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Gluten-free cookies made with white carrot (*Arracacia xanthorrhiza* Bancr) and rice (*Oryza sativa*) flour

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Galletas sin gluten elaboradas con zanahoria blanca (*Arracacia xanthorrhiza* Bancr) y arroz (*Oryza sativa*)

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ABSTRACT

Keywords:
Gluten-free diet
Food safety
Nutritional value
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Sensory analysis
White carrot

White carrot (*Arracacia xanthorrhiza* Bancr) flour is a rich source of nutrients, dietary fiber, and antioxidants such as polyphenols, while rice (*Oryza sativa*) flour is valued for its flavor and emulsifying properties. This study aimed to develop gluten-free cookies by combining white carrot flour and rice flour. A completely randomized design with a factorial arrangement A×B was used, where factor A was the flour ratio and factor B was the dough resting time, resulting in six treatments with three replicates (18 experimental units). Physicochemical, sensory, and microbiological analyses were conducted. Statistical differences were determined using the Tukey test ($P<0.05$) with InfoStat software. The results of the physicochemical analysis showed that treatment T1 (90% carrot flour/10% rice flour + 10 min rest) had the highest values of protein (5.39%), fat (20.01%), and fiber (18.66%). In sensory evaluation, T1 also obtained the highest scores for odor (4.4), flavor (4.2), and texture (4.0). Microbiological results confirmed that counts for molds, yeasts, and mesophilic aerobic bacteria were below the permissible limits established by INEN 1529-10 and NTE INEN 1529-5 standards. In conclusion, the proportion of white carrot and rice flour significantly influenced the physicochemical and sensory qualities of the gluten-free cookies, demonstrating the potential of these ingredients in functional food formulations.

RESUMEN

Palabras clave:
Dieta sin gluten
Seguridad alimentaria
Valor nutricional
Productos a base de arroz
Análisis sensorial
Zanahoria blanca

La harina de zanahoria blanca (*Arracacia xanthorrhiza*) es una fuente rica en nutrientes, fibra dietética y compuestos antioxidantes como los polifenoles, mientras que la harina de arroz (*Oryza sativa*) se caracteriza por su sabor y capacidad emulsionante. El objetivo de este estudio fue elaborar galletas libres de gluten a partir de la combinación de harina de zanahoria blanca y harina de arroz. Se utilizó un diseño completamente al azar con un arreglo factorial A×B, donde el factor A fue la proporción de harinas y el factor B el tiempo de reposo de la masa, obteniendo seis tratamientos con tres repeticiones (18 unidades experimentales). Se realizaron análisis fisicoquímicos, sensoriales y microbiológicos. Las diferencias estadísticas se evaluaron mediante la prueba de Tukey ($P<0,05$) utilizando el software InfoStat. Los resultados del análisis fisicoquímico indicaron que el tratamiento T1 (90% harina de zanahoria/10% harina de arroz + 10 min de reposo) presentó los mayores valores de proteína (5,39%), grasa (20,01%) y fibra (18,66%). En la evaluación sensorial, T1 también destacó con puntajes más altos en olor (4,4), sabor (4,2) y textura (4,0). El análisis microbiológico mostró que los conteos de mohos, levaduras y aerobios mesófilos estuvieron por debajo de los límites permitidos según las normas INEN 1529-10 y NTE INEN 1529-5. En conclusión, la proporción de harinas influyó significativamente en las características fisicoquímicas y sensoriales de las galletas, demostrando el potencial de estos ingredientes en formulaciones de alimentos funcionales.

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For a long time, wheat flour has been widely used in the manufacture of various bakery products due to its gluten content. However, gluten consumption is associated with celiac disease (Ahmad et al. 2016), which has driven the need to develop safe, gluten-free alternatives, including cookies (Nieto-Mazzocco et al. 2018). One promising approach involves the use of unconventional flours such as white carrot (*Arracacia xanthorrhiza* Bancr.) flour and rice (*Oryza sativa* L.) flour for gluten-free product development.

White carrot (*Arracacia xanthorrhiza* Bancr.) is a tuberous root cultivated along the Andean Mountain range from Venezuela to northern Chile, notable for its geographic adaptability and classified into three varieties: white, yellow, and purple. In Ecuador, yields of up to 5,000 kg per hectare have been reported, with annual production reaching between 12,000 and 24,000 tons (Nayghit Carrero et al. 2018). Rich in starch, calcium, vitamin A, niacin, ascorbic acid, and phosphorus, white carrot flour is utilized in the production of breads, snacks, instant soups, desserts, beer, dog food, cookies, porridges, and functional foods for children (Mandrich et al. 2023).

The incorporation of fruits and vegetables into the food industry is increasingly valued for their content of dietary fiber, minerals, vitamins, antioxidants, and bioactive compounds (Bas-Bellver et al. 2024). Specifically, white carrot flour has been identified as a promising source of carbohydrates, bioactive compounds, and antioxidants such as polyphenols and carotenoids, which may confer functional properties (Jordán Villamar 2018).

In recent years, cereals have gained attention in the food industry due to their functional properties, including water absorption and retention, emulsification, and stability. Additionally, their high protein content enhances the nutritional value of food products (Pérez Ramos et al. 2017). Rice (*Oryza sativa* L.) flour, recognized for its neutral flavor and dough-forming capacity, is widely used in gluten-free products. It also serves as a suitable source of starch and quality protein, making it ideal for baked goods such as cookies (Almora-Hernández et al. 2023).

Cookies are among the most popular bakery products worldwide, with their diverse flavors and shelf life fostering continuous product development. The use of novel flours in cookie production has gained popularity due to their potential nutritional benefits (Ranasinhe et al. 2022).

Despite the growing interest in gluten-free bakery products, there is limited research on the combined use of white carrot and rice flours for cookie production. Therefore, this study aims to develop gluten-free cookies using white carrot (*Arracacia xanthorrhiza* Bancr.) flour and rice (*Oryza sativa* L.) flour, evaluating their potential to deliver nutritionally enhanced and functional bakery products that meet the increasing demand for gluten-free alternatives.

MATERIALS AND METHODS

The raw materials used in the study were purchased at the local market in the Quevedo canton, located in the Los Ríos province of Ecuador. The physicochemical and microbiological analysis were performed in the Biotechnology Laboratory of the "La María" experimental farm, part of the Quevedo State Technical University (UTEQ), located in the city of Quevedo (1.0285° S, 79.4603° W).

Experimental design

A complete randomized design with factorial arrangement AxB was applied, where factor A: ratio of white carrot flour -rice flour and factor B: dough rest, thus obtaining a total of six treatments with three replicates resulting in 18 experimental units. To determine statistical differences, a Tukey test ($P<0.05$) was applied using the InfoStat Software. The treatments are detailed in Table 1.

Table 1. Treatments for the development of gluten-free cookies using white carrot flour and rice flour.

Treatments	Description
T1	90% white carrot flour/10% rice flour +10 min.
T2	90% white carrot flour/10% rice flour +20 min.
T3	80% white carrot flour/20% rice flour +10 min.
T4	80% white carrot flour/20% rice flour +20 min.
T5	70% white carrot flour/30% rice flour +10 min.
T6	70% white carrot flour/30% rice flour +20 min.

Process for the elaboration of white carrot and rice flour-based cookies

The raw materials were received and visually checked to ensure they were free from damage. The white carrots were previously washed to remove impurities, cut into

2 mm pieces, placed in aluminum trays, and dehydrated in an oven for 24 h at 65 °C. This temperature was selected because it is below the gelatinization temperature of starch (typically 68–75 °C), preventing structural changes that could negatively affect the functionality of the flour. Once the white carrot flour was obtained, the following ingredients were mixed and homogenized using a mixer until a consistent dough was formed: vegetable shortening (60 g), egg (50 g), sugar (80 g), baking powder (5 g), coconut essence (2 mL), salt (1 g), white carrot flour (100 g), and rice flour (100 g). The dough was left to rest for 20 min to allow for proper hydration of the flours and to relax the structure, facilitating handling and improving the texture of the final baked product. Afterward, the dough was baked for 30 min at 150 °C and finally stored at room temperature (28 °C).

Physicochemical analysis of gluten-free cookies

Moisture content was determined according to the Ecuadorian Technical Standard NTE INEN 2 085 (INEN 2005). Ash content was obtained by incineration in a muffle furnace at 100 °C for 30 minutes, following the procedure established in NTE INEN (1981). Protein and fat contents were determined based on the reference methods NTE INEN 0523 (INEN 1980) and AOAC 21st ed. 920.87, respectively. Crude fiber was determined according to NTE INEN 522 (INEN 1981). Carbohydrate content was calculated by difference, subtracting the sum of moisture, ash, protein, fat, and fiber from 100. The energy value was estimated using the Atwater system, applying the following conversion factors: 4 kcal g^{-1} for protein, 9 kcal g^{-1} for fat, and 4 kcal g^{-1} for carbohydrates.

Sensory analysis

The sensory profiles were evaluated by a panel of 25 semi-trained evaluators, each of whom received a 10 g sample for analysis. The sensory evaluation employed a structured 5-point hedonic scale, where 5 represented “very liked” and 1 indicated “disliked.” The attributes evaluated included color, aroma, flavor, and overall acceptability.

Microbiological analysis

Mold and yeast analyses were performed on the treatment that presented the best sensory characteristics. These were carried out in certified laboratories using the methods described in the Ecuadorian Technical Standard NTE INEN 1529-10 (INEN 2013).

RESULTS AND DISCUSSION

According to Table 2 there were significant differences in moisture content (P<0.05), where T3 had a higher moisture content of 7.30%, while T5-T6 had a lower moisture content of 5.20. These values were lower than those obtained in the present study where cookies made from brown rice with the addition of Stevia obtained moisture values ranging from 4.43 to 3.96% (Almora-Hernández et al. 2023). Bazan-Aliaga et al. (2015) mention that obtaining a moisture content lower than 10%, significantly reduces the risk of spoilage by microorganisms and in turn prolongs the shelf life of the product.

The ash results showed similarity between treatments T2, T5, and T6, with a value of 3.7% where the highest content was observed. On the other hand, treatments T1, T3, and T4 showed the lowest contents with a value of 3.5%. Elías Silupu et al. (2021) emphasize that ash content is directly correlated with the percentages of minerals present in the raw material. In other research, values of 1.75 to 2.16% have been reported when replacing 50% with potato flour, indicating that increasing the percentage leads to an increase in ash content (Cerón et al. 2014).

Table 2. Physicochemical characterization of cookies.

Treatments	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fiber (%)	Energy (kcal)	Carbohydrates (%)
T1	6.24±0.01^{b}	3.5±0.01^{a}	5.39±0.01^{c}	20.01±0.01^{e}	18.66±0.01^{f}	5.13±0.01^{d}	46.17±0.01^{a}
T2	6.37±0.01^{c}	3.7±0.01^{b}	5.72±0.01^{e}	18.99±0.01^{d}	10.20±0.01^{a}	4.46±0.01^{a}	55.06±0.01^{e}
T3	7.30±0.01^{e}	3.5±0.01^{a}	5.44±0.01^{d}	18.07±0.02^{a}	11.29±0.01^{b}	4.46±0.01^{a}	54.44±0.01^{d}
T4	7.27±0.02^{d}	3.5±0.01^{a}	4.36±0.01^{a}	18.25±0.01^{c}	16.96±0.01^{e}	4.96±0.01^{b}	49.62±0.01^{b}
T5	5.20±0.01^{a}	3.7±0.02^{b}	5.44±0.01^{d}	18.89±0.01^{d}	13.64±0.01^{d}	5.01±0.01^{c}	53.11±0.01^{c}
T6	5.20±0.01^{a}	3.7±0.01^{b}	5.25±0.01^{b}	18.19±0.01^{b}	11.50±0.01^{c}	7.21±0.01^{e}	56.18±0.01^{f}

Table 2 shows the protein values, where it was noted that T2 is statistically different (*P*<0.05) from T6, showing a decrease with a value of 5.72 to 5.25%, respectively. In this way, it is highlighted that by using 70% white carrot flour/30% rice flour for a period of 20 min of rest, a greater loss was obtained. In several investigations, values between 3.60 to 6.05% were determined, indicating that the variation is associated with the percentage of carrot flour used (Sanaguano et al. 2017). On the other hand, the Ecuadorian Technical Standard INEN 2085:2005 specifies within the bromatological requirements for cookies a minimum protein content of 3%. This indicates that the cookies made from white carrot flour and rice are within the requirements of the standard.

Regarding fat content, variability was observed among the results of the treatments (*P*<0.05), showing that T1 had the highest value with 20.01%, compared to T3, which obtained a lower result with 18.07%. Aji Sunaryo et al. (2021) reported values from 7.6 to 9.22%, which were lower than those presented in this study. This difference can be attributed to the lower percentage of carrot flour used in their different formulations (10, 20, and 30%) in their research on the elaboration of pumpkin (*Cucurbita moschata Duchesne*) and carrot (*Daucus carota* L.) cookies. In relation to Ecuadorian regulations, according to the Norma Técnica Ecuatoriana NTE INEN 1415: (INEN 2011) ("Galletas y productos de panadería similares – Requisitos"), the maximum fat content recommended for cookies and similar products is 15%. The fat content values found in this study (18.07–20.01%) exceed this limit, classifying these samples as high-fat products. This higher fat content could influence the product's nutritional labeling and consumer acceptance, especially considering the Ministerio de Salud Publica recommendations to limit fat intake to reduce risks of cardiovascular diseases and obesity. Therefore, if these products are intended for commercialization within Ecuador, reformulation to reduce fat content or explicit labeling as high-fat products would be necessary to comply with national standards and protect consumer health.

In relation to fiber content, a significant increase was observed in T1 with 18.66%, being statistically different (*P*<0.05) compared to T3 with 10.20%, which showed a lower content. This suggests that by using a composition of 90% white carrot flour/10% rice flour, with a resting period of 10 minutes, the amount of fiber present in the sample is remarkably representative. This result was expected, since carrot flour increases the fiber content due to its richness in this nutrient (Santos et al. 2022). According to the literature, the fiber in carrot flour is predominantly insoluble, which contributes mainly to promoting intestinal transit and enhancing satiety. On the other hand, when using 20% carrot peel flour, a fiber content of 3.32% was found (Quitral et al. 2023). Consuming products rich in fiber is not only beneficial for health but also contributes to the feeling of satiety when consumed (Venegas et al. 2022).

Regarding energy content, the highest value was recorded in T6 with 7.21 kcal, which differs significantly (*P*<0.05) from treatments T2 and T3, which presented lower values with 4.96 kcal. This finding indicates that the inclusion of 30% rice flour significantly increases the energy content. According to research on the nutritional characteristics of commercially available cookies, an energy value of 471.86 per 100 g has been observed, mainly attributed to the presence of added sugars (Hoyos et al. 2020). Studies on cookies enriched with flaxseed, they provide an energy value of 383.04–397.59 kcal. It is necessary to mention that researchers mention that proteins should provide between 12–14% of the total of a diet (Benítez 2017).

A statistically significant effect (*P*<0.05) was observed in the percentage of carbohydrates among the evaluated treatments. Treatment T6, with 56.18%, showed a notable increase compared to T3, which registered the lowest percentage with 46.17%, positioning itself as the treatment with the lowest carbohydrate content. This highlights the influence of the treatments on carbohydrate content, underlining the variability observed in each one. On the other hand, in previous research, the incorporation of carrot flour in cookie production values ranging from 52.77 to 63.47% were reported. These values are consistent with those obtained in the present study (Kiin et al. 2021). In addition, carbohydrates play a crucial role in consumer food choice in relation to health. Previous research, such as the study on fig and oat flour-based cookies, highlights the importance of carbohydrates by constituting a significant part (49.79%) of the total product composition (Quelal 2023).

Sensory characterization

Through the evaluation of the sensory profiles of cookies made from carrot and rice flour (Figure 1), it was determined that T1 (90% carrot flour/10% rice flour +10 min) obtained the best scores for odor 4.4; flavor 4.2 and texture 4.0; while, T6 (70% carrot flour/30% rice flour +20 min) had the lowest scores in the odor and texture profiles 3.7. In general, O´Sullivan (2017) emphasizes that, to achieve success, a product must satisfy the consumer through sensory perceptions. According to the sensory analysis on brown rice-based cookies with moringa (*Moringa oleifera*) and stevia (*Stevia rebaudiana Bertoni*) conducted by Almora-Hernández et al. (2023) the cookies received moderate criticism in terms of their texture, specifically in terms of their ability to fracture and their level of crunchiness. Castro García et al. (2024) evaluated the sensory profile of cookies made with brown rice (*O. Sativa*), carob (Prosopis alba) and pigeon pea (*Cajanus cajan*), obtaining values of 4.2 color, 3.6 odor, 4.0 flavor, and 4.20 for texture, which are comparable to the results reported in this study. On the other hand, in studies of cookies based on carrot peel in concentrations of 5, 10, and 20%, in which a sensory characterization determined that including 20% in the formulation and preparation was significantly preferable (Quitral et al. 2023).

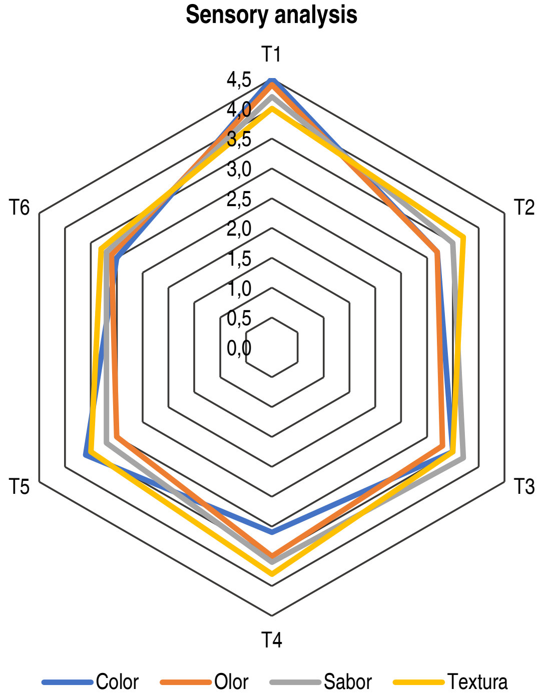

Figure 1. Sensory profile of gluten-free cookies made with white carrot flour and rice flour. The values represent the average scores given by the sensory panelists for each attribute (color, aroma, flavor, and texture).

Microbiological analysis

Microbiological analyzes were conducted on treatment T1 (90% carrot flour / 10% rice flour + 10 min), which showed the highest sensory acceptance. The results indicated that mesophilic aerobic bacteria, molds, and yeasts were within the acceptable limits established by the Ecuadorian Technical Standards NTE INEN 1529-10 (INEN 2013) and NTE INEN 1529-5 (INEN 2012) for microbiological control in food products. Specifically, the counts of viable molds and yeasts, determined by plate count with deep inoculation, were consistent with the regulatory thresholds (Table 3), confirming the microbiological safety of the cookies. Furthermore, according to Smelt and Brul (2014), the low presence of molds and yeasts may be attributed to the thermal treatment applied during baking, as these microorganisms are sensitive to high temperatures (189 °C), which significantly reduces their survival in the final product.

Table 3. Microbiological analysis of the best treatment of cookies made with white carrot flour and rice flour.

Treatments	Unit	Results	Method/Ref.
Molds and yeasts	UFC g^{-1}	$1.2x10^2$	Ecuadorian Technical Standards NTE INEN 1529-10 (2013) and NTE INEN 1529-5 (2012)
Mesophilic aerobes	UFC g^{-1}	30	

CONCLUSION

The incorporation of 90% white carrot flour and 10% rice flour in the formulation of gluten-free cookies (T1) significantly improved their nutritional composition, increasing protein (5.39%), fat (20.01%), and fiber content (18.66%) compared to other formulations. These values highlight the potential of white carrot flour as a functional ingredient for enhancing the nutritional profile of baked products. Additionally, the sensory analysis indicated high consumer acceptance in terms of odor, taste, and texture for treatment T1, making it the most preferred formulation. Microbiological evaluation confirmed the safety of the cookies, with mold, yeast, and mesophilic counts within acceptable limits according to Ecuadorian regulations. These results demonstrate that white carrot flour can be successfully used to develop nutritionally enhanced, microbiologically safe, and organoleptically acceptable gluten-free cookies. The study contributes to the diversification of gluten-free products using underutilized root crops with functional properties. Future research should focus on evaluating the shelf-life stability of cookies under different storage conditions, analyzing bioactive compound retention, and assessing consumer acceptance in broader demographic groups. Additionally, exploring the use of white carrot flour in other gluten-free baked goods could expand its applicability in the functional food industry.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

REFERENCES

Ahmad M, Ahmed-Wani T, Wani SM, Masoodi and Gani A (2016) Incorporation of carrot pomace powder in wheat flour: effect on flour, dough and cookie characteristics. Journal of Food Science and Technology 53(10): 3715-3724. https://doi.org/10.1007/s13197-016-2345-2

Aji Sunaryo N, Devi M, Saputri AM, Cahyani R (2021) Proximate analysis of pumpkin and carrot cookies International Conference on Life Sciences and Technology. https://doi.org/10.1063/5.0052617

Almora-Hernández E, Monteagudo-Borges R, Lago-Abascal V et al (2023) Evaluation physicochemical and sensory of enriched integral rice cookies with Moringa oleifera and Stevia rebaudiana. Tecnología Química 43(1):1-20. https://tecnologiaquimica.uo.edu.cu/index.php/tq/article/view/5309/4770

Bas-Bellver C, Barrera C, Betoret N, Segui L and Harasym J (2024) IV-Range Carrot Waste Flour Enhances Nutritional and Functional Properties of Rice-Based Gluten-Free Muffins. Foods 13(9). https://doi.org/10.3390/foods13091312

Bazan-Aliaga G, Gabrielli González R, Acosta Chinchayhuara D, Rojas Castillo JA et al (2015) Highly adaptable biscuits made from rice flour (*Oryza sativa*) and potato flour (*Solanum tuberosum*) var.parda pastasa. Agroindustrial Science *5*(1): 69-75. https://doi.org/10.17268/agroind.science.2015.01.07

Benítez B, Ortega J, Barboza M, Rangel Y, Romero L et al (2017) Formulation and physicochemical, microbiological, and sensory evaluation of biscuits enriched with flaxseed as a functional food. Venezuelan Archives of Pharmacology and Therapeutics. 36(4): 106-113. https://www.redalyc.org/pdf/559/55952806003.pdf

Castro García AI, Caicedo Hinojosa LA, Núñez Rodríguez PJ and Peñafiel Zamaro MJ (2024) Sensory and Food Evaluation of Brown Rice (*Oryza Sativa*), Carob (*Prosopis Alba*) and Pigeon Pea (*Cajanus Cajan*) Cookies.Journal of Science and Research 8(2). https://revistas.utb.edu.ec/index.php/sr/article/view/3133

Cerón Cardenas AF, Bucheli Jurado MA and Osorio Mora O (2014) Production of biscuits using potato flour from the Parda Pastusa variety (*Solanum tuberosum* L.). Acta Agronomica. 63(2). http://doi.org/10.15446/acag.v63n2.39575

Elías Silupu JW, García Rivas CE, Pérez Salcedo R and Yauris Silvera CV (2021) Physicochemical characterization of bread with partial replacement of wheat flour by germinated quinoa (*Chenopodium quinoa* willd) and Kiwicha (*Amaranthus caudatus* L.) flour. SENDAS 2(2): 69-83. https://doi.org/10.47192/rcs.v2i2.64

Hoyos Vázquez SM, García Castillo S, Rodríguez Delgado J and Praena Crespo M (2020) Nutritional characteristics and composition of cookies available on the Spanish market and cookies aimed at children. Primary Care Pediatrics. 22(86). https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1139-76322020000300004

INEN - Ecuadorian Institute of Standardization (1980) Ecuadorian Technical Standard NTE INEN 0523. Flours of vegetable origin, Fat determination.

INEN - Ecuadorian Institute for Standardization (1981) Ecuadorian Technical Standard NTE INEN 0520. Flours of vegetable origin. Determination of ash.

INEN - Ecuadorian Institute for Standardization (1981) Ecuadorian Technical Standard NTE INEN 522. Flours of vegetable origin. Determination of crude fiber.

INEN - Ecuadorian Institute of Standardization (2005) Ecuadorian Technical Standard NTE INEN 2 085. Cookies. Bramatological Requirements. Quito.

INEN - Ecuadorian Institute for Standardization (2012) Ecuadorian Technical Standard NTE INEN 1529-5. Microbiological control of food.

Determination of the quantity of mesophilic aerobic microorganisms. *Rep.* Quito. https://es.scribd.com/doc/240179897/1529-5-1-c-Mesofilos-Aerobios

INEN - Ecuadorian Institute of Standardization (2013) Ecuadorian Technical Standard NTE INEN 1529-10. Microbiological control of food: viable molds and yeasts, plate counts by deep seeding. Quito. https://es.scribd.com/document/488093112/1529-10-1R-MOHOS-Y-LEVADURAS-VIABLES-pdf

INEN - Ecuadorian Institute for Standardization (2011) Ecuadorian Technical Standard NTE INEN 1415:2011. Cookies and similar bakery products – Requirements. https://www.normalizacion.gob.ec

Jordán Villamar RE (2018) Development of a formula for an instant dessert using white carrot (*Arracacia xanthorrhiza* Bancroft) and pumpkin (*Cucurbita maxima* Duchesne) flours. [Degree thesis]. Catholic University of Santiago de Guayaquil, Guayaquil. Institutional repository. http://repositorio.ucsg.edu.ec/handle/3317/10198

Kiin Kabani D, Uzoamaka MC and Akuso O (2021) Production, Nutritional Evaluation and Acceptability of Cookies Made from a Blend of Wheat, African Walnut, and Carrot Flours. Asian Food Science Journal 20(6): 60-76. https://doi.org/10.9734/afsj/2021/v20i630310

Mandrich L, Valeria Esposito A, Costa S and Caputo E (2023) Chemical Composition, Functional and Anticancer Properties of Carrot. Moleculas 28(20). https://doi.org/10.3390/molecules28207161

Nayghit Carrero Y, Acosta M and Dávila M (2018) White carrot *(Arracacia xhanthorrhiza bancr)* potential phytopharmaceutical: mini-review. Clinical Research. 59(1): 109-111. https://www.researchgate.net/publication/326449587_ZANAHORIA_BLANCA_Arracacia_xhanthorrhiza_bancr_POTENCIAL_FITOFARMACO_MINI_REVISION

Nieto-Mazzocco E, Rangel Contreras A, Saldaña Robles A, Abraham Juárez and Ozuna C (2018) Characterization of gluten-free flours and their incorporation into bakery products. Research and Development in Food Science and Technology. 3(4): 1-8.

Pérez Ramos K, Penafiel CE and Delgado Soriano V (2017) High protein snack: an extruded product made from quinoa (*Chenopodium quinoa* Willd.), tarwi (*Lupinus mutabilis* Sweet) and sweet potato (*Ipomoea batatas* L.). Scientia Agropecuaria 8(4): 377-388. http://doi.org/10.17268/sci.agropecu.2017.04.09

Quelal Peralta ML (2023) Production of cookies based on fig flour (Ficus carica) and oat flour (*Avena sativa*) using three types of sweeteners (brown sugar, white sugar, and erythritol) for young adults aged 18–25 [Undergraduate thesis], Technical University of Ambato, Ambato. Institutional repository: https://repositorio.uta.edu.ec/bitstream/123456789/37915/1/CAL%20041.pdf

Quitral V, Flores M, Plaza K, Quezada F and Arce H (2023) Carrot peel flour as an ingredient in cookie making. Chilean Nutrition Journal. 50(2): 226-232. http://doi.org/10.4067/s0717-75182023000200226

Ranasinhe M, Manikas I, Maqsood S and Stathopoulos C (2022) Date Components as Promising Plant-Based Materials to Be Incorporated into Baked Goods—A Review. Sustaninability 14(2): 605. https://doi.org/10.3390/su14020605

Sanaguano Salguero H, Tigre León A, Bayas Morejón F and Ruilova B (2017) Nutritional value and sensory properties of cookies prepared from flour mixes of carrot (*Daucus carota*), Lupine (*Lupinus perennis*) and Barley (*Hordeum vulgare*). European Scientific Journal 13(9): 378-391.

Santos D, Lopes Da Silva J and Pintado M (2022) Fruit and vegetable by-products' flours as ingredients: A review on production process, health benefits and technological functionalities. LWT, 154(15). https://doi.org/10.1016/j.lwt.2021.112707

Smelt J and Brul S (2014) Thermal inactivation of microorganisms. Critical Reviews in Food Science and Nutrition 54(10): 1371-1385. https://doi.org/10.1080/10408398.2011.637645

O´Sullivan MG (2017) A handbook for sensory and consumer-driven new product development: Innovative technologies for the food and beverage industry. https://doi.org/10.1016/C2014-0-03843-9

Venegas C, Farfan Beltrán N, Bucchi C, Martínez Gomis J and Fuentes R (2022) Effect of chewing behavior modification on food intake, appetite and satiety-related hormones: A systematic review. Revista Chilena de Nutrición 49(6): 760-774. https://doi.org/10.4067/S0717-75182022000700760