, ORCID 0009-0007-3181-7354, ORCID 0000-0001-7227-448X.
*Corresponding author: sirendonpi@unal.edu.co

Introduction: Opossums, *Didelphis marsupialis*, are wild mammals of wide distribution and abundance in Colombia. This species has a relevant ecological function for ecosystems, as they are seed dispersers, forest regenerators, and pest controllers. Opossums are nocturnal, omnivorous, opportunistic, and they are the species that most enter the CAVR (Wildlife Care, Assessment and Rehabilitation Center). **Objective:** This work carried out at the CAVR of the Metropolitan Area of the Aburrá Valley (AMVA) seeks, through observation and data collection, to implement the zootechnical aspects associated with the feeding and nutrition of this species, such as their feeding behavior, energy requirements, digestive physiology and the formulation of diets. **Methods:** At the CAVR, they feed on fruits and meat, although through a cafeteria test, we aim to include more fibrous and palatable foods to resemble their diet to the one they have in the wild. **Results and Discussion:** The vegetables with the highest acceptance are chard and spinach (P>0.05), with 71% and 73% respectively; in addition, the inclusion of different fibrous foods in the diet allows the contribution of this nutrient to increase from 1.47% to 11.58% on average. **Conclusion:** This species, like many marsupials, is efficient in the use of energy; the food they are currently fed at the CAVR meets their nutritional requirements, which allows them to express adequate growth and development.

Keywords: Dietary habits, fiber, marsupial mammals, metabolic rate, nutritional requirements

Palabras claves: Hábitos alimenticios, fibra, mamíferos marsupiales, tasa metabólica requerimientos nutricionales

RESUMENES

MÓDULO 9

ANIMALES DE COMPAÑÍA

FISIOLOGÍA, BIENESTAR Y COMPORTAMIENTO

Design of intelligent entertainment systems for the welfare of dogs.

Diseño de sistemas de entretenimiento inteligentes para el bienestar de perros

Sergio Castañeda Serrano[1]*, Mauricio Sotelo Barrios[1], Román Castañeda Serrano[1] and Roy Rodríguez Hernández[2]

[1]Universidad de Pamplona, Colombia. [2]Universidad del Tolima, Colombia.

Corresponding author: sergio.castaneda@unipamplona.edu.co

Introduction: Currently, the pet industry is experiencing significant growth both in Colombia and worldwide. As a result, animal welfare has become an important trend in developing products that address specific needs. Therefore, it is necessary to develop innovative products that are in line with the physiological and ethological needs of animals**. Objective:** To design intelligent entertainment systems for the welfare of dogs. **Methods:** This project was carried out in three phases: phase 1 literature review; phase 2 design of intelligent systems; Phase 3 field experimentation. Currently, the project is in phase 1. In this phase, the Web of Science, Science Direct, Scielo, Scopus, Directory of Open Access Journal databases were reviewed. Keywords were identified using the scientific thesaurus of Science Direct: “animal welfare science” “animal health” “dog” “ethology” “animal behaviour” “smart systems” “product design” “design thinking” “ecodesign” “user experience”. A matrix was created using these terms to later perform a search equation with Boolean connectors. Finally, network graphs, density graphs, author graphs, and chronology graphs were developed with the help of the VOSviewer program. **Results and Discussion:** It was observed that the correlation of keywords for research was 58% for veterinary sciences, 13% for multidisciplinary sciences, 9% for electrical engineering, 9% for multidisciplinary engineering, and 20% for other categories. The profiles of researchers by countries correspond to 22% USA, 11% England, 9% Italy, 9% China, 51% in other countries. 53 articles and 26 patents relating to the design of products for dogs were found. Of the selected articles, only 10% integrated and correlated animal welfare with intelligent design. **Conclusion:** As a result of the extensive literature review, it is concluded that the information in the area of design of intelligent systems and products for dogs that take into account animal welfare available in the databases of the last 20 years is scarce. Therefore, the development of this type of products and systems is a promising area given the current and future trends in the pet owner-pet relationship.

Keywords: Product design, animal behaviour, canine, ecodesign
Palabras clave: Diseño de productos, comportamiento animal, canine, ecodiseño

SISTEMAS DE PRODUCCIÓN Y AGROINDUSTRIA

In vitro evaluation of microencapsuled *Lactobacillus lactis* ATCC under gastrointestinal condicions and in cell cultures

Evaluación *in vitro* de *Lactobacillus lactis* ATCC microencapsulado bajo condiciones gastrointestinales y en cultivos celulares

Henry A Jurado Gámez[1]*, Carlos A Jojoa Rodríguez[1], Efrén G Insuasty Santacruz[1], Ivonne C Fajardo Argoti[1], Luis C Muñoz Domínguez[1] and Jhon F Cerón Córdoba[1]

[1]Universidad de Nariño. Facultad de Ciencias Pecuarias, Programa de Zootecnia, Colombia, ORCID 0000-0003-2118-7997, ORCID 0000-0003-3547-0179 , ORCID 0000-0003-0632-4033, ORCID 0000-0003-1993-6573, ORCID 0000-0002-4914-1870, ORCID 0000-0003-4160-5797.
*Corresponding autor: henryjugam@udenar.edu.co

Introduction: Research work funded by the Vice-Rector's Office for Research and Social Interaction of the University of Nariño, Code 2853, Teaching Call 2023. Research on food, such as the development of ice cream, indicates that *Lactobacillus lactis* is suitable for the development of food. nutraceuticals and functional. **Justification**: An effective probiotic action of *L. lactis*, in addition its microencapsulation increases its viability and resistance to gastrointestinal conditions. **Objective**: the in vitro effect of microencapsulated *L. lactis* was evaluated under simulated gastrointestinal conditions and adhesion cultures in CaCO2. **Methods**: Microencapsulation of *L. lactis* was carried out by spray drying, with a matrix of maltodextrin and inulin at 20% w/v; Its viability was also evaluated under simulated gastrointestinal conditions at pH 2.5 (gastric phase) and enteric phase at pH 5.0 and 6.5 and bile salts (0.3%) and bovine bile (0.4%). The viability of microencapsulated *L. lactis* was evaluated during 30 days of storage; In addition, the physical characterization of the microencapsulated material was carried out. **Results and Discussion**: The viability of *L.lactis* at pH 2.5 was 2.5x109 CFU/mL (gastric phase), enteric phase at pH 5.0 and 6.5 was 2.3x109 CFU/mL and 2.3x108 CFU/mL respectively, and bile salts (0.3%) and bovine bile (0.4%) with values of 2.2x108 CFU/mL and 2.3x108 CFU/mL respectively. The viability at 30 days of microencapsulated *L. lactis* was 80.3%. The physical and chemical variables of the microencapsulation were: Moisture content (% bs) 7.7; Water activity (Aw) 0.350; Hygroscopicity (g moisture/100 g dry solid) 1.7; Wettability (min) 2.6 and Solubility (%) 81.7. Adhesion cultures to CACO2 cells indicated adequate adhesion compared to the pathogenic bacteria. **Conclusion**: Microencapsulated *L. lactis* presented an effective probiotic action, becoming an alternative to be used in nutraceutical and functional foods.

Keywords: Food safety, human and animal health, *Lactobacillus lactis*
Palabras clave: Inocuidad alimentaria, salud humana y animal, *Lactobacillus lactis*

Índice de autores

A

Abel Villa-Mancera 93, 126, 131,152
Abid S Cañate González 120
Adriana C Rada 139
Adriana Quintana Canaba 137
Adrián F Medina Montes 146
Addy Anchondo Aguilar 131
Albeiro López-Herrera 77, 78, 117, 118
Aldo J Ibarra-Rondón 60
Alejandra Álvarez Múnera 52
Alejandra Cuatrin 71, 72, 80
Alejandro Britos 61, 116
Alejandro Córdova-Izquierdo 93, 152
Alejandro L Soraci 96
Alejandro J Montiel Flores 126
Alejandro Ramírez Madrigal 66
Alejandro Strauch 60
Alessandra Stella 127
Alexander Moreno 110
Alexandra Úsuga Suárez 93, 95
Álvaro J Uribe Serrano 89, 112, 117
Alvaro M Cadena Pastrana 45, 145
Álvaro Rincón Castillo 86, 88
Amanda L Mora Martínez 79
Amanda Silva Parra 62
Ana Peralta Vega 129
Andrea X Montilla Duque 23
Andrés Acevedo 66
Andrés F Rodríguez Reyes 78
Andrés Gómez Zapata 88, 91
Andrés Mejía 48
Ángela R Martínez 90
Angélica M Torres Bejarano 149
Angelica Santos Escobar 110
Ángel M Benítez Rodríguez 65
Ángel T Piñeiro-Vázquez 131
Angely G Garzón Torres 110
Antonella Picca 71, 72
Antonio Duque Ramírez 58
Aramy J Vásquez Hermosilla 68, 129
Arianna Manunza 127

B

Belloncy Gallego Rey 58
Benjamín A Rojano 103
Blanca C Martínez Morales 89, 112, 117
Brandon S Bustamante Castañeda 48, 57
Brayan S Mantilla Delgado 73, 75
Bryan Stiven Sánchez Beltrán 70
Byron A Hernández Ortíz 88, 110

C

Camila A Ruiz Jiménez 120
Camila A Villalobos Gutiérrez 111
Camila Moreira 61
Camila S De Oliveira 69
Carla D Suguimoto Leite 114, 122
Carlos A David Ruales 139
Carlos A García Bayona 137
Carlos A Jojoa Rodríguez 164
Carlos A Maya Ortega 88, 91, 111,118, 149
Carlos F Duque Ramírez 111, 112, 114, 115, 117
Carlos F Prada Quiroga 130
Carlos M Pérez Nanclares 15
Carolina Jaramillo Gómez 101
Carolina Mendoza Hortúa 96
Caterine López Sánchez 77, 78
Cecilia Cajarville 61
Cecilia Jiménez Plascencia 92
Cindy A Taborda Piedrahíta 61
Claudia D De Paula 139
Claudia del P Herrera Farfán 46
Claudia P Rendón Ocampo 80
Cristian C Rúa Giraldo 77, 78
Cristina Álvarez Múnera 51, 52
Cristina Úsuga- Monroy 77, 78
Cruz E Enríquez Valencia 111, 112, 114

D

Dalia M Rodríguez Jiménez 60
Daniela Ahumada Cabarcas 137
Daniela García González 151
Daniela Velandia Benito 110
Daniel F Ovalle Orjuela 61
Daniel Guzmán Zapata 70
Daniel M Echeverri De la Hoz 120
Daniel Scandolo 71, 72, 80
Danny Barney Borrero 152
Darwin A García 125
Darwin Y Hernández Herrera 50, 132, 151
David A Hernández Ricaurte 94
David E Quintero-Bastidas 72
David F Nieto Sierra 87
David J González Arenas 78
David R Sánchez Chipres 92
David White 34
Dayra García 107
Deilen P Sotelo Moreno 62, 68, 69, 70, 107
Deisy J Díaz Sánchez 73
Diana C Mogollón Vergara 48, 64,130
Diana E Buendía-Lara 139
Diana M Bolívar Vergara 50, 51, 52, 54, 81
Diana M Valencia-Echavarria 113
Diego A Hernández Pulido 58
Diego A Moya Martínez 68, 129
Diego A Velasco-Acosta 74
Diego Camisasso 71, 72
Diego F Carrillo González 73, 75, 146
Diego F Dubeibe Marín 73
Diego Hernando Angulo-Florez 82
Diego Scandolo 71, 72, 80

E

Edgar Aguilar-Urquizo 108, 122, 131
Edgar A Martinez 62, 107
Edgardo Ortega 71, 72
Edgar R Moreno Jerez 73, 86
Edimer D Jaramillo 50
Edison J Ramírez Toro 87
Edwin Castro Rincón 80, 145
Edwin D Correa Rojas 149
Edy S Acosta Calderón 113
Efrén G Insuasty Santacruz 164
Eliana M Ruiz Bayona 128
Eliana Neira Rivera 94
Elis O Figueroa Castillo 110
Elizabeth Quenza 75
Elkin O Romero-Cárdenas 76, 125
Elkin S Mendoza Doncel 82
Emiro R Canchila Asencio 125
Enrique Murgueitio 63
Eric Siqueiros 34
Erika Meneses Estrada 145

Erika M Marcín-Marrufo 131
Erika P Grijalba Bernal 63
Ernesto Orozco-Lucero 108
Estefanía Herrera Pasos 94
Estefanía Jaimes Hernández 120
Ethel Caterina García y González 131

F
Fabián L Rueda Alfonso 74, 94
Fabyola Barros de Carvalho 114, 122
Felipe A Diaz Trujillo 113
Fernando Freire 127
Fernando Rodríguez Villamizar 63
Fernando Utrera-Quintana 93, 126, 131, 152
Filippo Biscarini 127
Francisco R Ramírez García 101
Freddy Hernández Barajas 81
Fredy G Galindo Morales 149
Fuensanta Hernández Ruipérez 91

G
Gabriela Arévalo Pinzón 152
Gabriel Ciappesoni 127
Gabriele Rodrigues de Lara 141
Gabrieli A de Lima 110
Gabriel J Colorado Zuluaga 149
Georgina G López Santillán 92
Gerson Barreto Mourao 127
Gilberto Tovar Claros 87, 113
Gilma Hernández Herrera 96
Giovanni Restrepo Betancur 93, 95, 103
Gonzalo J Restrepo-Castañeda 113
Gonzalo Villegas 63
Guido A Portillo 65, 128
Guillermo Vásquez Velásquez 12
Gustavo Zimmermann 71, 72, 80

H
Hanzel A Hortúa Castro 60
Héctor J Correa Cardona 48, 57, 64
Heiner F Uribe García 79
Heli F Valencia Ocampo 85
Hellen G Díaz Perea 101
Henry A Jurado Gámez 154, 164
Henry C Arana Chico 145
Hermes Ordoñez Olivares 89
Herminio Jiménez Cortez 152
Hernán A Alzate Díaz 137, 138
Hugo R Jiménez Sabogal 63
Hugo Velandia León 66

I
Iang S Rondón Barragán 79
Isabel C Guerrero Naudín 101
Isobel M Whiting 109, 118
Iván A Celis 53, 55
Iván Pino 66
Ivonne C Fajardo Argoti 164

J
Jaiberth A Cardona-Arias 120
Jaime A Ángel-Isaza 89, 91 112, 117, 118
Jaime A Durán Prada 97
Jaime E Parra Suescún 88, 91, 111, 117, 118
Jairo A Osorio Saraz 16
Jairo A Pardo Guzmán 48, 64,130
Jane Eastham 34
Janeth Dehaquitz 132
Janny J Cuatindoy Londoño 151
Javier Camisasso 71, 72
Javier F González Cabañas 128
Javier M Agudelo Rendón 66, 90
Jéssica T Morales Piñeyrúa 49
Jesús A Berdugo Gutiérrez 53, 75
Jesús A Sánchez Viafara 73
Jhefferson D Diaz Rojas 79
Jhonatan Sencio López 129
Jhon F Cerón Córdoba 154, 164
Jhon J Borja Tintinago 145
Joao Alvarado Rincón 49
Johana M Leiva Méndez 58
Johanna Ramírez-Díaz 127
Jordán C Hernández Martelo 137
Jorge D Caballero Mascheroni 65, 128
Jorge E Forero Duarte 120
Jorge E Franco Rodríguez 76, 89, 125
Jorge Galindo García 92
Jorge G Noriega-Márquez 87, 113
Jorge H Contreras Castro 89, 125
Jorge Hidalgo 52
Jorge M Noreña Grisales 66
Jorge M Romero Kleber 61
Jorge Triana Valenzuela 49
José Arranz 127
José Carrera-Chávez 108
José C Montes Vergara 80
José E Escobar Riomalo 64
José E Mojica-Rodríguez 60
José F Guarín 53
José F Naranjo Rativa 96
José F Peñaloza García 66
José Garcés Urrego 65
José H Stringhini 29, 114, 122
José H Velásquez Penagos 72
José J Echeverri Zuluaga 53, 55
José L Escudero 97
José L Guzmán Mendoza 61
José L Ponce Covarrubias 131
José M Alba Maldonado 85
José M Barbosa Gelvez 46
José M. Robles Robles 126,131
José Rodríguez-Castillo 93, 126, 131, 152
José R Sartori 110
José U Sepúlveda Valencia 154
Josué N Ramón Estévez 66
Joyce A da Silva 110
Juan C Rincón 127
Juan C Arroyave Manco 66, 90
Juan C de los Ríos Cardona 17
Juan C Ovalle Masmela 63
Juan C Pareja Arcila 90
Juan C Ramírez Herrera 51, 54, 55
Juan C Rincón Florez 18, 50, 51, 54, 55, 132, 147
Juan C Velásquez Mosquera 49
Juan D Cano Gil 139
Juan D Montoya Páez 93, 95
Juan D Zuluaga López 21, 32
Juan F de J Torres-Acosta 131
Juan F Naranjo Ramírez 67, 90
Juan A Javierre 111, 112, 113, 114, 117
Juan J Mazo Londoño 46
Juan L Cardona Iglesias 45, 66, 80
Juan M Bonilla Hernández 52, 54
Juan M Niño Arcila 66
Juan P Arismendy Morales 77, 78
Juan P Damián Cabrera 27, 49
Juan P Uzcátegui-Varela 116
Juan Rueda Albarracín 66
Juan R Zambrano Ortíz 45
Juan S Pineda Arango 6, 37
Julia E Ayazo Genes 141
Julia I Lema Vélez 58
Julián Chará 63
Julián Mejía Orozco 61
Julián Valencia 76

Julio Echeverri Gómez 82
Julio Salas Mayeregger 128

K
Karl Behrendt 34
Karent Carrero Contreras 79
Katerin Luna 112
Katerin Silva Portela 114
Katty G Bernal González 115
Kelly V Zapata Carmona 93, 95
Kristina Osbjer 96

L
Lady L Restrepo Bolivar 90
Laís G Cordeiro 110
Laura Vickers 34
Leonardo A Alemán 139
Leonardo Alzate Mejia 120
Leylis Y Nuñez López 137
Ligia J Jaimes Cruz 48, 57, 64
Ligia Sarneiro Pereira 114,122
Lina M Peñuela Sierra 111, 112, 114
Lina M Pérez Arenas 75
Liranis L Flórez Botello 46
Lisbeth Campos-Arenas 125
Loufrantz J Parra Méndez 112, 117
Luane B Gonçalves Andrade 110
Luciano Prímola de Melo 62, 68
Lucia Toledo 61
Luis A Alonzo Griffith 128
Luisa F García Ospina 115
Luis Altahona Buelvas 65, 67
Luis Carlos Ramírez Villa 62
Luis C Muñoz Domínguez 154, 164
Luis C Ramírez Villa 107
Luis C Veloza Angulo 90
Luis Ernesto López 70
Luis F Escalante Ramírez 137
Luis F Vargas Vivas 72
Luis G González Herrera 50, 51, 52, 54, 55, 56, 81
Luis M Cohen Teherán 53, 81
Luz A Gutiérrez Ramírez 139
Luz A Álvarez 127
Luz E Castillo Pabón 110
Luz M Botero Arango 45
Luz M Guevara Rincón 137
Luz M Salazar 149

M
Mabel J Ortiz de Leo 96
Maira A Mejía Sánchez 48
Manuela Liebano Arango 52, 54
Manuel Casas 71, 72
Manuel Robles Robles 152
Manuel Robles-Robles 93
Marbel Y Monroy González 78
Marcela Beristaín-Ruiz 108, 122
María C Londoño Méndez 74
María C Renjifo Ibañez 152
María C Rozo Florez 94
María del P Pineda Ortiz 96
Maria E Bohórquez López 67
María J Hernández Ruíz 101
María J Muñoz Ramirez 64, 130
María K Gómez Morales 66
Mariana H Paes Barboza 141
Mariano E Acosta Lobo 103
María S Sánchez Pinzón 58
María Yepes Pérez 79
Maribel Echeverry Tangarife 58
Marina Fernández-García 116
Marisela Méndez-Rosas 93
Martha I Gómez Álvarez 63
Martha J Prieto-Guevara 139
Martha L Chaparro Rodriguez 63
Martha R. Valverde Luna 37
Martha Y Gutiérrez Ibáñez 73, 86, 88, 94, 97
Martin Maciel 71, 72
Mateo Itza-Ortiz 28, 30, 108, 122, 131
Mateo Sepúlveda Rodríguez 116
Matheus S Da Silva Ferreira 132
Matías Bermann 52
Mauricio Rojas López 93, 95
Mauricio Sotelo Barrios 163
Mayerling Sanabria Buitrago 49
Mayra A Cervera Ricardo 129
Mayra Diaz Vargas 111, 112, 113, 114, 115, 116, 117
Miguel A Ayala Valdovinos 92
Miguel Á Magaña-Magaña 131
Miguel A Peña Joya 72
Miranda E Smith 109
Miselly López 89
Moisés A Gaibao Pérez 67
Mónica M Ávila Sarmiento 53
Mónica M Segura Restrepo 91
Mónica Reinartz Estrada 159

N
Nancy Rodríguez Colorado 85
Neil Vásquez Araque 79
Nelson E Arenas 149
Nelson S Peña Barreto 68
Nikolay Karkelanov 118
Nina Y Sepúlveda Monroy 117
Noemí Pérez-Mendoza 93, 152
Norberto Villa Duque 76

O
Olga Barreto 48
Olga LTorres-Neira 82
Orleydy Racero Espitia 139
Oscar A Sáenz Ruiz 67, 90
Oscar E Yepes Higuita 51, 54, 55

P
Pablo López del Cerro 71, 72
Pablo Peraza 127
Paola A Damázio Rodrigues 110
Paolo Cozzi 127
Patricia Herrera Demares 120
Paula A Vargas Martínez 46
Pedro J Fragoso-Castilla 60
Pedro J Madrid-Garcés 41
Pedro P Bacca Acosta 145
Piedad Y Martínez-Oquendo 113

R
Rafael J Otero Arroyo 73, 75
Raúl A Velásquez Vélez 128
René M Patiño Pardo 45, 65, 67, 68, 129
René Ramírez Garcia 67, 70, 90
Ricardo González Quintero 58
Ricardo J. Ocampo Gallego 87
Ricardo Mora Quintero 38
Ricaute Lopera Vásquez 79
Ricci Terraza Martínez 76, 125
Rodolfo Ruiz Posada 125
Rodrigo Urrego Álvarez 24, 70
Rolando Barahona-Rosales 58, 60, 61, 63
Román Castañeda Serrano 48, 64, 130 163
Román E Maza Ortega 62
Ronnal E Ortiz Cuadros 80
Roy Rodríguez Hernández 163

S
Sabrina del C Jiménez Velásquez 152
Saira Romero Sanchez 48, 64, 130

Samir J Calvo Cardona 56
Sandra C Pardo Carrasco 137, 138, 139
Sandra J Castañeda 97
Sandra P Rodríguez González 117, 132
Santiago Berrío Calle 67
Santiago Henao Villegas 101
Santiago J. Torreblanca Zárate 126
Santiago Jaramillo Sepúlveda 53, 55
Sara C Chaverra Garcés 141
Sara Guerrero Chávez 128, 159
Sara I Rendón Pineda 128, 159
Sara Muñoz 64
Sashka Chobanova 118
Sebastián Brambillasca 116
Sebastián Castrillón Mojica 48, 57, 58
Sebastián Pineda Sierra 87
Sergio A Pizarro Cano 101
Sergio Castañeda Serrano 163
Sergio Montoya Botero 45
Silvia Martínez Miró 91
Simón E Zuleta Zuleta 128
Sonia D Ospina Hernández 72
Sonia L Gutiérrez Parrado 86
Sonia X Maldonado Soto 68
Sorany M Barrientos Grajales 147
Stephen C Mansbridge 34, 109, 118
Stephen P Rose 109, 118
Susana Misas Vargas 56

T

Tania Fariña Diaz 65
Tatiana C Aviles Vargas 45
Tatiana Ruiz-Cortés 77
Theodor Duifhuis Rivera 92
Tomás A Madrid-Garcés 41, 111, 118

V

Vasco Fitas da Cruz 30
Vasil R Pirgozliev 34, 109, 118
Verónica González Cadavid 90, 91, 94
Víctor H Herrera Franco 88, 91
Vinícius Fardin 110
Viviana L Cuarán 66
Viviana M Ramírez Navarro V 79
Viviana Parada Roa 117
Vladimir Tovar Urrea 64, 130

W

Wilmar A Botello 112, 114
Wilson D Rangel García 94
Wilyer Garcia Arboleda 66

X

Ximena M Guzmán Perlaza 132

Y

Yasser Y Lenis 146
Yeikot S Escobar Aguilar 69
Yenni C Mateus Moreno 92
Yeraldine Melo Pedroza 110
Yerelis K Anaya Bustos 120
Yesid Avellaneda Avellaneda 66
Yesid O González-Torres 82
Yury T Granja-Salcedo 113

Z

Zuhelen C Valencia Núñez 141