*Rev. Colomb. Cienc. Quím. Farm.*, **54**(3), 658–678 (2025)

*Review article*

# Popular Brazilian medicinal plants for therapeutic use in combating Diabetes

André G. P. de Paula[1]*, Jordana D. de Lima[1]*, Camila Peitz[3], Rafael U. Veiga[1], Rebeca Bosso dos Santos Luz[1*], Leonel W. Junior[1], Victor H. Q. Bordenowski[4], Andressa K. da Fontoura[1], Amanda G. Somensi[1], Thalita S. Uada[1], Natália P. Fernandes[1], Juliana B.B. Maurer[3] & Tarcio Teodoro Braga[1,2]**

[1] Department of Pathology, Federal University of Parana, Brazil
[2] Graduate Program in Biosciences and Biotechnology, Institute Carlos Chagas, Fiocruz-Parana, Brazil
[3] Department of Biochemistry and Molecular Biology, Federal University of Parana, Brazil.
[4] University Tuiuti of Parana, Brazil

*These authors contributed equally
**Corresponding author E-mail: tarcio.braga@ufpr.br

Received: June 17, 2025
Corrected: July 5, 2025
Accepted: July 8, 2025

https://doi.org/10.15446/rcciquifa.v54n3.120983

**SUMMARY**

**Introduction:** Type 2 diabetes (T2D) is a chronic metabolic disorder characterized by persistent hyperglycemia. This condition is associated with a range of complications, including cardiovascular disease, nephropathy, and neuropathy, all of which arise due to the dysregulation of glucose and lipid metabolism. Plant-derived compounds have emerged as a promising source of novel therapeutic agents for the management of T2D. Their action dwells mainly in three key mechanisms: reduction of blood glucose levels, modulation of inflammation, and attenuation of lipid mobilization. Among the active constituents identified in various plant species, compounds such as terpenes, flavonoids, alkaloids, and phenolic acids have been recognized as important candidates for mitigating mechanisms that result in diabetic complications. However, many plant species, particularly those native to tropical regions such as Brazil, remain insufficiently studied, limiting the full exploration of their therapeutic potential. **Objectives:** This review highlights five Brazilian plant species that have demonstrated traditional use in the treatment of T2D: *Sphagneticola trilobata* (L.) Pruski Astereaceae, *Salvia officinalis* Linneaus Laminaceae, *Myrcia sphaerocarpa* DC Myrtaceae, *Eugenia jambolana* Lam., Myrtaceae, and *Bauhinia forficata* Link Fabaceae, as well as the compounds that might be responsible for their beneficial effects. **Conclusion:** Traditional Brazilian medicinal plants have been shown to exhibit a hypoglycemic effect, as well as increased insulin sensitivity, in tested animal models. Its low cost makes it an interesting research topic for Diabetes treatment.

***Keywords:*** Brazilian plants; diabetes; traditional medicine; alternative therapies.

**RESUMEN**

**Plantas medicinales brasileñas populares para uso terapéutico en la diabetes**

**Introducción:** La diabetes tipo 2 (DT2) es un trastorno metabólico crónico caracterizado por hiperglucemia persistente. Esta afección se asocia con diversas complicaciones, como enfermedades cardiovasculares, nefropatía y neuropatía, afecciones que surgen debido a la desregulación del metabolismo de

la glucosa y los lípidos. Se ha demostrado que los compuestos derivados de plantas constituyen una fuente prometedora de nuevos agentes terapéuticos para el tratamiento de la DT2. Estos compuestos actúan mediante tres mecanismos principales: reducción de la glucemia, modulación de la inflamación y atenuación de la movilización de lípidos. Los componentes caracterizados pertenecen a las clases de flavonoides, alcaloides y ácidos fenólicos, y son candidatos potenciales para el tratamiento de las complicaciones de la diabetes. Sin embargo, varias especies de plantas, en particular las nativas de regiones tropicales como Brasil, han sido poco estudiadas. **Objetivos**: Esta revisión destaca cinco especies de plantas brasileñas de uso tradicional en el tratamiento de la diabetes tipo 2: *Sphagneticola trilobata* (L.) Pruski Astereaceae, *Salvia officinalis* Linneaus Laminaceae, *Myrcia sphaerocarpa* DC Myrtaceae, *Eugenia jambolana* Lam., Myrtaceae y *Bauhinia forficata* Link Fabaceae, así como sus componentes que podrían ser responsables del beneficio terapéutico. **Conclusión**: Las plantas tradicionales brasileñas mostraron un efecto hipoglucemiante y un aumento de la sensibilidad a la insulina en modelos animales evaluados. Se requieren más estudios para explorar el potencial terapéutico de estas plantas, principalmente por su bajo costo.

***Palavras clave:*** Plantas brasileñas; diabetes; medicina tradicional; terapias alternativas.

**RESUMO**

**Plantas medicinais brasileiras populares, para o uso terapêutico na Diabetes**

Diabetes tipo 2 (DT2) é um distúrbio metabólico crônico caracterizado por hiperglicemia persistente. Essa condição é associada com uma variedade de complicações, incluindo doenças cardiovasculares, nefropatia, e neuropatia, condições que surgem por conta da desrregulação da glicose e do metabolismo lipídico. Compostos derivados de plantas têm são uma fonte promissora de novos agentes terapêuticos para o tratamento da DT2. Estes compostos atuam em 3 mecanismos principais: redução da glicemia, modulação da inflamação e atenuação da mobilização lipídica. Os componentes caracterizados são pertencentes das classes de flavonoides, alcaloides e ácidos fenólicos, são potenciais candidatos para o tratamento das compliações da diabetes. No entanto, várias espécies de plantas, particularmente nativas de regiões tropicais como o Brasil, são pouco estudadas. **Objetivos:** Essa revisão destaca cinco espécies de plantas brasileiras que possuem uso tradicional no tratamento da DT2: *Sphagneticola trilobata* (L.) *Pruski Astereaceae*, *Salvia officinalis* Linneaus Laminaceae, *Myrcia sphaerocarpa* DC Myrtaceae, *Eugenia jambolana* Lam., Myrtaceae e *Bauhinia forficata* Link Fabaceae, assim como seus components que podem ser responsáveis pelo benefício terapêutico. **Conclusão:** Plantas tradicionais brasileiras mostraram um efeito hipoglicêmico e um aumento da sensibilidade da insulina, em modelos animais testados. Mais estudos são essenciais para explorar o potencial terapêutico destas plantas, principalmente por possuírem um baixo custo.

***Palavras-chave:*** Plantas brasileiras; diabetes; medicina tradicional; terapias alternativas.

## 1. INTRODUCTION

Type 2 diabetes (T2D) is a condition characterized by an excess of glucose in the bloodstream, which can lead to various diseases. The incidence and prevalence of T2D have reached high levels, causing the disease to be categorized as an epidemic. In the current scenario, it is estimated that by 2045, around 629 million people will be diabetic [1]. Moreover, the life-threatening risk of T2D does not result directly from the condition itself but rather from the complications it triggers [2]. Among them, elevated glucose levels lead to endothelial dysfunction, contributing to cardiovascular and renal diseases. Also, insulin resistance exacerbates glucose uptake inefficiency, leading to hyperglucagonemia. Increased lipid mobilization, in turn, results in hypertriglyceridemia and inflammasome activation, which drive the production of IL-

1β in the context of T2D [3]. A direct consequence is the synthesis of other pro-inflammatory mediators, increasing IL-6 and TNF-$\alpha$, further amplifying inflammation.

At the molecular level, prolonged glucose exposure can lead to the formation of advanced glycation end products (AGEs), which are linked to tissue damage and chronic inflammation. Hyperglycemia also stimulates the production of reactive oxygen species (ROS), negatively affecting mitochondrial metabolism [4]. Additionally, the shift from glucose to lipid metabolism, common in advanced diabetes, increases blood concentrations of ketone bodies, byproducts of lipid breakdown, among many other affected pathways [5]. While genetic predisposition plays a significant role in the development of T2D [6], environmental factors can reduce this risk. Beyond the traditional strategies, such as limited carbohydrate intake and regular physical exercise, the use of plant compounds shows potential in modulating the metabolic and inflammatory responses associated with T2D [7].

Accordingly, many plants have been described as influencing different mechanisms of T2D [8], and represent high accessibility due to their low cost [9, 10]. However, Brazilian plants show off an immense diversity and still lack studies regarding their impact on T2D mitigation. In this sense, this review described the cellular and molecular mechanisms influenced by the five commonly used plant extracts for treating T2D in Brazil: *Sphagneticola trilobata*, *Salvia officinalis*, *Myrcia sphaerocarpa*, *Eugenia jambolana*, and *Bauhinia forficata* (Table 1), with a focus on the active compounds present in each extract.

## 2. BRAZILIAN MEDICINAL PLANTS USED IN COMBATING DIABETES

### 2.1. *Sphagneticola trilobata*

The species *Sphagneticola trilobata,* described by L. Pruski, of the Asteraceae family, is also known as *Wedelia brasiliensis* (Spreng.) S.F. Blake, or *Wedelia paludosa* DC., or even *Wedelia trilobata* A.St. -Hil, and is commonly found in various parts of the world, such as South America and Asia [11]. In Brazil, it is known as *arnica-do-brejo*, *arnica-do-mato, vedélia, mal-me-quer do brejo, margaridão* and *insulina* vegetal [12, 13]. The literature highlights several popular uses of *S. trilobata* due to its broad biological activity, including antioxidant, anti-inflammatory, antimicrobial, hypoglycemic, analgesic, and larvicidal activities. These biological activities are attributed to its abundance in secondary metabolites, which include phenolic compounds, flavonoids, saponins, terpenoids, diterpenes, triterpenes, sesquiterpenes, cycloterpenes, benzene derivatives, and phytosterols such as stigmasterol [14-16], mainly in the leaves [17].

Popularly, *S. trilobata* is used as a complementary treatment for diabetes, by drinking its leaves tea [18-23]. The most widely cited characteristic of *S. trilobata* in diabetes is its hypoglycemic potential [18, 23-25], although this plant can present a very long list of promising pharmacological effects, ranging from antiviral, antibacterial, and antiparasitic activity to antioxidant, anti-inflammatory, and even antitumor activity [16, 26]. It was observed that oral administration of the ethanolic extract of *Wedelia trilobata* flowers in diabetic rats for 8 weeks reduced blood glucose levels [24]. The aqueous extract from the dried and ground leaves of *S. trilobata* administered to rats with induced diabetes for 30 days also showed a reduction in blood glucose levels [27].

The first antidiabetic mechanism observed in the use of *S. trilobata* extracts is related to the inhibitory potential of the $\alpha$-amylase and $\alpha$-glucosidase enzymes. Inhibition of these enzymes results in impaired digestion of carbohydrates, which consequently reduces glucose absorption and lowers blood glucose levels [28-34]. Extracts produced from the solvents ethyl acetate,

methanol, and water obtained $\alpha$-amylase inhibition rates of 52.29%, 88.38%, and 63.57%, respectively [35]. The concentration of 40 $\mu g.mL^{-1}$ of the extract produced from the whole plant in different solvents resulted in inhibition of 75% of the $\alpha$-glucosidase enzyme [36]. Although it is not clear which compounds are responsible for the enzymatic inhibition in *S. trilobata*, the study on another plant, *Withania somnifera*, which shares the 3-hydroxycavicol 1-[rhamnosyl-(1->6)-glucoside], suggested that this compound is responsible for such inhibition [34]. Bioinformatic studies suggests that camelianin A, also present in the composition of *S. trilobata*, may interact directly with $\alpha$-glucosidase, acting as a competitor for carbohydrate binding [37].

A second mechanism of action of *S. trilobata* extracts on glucose metabolism is the possibility of influencing insulin production or sensitivity. Unfortunately, most of the studies that have tested this herbal extract have induced diabetes through streptozotocin, a compound that selectively ablates pancreatic β-cells [24, 27]; while very few induce diabetes through a metabolic disorder, by using high glucose or high-fat diet, which will closely resemble type 2 diabetes [38]. Here, *S. trilobata* diminished glycemia by avoiding apoptosis of β-pancreatic cells by the action of a compound called 3,4-dicaffeoyl-1,5-quinolactone, tested in *Pluchea indica* extracts, shared with *S. trilobata* [39]. Still focusing on compounds that are present in *S. trilobata* but were tested in other plant extracts, the action of terpenes was described to decrease glycogenolysis by the liver and muscles, which was tested in herbal extracts from *Byrsonima crassifolia* [40]. Importantly, synergic effects should be considered for the investigation regarding the mechanism of action of these compounds, which still highlights the importance of testing if the previously cited mechanisms are also found when cells or animals are exposed to diabetic conditions together with *S. trilobata* extracts.

Another mechanism influenced by *S. trilobata* extracts is related to reduced damage caused by hyperglycemia, such as inflammatory and oxidative processes. A compound called (3$\alpha$)-3-(tiglinoyloxy)-ent-kaur-16-en-19-oic acid (WT-29) was described as able to modulate inflammation in LPS-stimulated macrophages by decreasing iNOS and COX-2 [41], and altering the Nrf2/NfκB balance [41, 42]. In addition to WT-29 decreasing cytokine production, probably the compound (+)-7-epi-Syringaresinol 4'-glucoside is contributing to this effect, being the decrease of TNF-$\alpha$, IL-1β, and IL-6 is reported in experiments testing another plant that shares this compound with *S. trilobata*, the *Mitragyna speciose* [38]. Still, the presence of *S. trilobata* extract performed an anti-proteinase activity [43], which might indicate why this extract was related to wound healing [44] and indicate its role in diminishing glucotoxicity-induced tissue damage. In animal models, *S. trilobata* ethanolic extracts performed an antioxidant role [24], while other experiments report inhibition of catalase, delta aminolevulinic acid dehydratase, and isoforms of lactate dehydrogenase [27].

### 2.2. *Salvia offcinalis*

*Salvia officinalis* is a plant from the Lamiaceae family, native to the Middle East and Mediterranean regions, now is distributed worldwide [45]. The main phytochemicals extracted from the plant are primarily obtained from its flowers, leaves, and stems, presenting a diverse composition of chemical compounds with pharmacological potential [46]. Numerous extraction techniques are employed, with essential oils, alcoholic and aqueous extracts, and infusions being the most prominent [47]. The essential oil extracted from the leaves contains a high concentration of bicyclic terpenes such as $\alpha$-thujone, β-thujone, camphor, and $\alpha$-pinene [48, 49]. This extract has demonstrated antibacterial, antioxidant, anti-inflammatory, and hypoglycemic properties [50, 51].

Alcoholic and aqueous extracts from the leaves have resulted in high concentrations of phenolic compounds and flavonoids, as well as the presence of anthraquinones, saponins, steroids, tannins, and resins. Together, these substances have exhibited antioxidant, antifungal, anti-inflammatory, hypoglycemic, and analgesic properties [52-55]. On the other hand, infusions have demonstrated concentrations of phenolic acids, flavonoids, terpenes, hydroxybenzoic acids, and hydroxycinnamic acids [56]. These extracts have shown an antioxidative profile, enhancing GST and γ-GCS in mice [57]. Moreover, infusions have been found to prevent increases in body weight while decreasing total cholesterol (TC), triglycerides (TG), and LDL cholesterol (LDL-C) in mice [58].

In *in vitro* models, the sequential crude extraction of the stems and leaves of *Salvia officinalis* was assessed for its activation of the PPARγ pathway. It was demonstrated that different extracts, such as α-linolenic acid and 12-O-methyl carnosic acid, act as PPARγ agonists, mainly favoring the release of adiponectin, which enhances insulin sensitivity (**Figure 1**) [59]. Furthermore, *in vitro* studies revealed that its leaves and stems extracts, obtained through decoction in a hydro-methanolic mixture, exhibited antidiabetic activity by inhibiting the enzymes α-amylase and α-glucosidase, which are responsible for carbohydrate digestion and monosaccharide hydrolysis, respectively [60].

*Salvia officinalis* is a plant recognized for its broad spectrum of chemical components, with antioxidant to antibacterial actions. Studies in mice have shown that oral administration of an aqueous extract of leaves increased the activity of oxidizing enzymes while reducing inflammatory mediators [61]. Additionally, its effects give the plant notable properties, especially its hypoglycemic effects in T2D individuals [62]. Several studies have shown that *Salvia officinalis* is a viable option for reducing glycemic indices in T2D models [63]. In a murine model of T2D associated with obesity, oral supplementation with an aqueous extract of leaves at two different doses (150 mg/kg and 300 mg/kg) resulted in an 8.18% and 19.16% reduction in glucose levels, respectively. In addition, insulin levels decreased by 30.88% and 49.26%, while adiponectin levels and antioxidant enzymes such as GSH and SOD increased. A reduction in inflammatory cytokines, including TNF-α, IL-6, and MCP-1, along with an increase in GLUT-4 expression, was also observed [64].

In humans, a randomized, double-blind, placebo-controlled, parallel-group study was conducted to evaluate the efficacy of *Salvia officinalis* in the treatment of T2D. The aqueous extract of leaves was concentrated, completely evaporated, and encapsulated at a dosage of 500 mg, while the placebo group received capsules containing toast powder [65]. Both groups were using metformin, glyburide, and atorvastatin in addition to the treatment with *Salvia officinalis* extract and placebo. A significant reduction in glycemic indices was observed in patients treated with the extract compared to placebo, including an 11% decrease in fasting glucose levels, a 23% decrease in postprandial glucose, and a 6.9% decrease in glycated hemoglobin [66, 67].

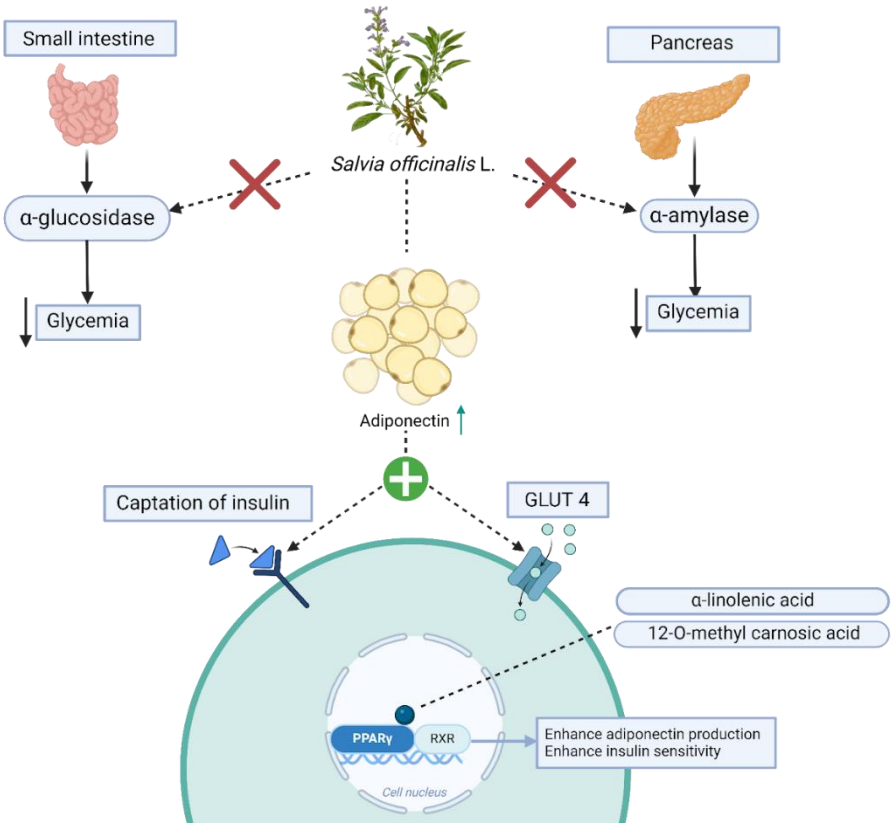


**Figure 1. Hypoglycemic effects of *Salvia officinalis*.** Inhibition of α-glucosidase and α-amylase leads to reduced glucose absorption, activation of PPARγ, enhanced insulin sensitivity, and increased production of adiponectin, which promotes glucose regulation and fatty acid oxidation. These pathways contribute to improved glycemic control.

In conclusion, *Salvia officinalis* exhibits a diverse profile of molecules with a wide spectrum of biological activities, ranging from anti-inflammatory to hypoglycemic effects. Its various extracts have shown similar activities, warranting further research to describe their mechanisms and potential stabilization for future treatments.

### 2.3. *Myrcia sphaerocarpa*

*Myrcia sphaerocarpa* is a shrub widely used in the treatment of diabetes by indigenous tribes in the Amazon region of Brazil. *Myrcia sphaerocarpa*, scientifically also known as *Myrcia multiflora* or *Eugenia multiflora*, has the popular name of "pedra hume caá" and is a plant species rich in phytochemicals with therapeutic potential for T2D [68]. Among the phytochemicals present in *Myrcia sphaerocarpa* extracts are flavonoids, antioxidants capable of reducing the damage caused by reactive oxygen species during cell metabolism [69]. Leaves are the parts of the plant most used for medicinal purposes, and aqueous/methanolic extracts can be produced by maceration, sonication, filtration, and infusion methods [70]. The molecular composition of *Myrcia sphaerocarpa* leaf extracts can induce hypoglycemic and antioxidant effects. The compounds that stand out are flavanone myrciacitrins I-II, the flavonols myrciacitrins, mearnsitrin, quercetin, desmantin-1, guaijaverin, and the acetophenone glycoside myrciaphenone.

The glycosides are molecules whose presence in the extract also may explain the medicinal function of this plant due to their ability to inhibit aldose reductase and α-glucosidase [71]. The alpha-glucosidase enzyme is a digestive enzyme and is present in the human intestine, acting in the degradation of carbohydrates [72], producing monosaccharides that can be absorbed by

the intestine, such as glucose, fructose, and galactose [73]. By inhibiting its activity, there is a reduction in glucose uptake and post-prandial hyperglycemia [74]. Therefore, the inhibition of these enzymes from the aqueous extracts of the plant may be the main factor responsible for the therapeutic potential of *Myrcia sphaerocarpa* [75], since it exhibited more inhibitory behavior than acarbose, an intestinal alpha-glucosidase inhibitor drug [70].

Oliveira and colleagues observed that after administering dried extracts of the leaves, mice showed a 74.7% reduction in glycemic levels when compared to animals without the treatment, in a streptozocin-induced diabetes model. Long-term administration of the extract showed that the antidiabetic function was preserved, and further analysis showed a synergistic nephroprotective and hepatoprotective effect [76]. In addition to hypoglycemic effects, compounds isolated from *M. sphaerocarpa*, such as phloroacetophenone (THA), may have hypolipidemic and anti-obesity effects by reducing triglyceride absorption and inhibiting pancreatic lipase [71]. THA has effects related to increased activity of cholesterol 7$\alpha$-hydroxylase, a fundamental enzyme in lipid regulation by converting cholesterol into bile acid [77]. Reductions in oxidative damage related to this compound were also observed, which was able to normalize the activity of antioxidant enzymes, such as catalase, glutathione peroxidase, and superoxide dismutase in mice with oxidative liver damage induced by carbon tetrachloride ($CCl_4$) [78].

### 2.4. *Eugenia jambolana*

The plant known as Jamun (*Eugenia jambolana*), belonging to the Myrtaceae family and native to India, has a rich and diverse constitution. This plant is constituted by minerals, carbohydrates, and phytochemicals with broad pharmacological properties, such as flavonoids, terpenes, and anthocyanins [79]. Its fruits, which can be round, oblong, or ellipsoidal, are highly nutritious and an excellent source of sodium, calcium, phosphorus, iron, and zinc, as well as water-soluble vitamins like vitamin C, thiamine, and niacin [80]. The Jamun plant, popularly known as jambul, is recognized for its numerous properties, including antioxidant, antibacterial, and antifungal potential, as well as contributing to the supplementation of vitamins and minerals [79]. In addition to these qualities, Jamun possesses significant immunomodulatory potential, exhibiting anti-inflammatory, gastroprotective, and hypoglycemic characteristics. These aspects highlight the medical and therapeutic potential of the plant in treating various pathologies that affect many individuals [81].

The traditional use of Jamun involves processing various parts of the plant. The hydroalcoholic, aqueous, or methanolic extract of the leaves is frequently utilized for its antibacterial properties [82]. Methanolic and ethyl acetate extracts from the seeds also exhibit antibacterial activity, while aqueous, ethanolic, and acetone extracts from the bark demonstrate immunomodulatory and antibacterial effects, as well as antifungal properties [83]. Additionally, the essential oil extracted from the leaves shows a direct impact on bacteria such as *Staphylococcus aureus* and *Escherichia coli* [84].

The pharmacological effects of the plant are varied: studies show that the antioxidant potential of the pulp extract inhibited iron-induced lipid peroxidation ($FeSO_4$) in the brain, liver, and testes of rats [85]. In addition, *Eugenia jambolana* was reported as presenting an antioxidant, metal chelating, and cytoprotective activity through chromatographic analysis, metal chelation assays, allelopathy, and cytoprotection tests both in eukaryotic and prokaryotic models. Therefore, it could be used as a new strategy against toxic metal pollution [81].

Its anti-inflammatory pharmacological potential was evidenced by the compound kaempferol-7-O-$\alpha$-L-rhamnopyranoside isolated from the leaves, which, at doses of 3, 10, and

30 mg.kg$^{-1}$, attenuated edema and reduced the levels of MPO, TNF-$\alpha$, and IL-1$\beta$ in mice with carrageenan-induced edema [86]. This compound also demonstrated significant antinociceptive effects in mice, inhibiting acetic acid-induced writhing and paw licking behavior in the formalin test, without presenting analgesic activity in central pain models. Additionally, it reduced the levels of TNF-$\alpha$ and IL-1$\beta$ in cultures of RAW 264.7 cells stimulated with LPS, corroborating its potential as a valuable analgesic agent and supporting its use in traditional medicine for the treatment of inflammatory pain [87].

Some effects, not yet widely explored, have already been reported in the literature, i.e., Jamun extract improved diet-induced obesity, hepatic steatosis, and insulin resistance in HFD fed mice, in addition to modulating the intestinal microbiota to reduce the ratio of Firmicutes:Bacteroidetes and increase the relative abundance of beneficial genera, such as Alistipes, Prevotella, Bacteroides, Alloprevotella, and Clostridium XIVb [88]. The methanolic extract of *Eugenia jambolana* seeds demonstrated hepatoprotective effects in Wistar rats treated with carbon tetrachloride ($CCl_4$), significantly preventing the increase in serum levels of SGOT, SGPT, ALP, ACP and bilirubin, in addition to promoting liver regeneration in a dose-dependent process, a fact that reveals its potential as a therapeutic agent for liver protection and recovery against induced toxicity [89].

*Eugenia jambolana* directly impacts glycemic levels, especially in patients with T2D. Aqueous extracts of the plant, administered to severely diabetic rabbits, resulted in a 37.1% reduction in fasting blood glucose, demonstrating a significant effect in critical conditions [90]. Furthermore, the study indicated an increase in plasma insulin levels following the administration of the seed extract, which may be attributed to the conversion of proinsulin to insulin, presumably mediated by the functionality of pancreatic cathepsin B. The extract also demonstrated a reduction in ceruloplasmin levels in diabetic rats, promoting a decrease in circulating unbound $Fe^{2+}$, resulting in reduced lipid peroxidation and attenuation of inflammatory damage and complications associated with T2D [91].

Additionally, the plant *Eugenia jambolana* exhibits important immunomodulatory properties, effectively providing therapeutic action against inflammatory and metabolic alterations. The use of the extract derived from its bark promotes a reduction in the secretion of inflammatory mediators, such as cytokines, prostaglandins, bradykinin, and others, aiding in a pro-resolutive immune response in adverse situations [92]. Therefore, *Eugenia jambolana* stands out not only for its antibacterial, antifungal, and antioxidant properties but also as a potential therapeutic agent in immune modulation, functioning as an analgesic and anti-inflammatory source (**Figure 2**). Further research is needed to fully elucidate the underlying mechanisms of these effects, establishing a solid foundation for future clinical applications.

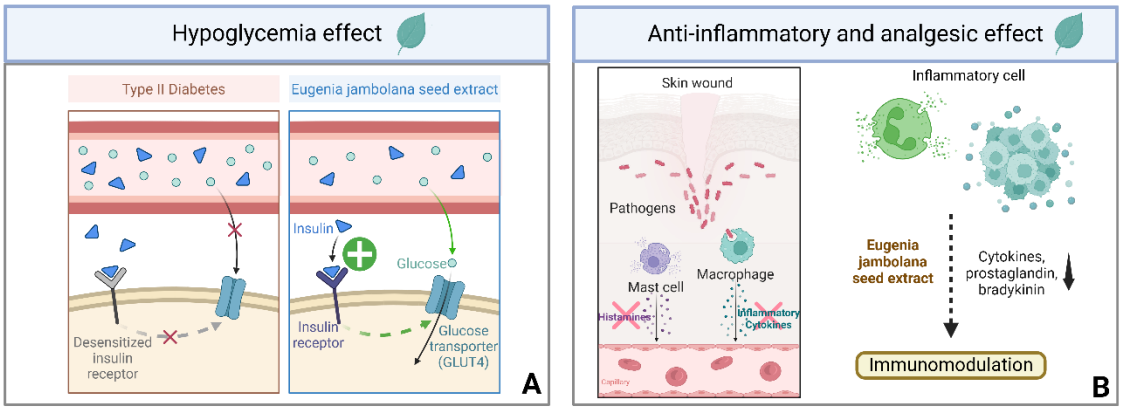


**Figure 2. Pharmacological action of compounds present in *Eugenia jambolana* extract.** *Eugenia jambolana* exhibits multiple therapeutic effects, as illustrated in the figure. A) The hypoglycemic effect of the plant is emphasized, leading to increased insulin secretion and improved glucose uptake, contributing to the regulation of blood glucose levels. B) The plant shows anti-inflammatory and analgesic action, reflected in the decrease of inflammatory cytokines and the reduction of inflammatory cell presence, supporting its potential as a therapeutic agent in inflammatory conditions. Source: Biorender.

### 2.5. *Bauhinia forficata*

*Bauhinia forficata*, popularly known as "cow's foot" due to the shape of its leaves, composed of two leaflets joined at the base [93], is a plant of the Fabaceae subfamily, whose leaves are popularly used in Brazil and Mexico for T2D treatment [94-100].

The anti-diabetic effects of the leaf extract of *B. forficata* are associated with the presence of polyphenols and flavonoids, which would contribute to the antioxidant, anti-glycation, and enzymatic inhibition capabilities observed [98, 101, 102]. The main polyphenol compounds are kaempferol derivatives, such as kaempferol-3-O-arabinoiside, kaempferol-3-O-(2-rhamnosyl) rutinoside, kaempferol-3-O-rutinoside, astragalin, and specially kaempferitrin (kaempferol-3,7-O-($\alpha$)-dirhamnoside) [97, 98, 101, 102]. Myrcetin and quercetin (like quercetin-3-O-(2-rhamnosyl) rutinoside and quercetin-3-O-rutinoside) derivatives are other anti-diabetes secondary metabolites found in high concentrations, where the last one results in enzymatic inhibition [96, 101-103]. In addition, it presents predominantly alkaloids, saponins, quinones, reducing sugars, and tannins, which can also contribute to the effects associated [97]. When separating the leaves fractions (dichloromethane, hexane, water, ethyl acetate, and n-butanol), the last two fractions (and water to some extent) have most of the phenolic, condensed tannins, and flavonoid composition, both with quercetin (like isorhamnetin-3-o-glucoside) and kaempferol derivatives. The two fractions have the best anti-diabetes activity [96]. Nevertheless, the contents of the leaf extracts can vary depending on the region. Extracts from two different regions in the south of Brazil had different flavonoid concentrations, including the kaempferitrin composition [94].

Studies involving *Bauhinia forficata* mainly use rodent models, such as rats and mice, to evaluate the therapeutic effects of the extracts. The streptozotocin (STZ)-induced diabetes model in rats is commonly used to test the hypoglycemic and antioxidant effects of the plant's extracts [98, 104]. *Bauhinia forficata* extracts are usually administered orally in animal models, reflecting their traditional use as infusions or decoctions of the plants' leaves [105]. Studies generally use standardized doses of the aqueous and hydroalcoholic extracts, administered daily for periods ranging from days to weeks [106].

In some cases, it is administered intraperitoneally, especially in studies that require a more direct and rapid action of the extract. The doses administered can vary, but the most common range is between 100 and 500 $mg.kg^{-1}$ of body weight, depending on the objective of the experiment [97, 107, 108]. Treatment with the extract results in a lower conversion rate of food intake into body weight in mice. This is associated with its predominantly polyphenol composition, which increases thermogenesis and fat oxidation. In addition, *Bauhinia forficata* leaves slowly down the development of T2D in mice. However, the extract is unable to reverse the low functional capacity of β-cells in these mice [98]. There are also promising results in patients with T2D. Ninety-two patients, aged between 18 and 75, were treated with *Bauhinia forficata* leaves capsules (2% flavonoids), using a placebo as a control. Those who received the capsules had lower plasma levels of fasting glucose, glycated hemoglobin, C-reactive protein, and IL-6. However, the plant used in this clinical trial did not contain kaempferitrin, due to the plant's regional origin [103].

The compounds present in *Bauhinia forficata* act differently to insulin and sulphonylurea drugs, which stimulate insulin secretion by pancreatic β-cells. This supports the hypothesis that this plant has substances with anti-insulin action, capable of increasing the effectiveness of residual insulin in diabetic patients [99]. The mechanism of action of the plant's extracts, widely used in the treatment of T2D, is closely linked to the inhibition of digestive enzymes, such as $\alpha$-amylase, $\alpha$-glucosidase, and lipase [96]. By inhibiting these enzymes, the plant's bioactive compounds, especially flavonoids such as quercetin, kaempferol, and isoquercetin, slow down the digestion of carbohydrates and lipids, limiting the absorption of glucose and fatty acids, which directly contributes to the control of postprandial hyperglycemia and hyperlipidemia [96, 100].

*Bauhinia forficata* has proven hypoglycemic activity in pharmacological studies, mainly due to the action of compounds such as kaempferitrin, rutin, and trigonelline. Kaempferitrin plays a central role in promoting glucose uptake in skeletal muscle by stimulating the translocation of the GLUT4 glucose transporter to the cell membrane [109]. This process is associated with the reactivation of the classic insulin transduction pathway, which not only facilitates GLUT4 translocation but also promotes the secretion of adiponectin, a protein hormone that suppresses the pathophysiological events associated with the development of T2D [105].

In addition, the activation of several insulin signaling pathways, including phosphoinositide 3-kinase (PI3K), protein kinase B (PKB), atypical protein kinase C (PKC) and the mitogen-activated protein kinase (p38 MAPK) pathway, plays a crucial role in regulating glucose uptake and glycogen synthesis in skeletal muscle and liver [109, 110]. Given the mechanism of action observed, *Bauhinia forficata* can be classified as a partial agonist of the insulin signaling pathway. Although it does not replace the action of endogenous insulin, kaempferitrin improves its function by stimulating the pathways related to glucose uptake and metabolism. This effect aids glycemic control in patients with T2D, especially those with insulin resistance, without directly competing with insulin at the receptors, but by optimizing the natural processes of glycolysis and gluconeogenesis [109].

*Bauhinia forficata* has also demonstrated immunomodulatory effects that play an important role in controlling T2D, one of the main mechanisms being its ability to reduce systemic inflammation, a common characteristic of diabetic patients, often associated with insulin resistance [105]. The bioactive compounds in *Bauhinia forficata*, such as flavonoids, can reduce the production of pro-inflammatory cytokines, such as TNF-$\alpha$ and IL-1, which are known to promote inflammation, contributing to insulin resistance and the deterioration of pancreatic β cells [111].

The plant's anti-inflammatory potential extends to the modulation of cellular components of the immune system, such as the proliferation of T lymphocytes and the activity of enzymes involved in the arachidonic acid pathway, such as phospholipase A2, cyclooxygenase, and lipoxygenase, favoring glycemic control and combating the chronic inflammation associated with the disease [111]. Therefore, the modulation of these inflammatory mediators suggests that the plant can improve insulin sensitivity and promote more effective glycemic control, preventing the worsening of chronic inflammation associated with T2D [112]. In addition, its antioxidant compounds, such as quercetin, neutralize ROS generated by chronic hyperglycemia, protecting pancreatic β-cells, which are essential for insulin production, and reducing oxidative stress, a key factor in cell dysfunction and the development of complications such as neuropathies and cardiovascular diseases [99].

**Table 1.** Mechanism of action of the molecules present in medicinal plant extracts.

| **Plant** | *Sphagneticola trilobata* | | | | | | | **Reference** |
|---|---|---|---|---|---|---|---|---|
| *Salvia officinalis* L. | camelianin A | Wedtriloside A, Wedtriloside B, and 3,4-dihydroxy-cinnamic acid | 9β-hydroxy-ent-kaur-16-en-19-oic acid, Pterokaurene L3 and 3α-tigloyloxy-9β-hydroxy-ent-kaur-16-en-19-oic acid | **Part obtained** | **Extract** | **Model** | **Route of administration** | **Mechanism of action** |
| phenolic acids, flavonoids, terpenes, hydroxybenzoic acids, and hydroxycinnamic acids | - | dry leaves | whole plant | leaves | high polarity solvents | *In vitro* test | addition to the reaction | α-glucosidase inhibitory activity | [113] |
| leaves | - | methanol | high polarity solvents | aqueous | *In vitro* test | *In vitro* test | addition to the reaction | α-amilase inhibitory activity | [33] |
| aqueous | - | *In silico* test | *In vitro* test | mice | *In silico* test | bioinformatic studies | α-glucosidase receptor agonist in carbohydrates | [37] |
| mice | *In silico* test | bioinformatic studies | addition to the reaction | oral administration | bioinformatic studies | α-glucosidase receptor agonist in carbohydrates | Prevent increases in body weight while decreasing total cholesterol, triglycerides, and LDL cholesterol | [52, 56, 58] |
| oral administration | bioinformatic studies | α-glucosidase receptor agonist in carbohydrates | Prevent increases in body weight while decreasing total cholesterol, triglycerides, and LDL cholesterol | [52, 56, 58] | | | | |

| *Eugenia jambolana* Lam. | *Myrcia sphaerocarpa* | | | | |
|---|---|---|---|---|---|
| kaempferol-7-O-α-L-rhamnopyranoside | Flavanone myrciacitrins I-II, the flavonols myrciacitrins, mearnsitrin, quercetin, desmantin-1, guaijaverin and the acetophenone | - | - | - | α-linolenic acid and 12-O-methyl carnosic acid |
| leaves | leaves | leaves | leaves | Stem and leaves | stem and leaves |
| - | aqueous/methanol | aqueous | aqueous | methanol | aqueous |
| mice | - | human | murine | *In vitro* test | *In vitro* test |
| - | - | oral administration | oral administration | addition to the reaction | addition to the reaction |
| Attenuated edema and reduced the levels of MPO, TNF-α and IL-1β | Inhibit aldose reductase and α-glucosidase | Reduction in glycemic indices, decrease in fasting glucose levels, decrease in postprandial glucose and decrease in glycated hemoglobin | Reduction in glucose levels, insulin levels decreased adiponectin levels and antioxidant enzymes such as GSH and SOD increased. A reduction in inflammatory cytokines, including TNF-α, IL-6, and MCP-1, along with an increase in GLUT-4 expression | Inhibiting the enzymes α-amylase and α-glucosidase, which are responsible for carbohydrate digestion and monosaccharide hydrolysis, respectively | Act as PPARγ agonists, mainly favoring the release of adiponectin, which enhances insulin sensitivity |
| [86] | [71] | [65-67] | [64] | [60] | [59] |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | - | seed | aqueous | rabbit, rat | - | Reduction in fasting blood glucose, increase in plasma insulin levels and reduction in ceruloplasmin levels | [90, 91] |
| *Bauhinia forficate* Link | flavonoids | leaves | aqueous | human | oral administration | Lower plasma levels of fasting glucose, glycated hemoglobin, C-reactive protein and IL-6 | [103] |
| | kaempferitrin, rutin and trigonelline | - | - | - | - | Promoting glucose uptake in skeletal muscle by stimulating the translocation of the GLUT4 glucose transporter to the cell membrane | [105, 109] |
| | quercetin | - | - | - | - | Neutralize ROS generated by chronic hyperglycemia, protecting pancreatic β-cells | [99] |

All the plants covered in the study, defining the main molecules observed in the works cited, and their actions against T2D.

## 3. CONCLUSION

Medicinal plants stand out as alternative forms of therapy for T2D due to their accessibility and are options for regions where access to conventional medicine is precarious. Extracts obtained from plants have bioactive properties with promising potential for metabolic regulation, inflammatory and antioxidant modulation. Extracts of *Sphagneticola trilobata, Salvia officinalis, Myrcia sphaerocarpa, Eugenia jambolana,* and *Bauhinia forficata* have been shown to have a hypoglycemic effect in various animal models, an effect resulting from the inhibition of digestive enzymes or increased insulin sensitivity. Further studies into the effects of medicinal plant extracts on humans are necessary in order to demonstrate their efficacy and safety in therapeutic use.

The accessibility and low cost of these plants are advantages for the development of new phytotherapeutic drugs, increasing access to patients in need of public health, as well as valuing traditional knowledge. Despite the advances in the knowledge about these plants, the development of new drugs requires robust clinical studies to guarantee the efficacy and safety of medicinal plants. The present review sheds light on the field of plants that can be used in the T2D treatment. A better understanding of the plant-derived compounds could, therefore, be applied for diabetic treatment.

## STATEMENT DECLARATIONS

**Competing interest:** The authors declare that there is no conflict of interest.

**Data availability:** Data availability not applicable to the manuscript.

**Founding statement:** No foundings were received for this manuscript.

**Ethics statement:** Not applicable to the manuscript.

**Dual publication:** This manuscript is not published or under consideration elsewhere.

**Authorship:** All authors read the journal policies and are in accordance with it.

## REFERENCES

1. M. Laakso. Biomarkers for Type 2 Diabetes. *Mol. Metab.*, **27**, S139–S146 (2019). Doi: https://doi.org/10.1016/j.molmet.2019.06.016
2. G.M. Samgir, G.A. Gaikwad & P. Yewale. Costus Ignus: Insulin plant and it's preparations as remedial approach for diabetes mellitus. *Int. J. Pharm. Sci.*, **2**(7), 976–983 (2024). URL: https://www.ijpsjournal.com/assetsbackoffice/uploads/article/Costus+Ignus+Insulin+Plant+And+Its+Preparations+As+Remedial+Approach+For+Diabetes+Mellitus.pdf
3. X. Chen, D. Zhang, Y. Li, W. Wang, W. Bei & J. Guo. NLRP3 inflammasome and IL-1β pathway in type 2 diabetes and atherosclerosis: Friend or foe? *Pharmacol. Res.*, **173**, 105885 (2021). Doi: https://doi.org/10.1016/j.phrs.2021.105885
4. A. Singh, R. Kukreti, L. Saso & S. KukretiS. Pathways and type 2 diabetes. *Molecules*, **27**(3), 950 (2022). Doi: https://doi.org/10.3390/molecules27030950
5. X. Lu, Q. Xie, X. Pan, R. Zhang, X. Zhang, G. Peng, Y. Zhang, S. Shen & N. Tong. Type 2 diabetes mellitus in adults: Pathogenesis, prevention and therapy. *Signal Transduct. Target. Ther.*, **9**(1), 262 (2024). Doi: https://doi.org/10.1038/s41392-024-01951-9
6. J.B. Meigs. The genetic epidemiology of type 2 diabetes: Opportunities for health translation. *Curr. Diab. Rep.*, **19**(8), 62 (2019). Doi: https://doi.org/10.1007/s11892-019-1173-y
7. Brasil. Ministério da Saúde. *Cadernos de Atenção Básica - Práticas Integrativas e Complementares: Plantas Medicinais e Fitoterapia Na Atenção Básica.* Brasília (DF), 2012; 154 p. URL: https://www.gov.br/saude/pt-br/composicao/saps/pics/publicacoes/cab-pics/view
8. J. Lee, S. Noh, S. Lim & B. Kim. Plant extracts for type 2 diabetes: From traditional medicine to modern drug discovery. *Antioxidants*, **10**(1), 81 (2021). Doi: https://doi.org/10.3390/antiox10010081
9. C.M. Carvalho-Lopes, S.M.R.R. Lima, E.C. de Arruda-Veiga, J.M. Soares-Jr & E.C. Baracat. Phytotherapeutic medicines: Reality or myth? *Rev. Assoc. Med. Bras.*, **65**(3), 292–294 (2019). Doi: https://doi.org/10.1590/1806-9282.65.3.292
10. C.C. Falzon & A. Balabanova. Phytotherapy: An introduction to herbal medicine. *Prim. Care: Clin. Off. Pract.*, **44**(2), 217–227 (2017). Doi: https://doi.org/10.1016/j.pop.2017.02.001
11. V.P. Lawane, R. Dipti & P.H. Chaudhary. A comprehensive review on *Sphagneticola trilobatal*. *International Journal of Pharmaceutical Research and Applications*, **9**(2), 1378–1389 (2024). URL: https://www.researchgate.net/publication/379993013_A_Comprehensive_Review_on_Sphagneticola_Trilobatal
12. K. Lang, J. Corrêa, F. Wolff, G.F. da Silva, A. Malheiros, V.C. Filho, *et al.* Biomonitored UHPLC-ESI-QTOF-MS$^2$ and HPLC-UV thermostability study of the aerial parts of *Sphagneticola trilobata* (L.) Pruski, Asteraceae. *Talanta*, **167**, 302–309 (2017). Doi: https://doi.org/10.1016/j.talanta.2017.02.024

13. C.A. Araújo, C.S.A. Morgado, A.K.C. Gomes, A.C.C. Gomes & N.K. Simas. Asteraceae family: A review of its allelopathic potential and the case of *Acmella oleracea* and *Sphagneticola trilobata*. *Rodriguésia*, **72**, e01622020 (2021). Doi: https://doi.org/10.1590/2175-7860202172137
14. N. Balekar, T. Nakpheng & T. Srichana. *Wedelia trilobata* L.: A phytochemical and pharmacological review. *Chiang Mai J. Sci.*, **41**(3), 590–605 (2014). URL: https://www.thaiscience.info/journals/Article/CMJS/10932829.pdf
15. A.G.B. Leite, E.T.N. Farias, A.P. de Oliveira, R.E.F. de Abreu, M.M. da Costa, J.R.G. Almeida, *et al.* Phytochemical screening and antimicrobial activity testing of crude hydroalcoholic extract from leaves of *Sphagneticola trilobata* (Asteraceae). *Cienc. Rural* (Santa Maria), **49**(4), e20180639 (2019). Doi: https://doi.org/10.1590/0103-8478cr20180639
16. M.T. Ali, D.A. Al-Mahdy, A.M.E. Fishawy & A.M. Otify. *Sphagneticola trilobata* (L.) Pruski: An updated exploration of its traditional applications, taxonomy, phytochemical profile and pharmacological properties. *South African J. Bot.*, **174**, 183–207 (2024). Doi: https://doi.org/10.1016/j.sajb.2024.08.060
17. S. Labhade, S. Jain, S. Chitlange & S. Sharma. LC/MS characterization of secondary metabolites of *Sphagneticola trilobata* J. F Pruski leaves. *Journal of Pharmaceutical Negative Results*, **14**(3), 1278–1283 (2023). Doi: https://doi.org/10.47750/pnr.2023.14.03.171
18. A. Balkrishna, R. Shankar, V. Arya, L. Mohammad, A. Kumar, H. Sharma, *et al.* Medicinal plants from Gangetic plains of West Bengal and Yoga for the management of lifestyle diseases. *Plants J.*, **12**(2), 11–18 (2024). Doi: https://doi.org/10.22271/plants.2024.v12.i2a.1648
19. A. Ghosh, S. Das, K. Jana, B. Debnath, J. Das & S. Mondal. The power of nature in managing diabetes: A database of ethno indigenous plants in India. *J. Nat. Remedies*, **24**(3), 475–521 (2024). Doi: https://doi.org/10.18311/jnr/2024/33431
20. M. Trojan-Rodrigues, T.L.S. Alves, G.L.G. Soares & M.R. Ritter. Plants used as antidiabetics in popular medicine in Rio Grande Do Sul, southern Brazil. *J. Ethnopharmacol.*, **139**(1), 155–163 (2012). Doi: https://doi.org/10.1016/j.jep.2011.10.034
21. A.P. Schmitz, P. Weimer, A.M. Weschenfelder, A.W. Hansen, R.W. Maluf, R.C. Rossi, *et al. In vitro* cytotoxic and genotoxic effects of *Cissus verticillata* and *Sphagneticola trilobata* used for treatment of diabetes mellitus in Brazilian folk medicine. *Acta Scientiarum - Biol. Sci.*, **43**, e56549 (2021). Doi: https://doi.org/10.4025/actascibiolsci.v43i1.56549
22. A.M. Feijó, M.E.N. Bueno, T. Ceolin, C.L. Linck, E. Schwartz, C. Lange, *et al.* Plantas medicinais utilizadas por idosos com diagnóstico de diabetes mellitus no tratamento dos sintomas da doença. *Rev. Bras. Plantas Med.*, **14**(1), 50–56 (2012). Doi: https://doi.org/10.1590/S1516-05722012000100008
23. M.A.M. Lemões, M. Jacondino, T. Ceolin, R.M. Heck, R.L. Brabieri & R.A Machado. The use of the plant *Sphagneticola trilobata* farmers affected by diabetes mellitus. *Rev. Pesq.: Cuid. Fundam. Online*, **6**(2), 776–784 (2012). URL: https://seer.unirio.br/cuidadofundamental/article/view/1592/pdf_485
24. N. Buddhakala & C. Talubmook. Toxicity and antidiabetic activity of ethanolic extract of *Sphagneticola trilobata* (L.) Pruski flower in rats. *J. Ethnopharmacol.*, **262**, 113128 (2020). Doi: https://doi.org/10.1016/j.jep.2020.113128
25. M.R. Faisal, N.W.O. Amanda, D.A. Mursidah, D. Mahdiyah & B.H. Mukti. Antidiabetic potential screening of ulin fruit extract (*Eusideroxylon Zwageri*) against streptozotocin-induced diabetic rats. *Indones. J. Pharm. Sci. Technol.*, **1**(1), 1–8 (2022). Doi: https://doi.org/10.24198/ijpst.v1i1.36621
26. N. Villa-Ruano, E. Lozoya-Gloria & Y. Pacheco-Hernández. Kaurenoic acid: A diterpene with a wide range of biological activities. *Stud. Nat. Prod. Chem.*, **51**, 151–174 (2016). Doi: https://doi.org/10.1016/B978-0-444-63932-5.00003-6
27. I.J. Kade, N.B.V. Barbosa, E.O. Ibukun, A.P. Igbakin, C.W. Nogueira & J.B.T. Rocha. Aqueous extracts of *Sphagneticola trilobata* attenuates streptozotocin-induced hyperglycaemia in rat models by modulating oxidative stress parameters. Biol. Med., **2**(3), 1–13 (2010). URL: https://www.researchgate.net/publication/286266434_Aqueous_extracts_of_Sphagneticola_trilobata_attenuates_streptozotocin-induced_hyperglycaemia_in_rat_models_by_modulating_oxidative_stress_parameters

28. L. Gong, D. Feng, T. Wang, Y. Ren, Y. Liu & J. Wang. Inhibitors of $\alpha$-amylase and $\alpha$-glucosidase: Potential linkage for whole cereal foods on prevention of hyperglycemia. *Food Sci. Nutr.*, **8**(12), 6320–6337 (2020). Doi: https://doi.org/10.1002/fsn3.1987
29. H. Kashtoh & K.-H. Baek. New insights into the latest advancement in $\alpha$-amylase. *Plants*, **12**(16), 2944 (2023). Doi: https://doi.org/10.3390/plants12162944
30. N. Kaur, V. Kumar, S.K. Nayak, P. Wadhwa, P. Kaur & S.K. Sahu. Alpha-amylase as molecular target for treatment of diabetes mellitus: A comprehensive review. *Chem. Biol. Drug Des.*, **98**(4), 539–560 (2021). Doi: https://doi.org/10.1111/cbdd.13909
31. T.-P. Lam, N.-V.N. Tran, L.-H.D. Pham, N.V.-T. Lai, B.-T.N. Dang, N.-L.N. Truong, *et al.* Flavonoids as dual-target inhibitors against $\alpha$-glucosidase and $\alpha$-amylase: A systematic review of *in vitro* studies. *Nat. Products Bioprospect.*, **14**(1), 4 (2024). Doi: https://doi.org/10.1007/s13659-023-00424-w
32. R. Tundis, M.R. Loizzo & F. Menichini. Natural products as α-amylase and α-glucosidase inhibitors and their hypoglycaemic potential in the treatment of diabetes: An update. *Mini-Rev. Med. Chem.*, **10**(4), 315–331 (2010). Doi: https://doi.org/10.2174/138955710791331007
33. N.T. Luyen, P.T. Binh, P.T. Tham, T.M. Hung, N.H. Dang, N.T. Dat & N.P. Thao. Wedtrilosides A and B, two new diterpenoid glycosides from the leaves of Wedelia trilobata (L.) Hitchc. with $\alpha$-amylase and $\alpha$-glucosidase inhibitory activities. *Bioorg. Chem.*, **85**, 319–324 (2019). Doi: https://doi.org/10.1016/j.bioorg.2019.01.010
34. A.S. Ponath, D.R. Volz, E.S. Suyenaga, A.L. Ziulkoski & M.S. Perassolo. Assessment of potential *in vitro* toxicity of *Cissus sicyoides* L. and *Wedelia paludosa* DC. leaves water extracts. *Toxicol. Res.* (Camb), **11**(5), 881–890 (2022). Doi: https://doi.org/10.1093/toxres/tfac066
35. S. Kurapati, R.K. Pallapatti, S. Kanikaram & H.B. Bollikolla. A quantitative estimation of phytochemicals, anti-diabetic and anti-oxidant activities of crude extracts of *Sphagneticola trilobata* (L.) and *Adathoda vasica* Linn., *Journal of Natural Products and Resources*, **4**(1), 155–159 (2018). Doi: https://doi.org/10.30799/jnpr.054.18040101
36. J. Chethan, P.M. Pradeep-Kumar & H.S. Prakash. Antidiabetic and antihypertensive potential of selected *Asteraceae* plant species. *Am. J. Adv. Drug Deliv.*, **2–3**, 355–363 (2014). URL: https://www.primescholars.com/articles/antidiabetic-and-antihypertensive-potential-of-selected-asteraceae-plant-species.pdf
37. J. Jia, L. Bai, Y. Chen & B. Liu. Inhibitory mechanism of Camellianin A against $\alpha$-glucosidase: *In vitro* and molecular simulation studies. *Foods*, **13**(17), 2835 (2024). Doi: https://doi.org/10.3390/foods13172835
38. L. Chen, S. Fei & O.J. Olatunji. LC/ESI/TOF-MS characterization, anxiolytic and antidepressant-like effects of *Mitragyna speciosa* Korth extract in diabetic rats. *Molecules*, **27**(7), 2208 (2022). Doi: https://doi.org/10.3390/molecules27072208
39. J. Nopparat, A. Nualla-Ong & A. Phongdara. Ethanolic extracts of *Pluchea indica* (L.) leaf pretreatment attenuates cytokine-induced β-cell apoptosis in multiple low-dose streptozotocin-induced diabetic mice. *PLoS One*, **14**(2), e0212133 (2019). Doi: https://doi.org/10.1371/journal.pone.0212133
40. R.M. Pérez-Gutiérrez & A. Muñiz-Ramirez. Hypoglycemic effects of sesquiterpene lactones from *Byrsonima crassifolia*. *Food Sci. Biotechnol.*, **25**(4), 1135–1145 (2016). Doi: https://doi.org/10.1007/s10068-016-0182-8
41. J. Xu, Z. Wang, L. Sun, Y. Wang, Y. Wang & X. He. (3$\alpha$)-3-(Tiglinoyloxy)-ent-kaur-16-en-19-oic acid, isolated from *Wedelia trilobata* L., exerts an anti-inflammatory effect via the modulation of NF-KB, MAPK and MTOR pathway and autophagy in LPS-stimulated macrophages. *Toxicology in vitro*, **73**, 105139 (2021). Doi: https://doi.org/10.1016/j.tiv.2021.105139
42. R. Wang, J. Zeng, L. Chen, L. Sun, Y. Wang, J. Xu & X. He. Diterpenoid WT-29 isolated from Wedelia exerted anti-inflammatory and anti-allergic activities. *J. Ethnopharmacol.*, **319**(Part 2), 117265 (2024). Doi: https://doi.org/10.1016/j.jep.2023.117265
43. M. Govindappa, S. Naga-Sravya, M.N. Poojashri, T.S. Sadananda, C.P. Chandrappa, G. Santoyo, *et al.* Antimicrobial, antioxidant and in vitro anti-inflammatory activity and phytochemical screening of water extract of *Wedelia trilobata* (L.) Hitchc. *J. Med. Plant Res.*, **5**(24), 5718–5729 (2011). URL: https://academicjournals.org/article/article1381318404_Govindappa%20et%20al.pdf

44. A. Shedoeva, D. Leavesley, Z. Upton & C. Fan. Wound healing and the use of medicinal plants. *Evidence-based Complement. Altern. Med.*, **2019**, 684108 (2019). Doi: https://doi.org/10.1155/2019/2684108
45. M. Jug-Dujaković, M. Ristić, D. Pljevljakušić, Z. Dajić-Stevanović, Z. Liber, K. Hančević, *et al.* High diversity of indigenous populations of Dalmatian sage (*Salvia officinalis* L.) in essential-oil composition. *Chem. Biodivers.*, **9**(10), 2309–2323 (2012). Doi: https://doi.org/10.1002/cbdv.201200131
46. M. Mohammadhosseini. Chemical composition of the volatile fractions from flowers, leaves and stems of *Salvia mirzayanii* by HS-SPME-GC-MS. *J. Essent. Oil-Bearing Plants*, **18**(2), 464–476 (2015). Doi: https://doi.org/10.1080/0972060X.2014.1001185
47. A. Ghorbani & M. Esmaeilizadeh. Pharmacological properties of *Salvia officinalis* and its components. *J. Tradit. Complement. Med.*, **7**(4), 433–440 (2017). Doi: https://doi.org/10.1016/j.jtcme.2016.12.014
48. A. Porte, R.L.O. Godoy & L.H. Maia-Porte. Chemical composition of Sage (*Salvia officinalis* L.) essential oil from the Rio de Janeiro State (Brazil). *Rev. Bras. Pl. Med.* (Campinas), **15**(3), 438–441 (2013). Doi: https://doi.org/10.1590/s1516-05722013000300018
49. Z. Jažo, M. Glumac, V. Paštar, S. Bektić, M. Radan & I. Carev. Chemical composition and biological activity of *Salvia officinalis* L. essential oil. *Plants*, **12**(9), 1794 (2023). Doi: https://doi.org/10.3390/plants12091794
50. S. Maache, L. Zbadi, A. El-Ghouizi, N. Soulo, H. Saghrouchni, F. Siddique, *et al.* Antioxidant and antimicrobial effects of essential oils from two salvia species with *in vitro* and *in silico* analysis targeting 1AJ6 and 1R4U proteins. *Sci. Rep.*, **13**(1), 14038 (2023). Doi: https://doi.org/10.1038/s41598-023-41178-2
51. G. Zhumaliyeva, A. Zhussupova, G.E. Zhusupova, E. Błońska-Sikora, A. Cerreto, N. Omirbekova, *et al.* Natural compounds of *Salvia* L. genus and molecular mechanism of their biological activity. *Biomedicines*, **11**(12), 3151 (2023). Doi: https://doi.org/10.3390/biomedicines11123151
52. C.F. Lima, P.C.R. Valentao, P.B. Andrade, R.M. Seabra, M. Fernandes-Ferreira & C. Pereira-Wilson. Water and methanolic extracts of *Salvia officinalis* protect HepG2 cells from T-BHP induced oxidative damage. *Chem.-Biol. Interact.*, **167**(2), 107–115 (2007). Doi: https://doi.org/10.1016/j.cbi.2007.01.020
53. M.S. Abu-Darwish, C. Cabral, I.V. Ferreira, M.J. Gonçalves, C. Cavaleiro, M.T. Cruz, T.H. Al-Bdour & L. Salgueiro. Essential oil of common sage (*Salvia officinalis* L.) from Jordan: Assessment of safety in mammalian cells and its antifungal and anti-inflammatory potential. *BioMed Res. Int.*, **2013**, 538940 (2013). Doi: https://doi.org/10.1155/2013/538940
54. R. Kadhim, N.H. Ali & D. Aziz-Ibrahim. Enzymatic effectiveness of alcoholic and aqueous extract of *Salvia officinalis* in mice poisoned with tetrachloride. *Arch. Razi Inst.*, **76**(6), 1777–1786 (2021). Doi: https://doi.org/10.22092/ARI.2021.356239.1812
55. A.N.A. Abad, M.H.K. Nouri & F. Tavakkoli. Effect of *Salvia officinalis* hydroalcoholic extract on vincristine-induced neuropathy in mice. *Chin. J. Nat. Med.*, **9**(5), 354–358 (2011). Doi: https://doi.org/10.3724/SP.J.1009.2011.00354
56. B.F. Zimmermann, S.G. Walch, L.N. Tinzoh, W. Stühlinger & D.W. Lachenmeier. Rapid UHPLC determination of polyphenols in aqueous infusions of *Salvia officinalis* L. (Sage tea). *J. Chromatogr. B: Anal. Technol. Biomed. Life Sci.*, **879**(24), 2459–2464 (2011). Doi: https://doi.org/10.1016/j.jchromb.2011.06.038
57. C.F. Lima, P.B. Andrade, R.M. Seabra, M. Fernandes-Ferreira & C. Pereira-Wilson. The drinking of a *Salvia officinalis* infusion improves liver antioxidant status in mice and rats. *J. Ethnopharmacol.*, **97**(2), 383–389 (2005). Doi: https://doi.org/10.1016/j.jep.2004.11.029
58. D. Hernández-Saavedra, I.F. Pérez-Ramírez, M. Ramos-Gómez, S. Mendoza-Díaz, G. Loarca-Piña & R. Reynoso-Camacho. Phytochemical characterization and effect of *Calendula officinalis*, *Hypericum perforatum*, and *Salvia officinalis* infusions on obesity-associated cardiovascular risk. *Med. Chem. Res.*, **25**(1), 163–172 (2016). Doi: https://doi.org/10.1007/s00044-015-1454-1

59. K.B. Christensen, M. Jørgensen, D. Kotowska, R.K. Petersen, K. Kristiansen & L.P. Christensen. Activation of the nuclear receptor PPARγ by metabolites isolated from sage (*Salvia officinalis* L.). *J. Ethnopharmacol.*, **132**(1), 127–133 (2010). Doi: https://doi.org/10.1016/j.jep.2010.07.054
60. S. Mahdi, R. Azzi & F.B. Lahfa. Evaluation of *in vitro* α-amylase and α-glucosidase inhibitory potential and hemolytic effect of phenolic enriched fractions of the aerial part of *Salvia officinalis* L. *Diabetes Metab. Syndr. Clin. Res. Rev.*, **14**(4), 689–694 (2020). Doi: https://doi.org/10.1016/j.dsx.2020.05.002
61. U.K. Kolac, M.C. Ustuner, N. Tekin, D. Ustuner, E. Colak & E. Entok. The anti-inflammatory and antioxidant effects of *Salvia officinalis* on lipopolysaccharide-induced inflammation in rats. *J. Med. Food*, **20**(12), 1193–1200 (2017). Doi: https://doi.org/10.1089/jmf.2017.0035
62. S. Behradmanesh, F. Derees & M. Rafieian-Kopaei. Effect of *Salvia officinalis* on diabetic patients. *J. Renal Inj. Prev.*, **2**(2), 51–54 (2013). Doi: https://doi.org/10.12861/jrip.2013.18
63. A.A. Rashed & D.-N.G. Rathi. Bioactive components of *Salvia* and their potential antidiabetic properties: A review. *Molecules*, **26**(10), 3042 (2021). Doi: https://doi.org/10.3390/molecules26103042
64. D.A. Alsherif, M.A. Hussein & S.S. Abuelkasem. *Salvia officinalis* improves glycemia and suppresses pro-inflammatory features in obese rats with metabolic syndrome. *Curr. Pharm. Biotechnol.*, **25**(5), 390–399 (2023). Doi: https://doi.org/10.2174/1389201024666230811104740
65. S. Kianbakht & F.H. Dabaghian. Improved glycemic control and lipid profile in hyperlipidemic type 2 diabetic patients consuming *Salvia officinalis* L. leaf extract: a randomized placebo. Controlled clinical trial. *Complement. Therap. Med.*, **21**(5), 441–446 (2013). Doi: https://doi.org/10.1016/j.ctim.2013.07.004
66. S. Kianbakht, F. Nabati & B. Abasi. *Salvia officinalis* (Sage) leaf extract as add-on to statin therapy in hypercholesterolemic type 2 diabetic patients: A randomized clinical trial. *Int. J. Mol. Cell. Med.*, **5**(3), 141–148 (2016). URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC5125366/
67. C. Liu, W. Wang & J. Gu. Targeting ferroptosis: New perspectives of Chinese herbal medicine in the treatment of diabetes and its complications. *Heliyon*, **9**(12), e22250 (2023). Doi: https://doi.org/10.1016/j.heliyon.2023.e22250
68. C. Ulbricht. Focus: Diabetes. *J. Diet. Suppl.*, **8**(3), 239–256 (2011). Doi: https://doi.org/10.3109/19390211.2011.597975
69. M. Machado-Pereira & G.D. Piovezana-Bossolani. O uso de flavonoides no tratamento do diabetes mellitus tipo 2. *RevisSAJES: Revista Saúde Viva Multidisciplinar da AJES*, **3**(4), jul/dez (2020). URL: https://revista.ajes.edu.br/revistas-noroeste/index.php/revisajes/article/view/25
70. M. Figueiredo-González, C. Grosso, P. Valentão & P.B. Andrade. α-Glucosidase and α-amylase inhibitors from *Myrcia* Spp.: A stronger alternative to acarbose? *J. Pharm. Biomed. Anal.*, **118**, 322–327 (2016). Doi: https://doi.org/10.1016/j.jpba.2015.10.042
71. M.M. Cascaes, G.M.S.P. Guilhon, E.H. de Aguiar-Andrade, M.d.G. Bichara-Zoghbi & L. da Silva-Santos. Constituents and pharmacological activities of *Myrcia* (Myrtaceae): A review of an aromatic and medicinal group of plants. *Int. J. Mol. Sci.*, **16**(10), 23881–23904 (2015). Doi: https://doi.org/10.3390/ijms161023881
72. J. Vinholes & M. Vizzotto. Synergisms in alpha-glucosidase inhibition and antioxidant activity of *Camellia sinensis* L. Kuntze and *Eugenia uniflora* L. ethanolic extracts. *Pharmacog. Res.*, **9**(1), 101–107 (2017). Doi: https://doi.org/10.4103/0974-8490.197797
73. S.A. Tucci, E.J. Boyland & J.C.G. Halford. The role of lipid and carbohydrate digestive enzyme inhibitors in the management of obesity: A review of current and emerging therapeutic agents. *Diabetes, Metab. Syndr. Obes. Targets Ther.*, **3**, 125–143 (2010). Doi: https://doi.org/10.2147/dmso.s7005
74. W. Guo, J. Yun, B. Wang, S. Xu, C. Ye, X. Wang, *et al.* Comparative study on physicochemical properties and hypoglycemic activities of intracellular and extracellular polysaccharides from submerged fermentation of *Morchella esculenta*. *Int. J. Biol. Macromol.*, **278**(Part 2), 134759 (2024). Doi: https://doi.org/10.1016/j.ijbiomac.2024.134759

75. A.R. de Oliveira & C.A. Pereira. Inhibition of alpha-amylase by "insulin plant" (*Myrcia sphaerocarpa* DC) extracts: An alternative for the treatment of diabetes mellitus? *J. Appl. Pharm. Sci.*, **5**(5), 89–93 (2015). Doi: https://doi.org/10.7324/JAPS.2015.50517
76. E.S.C. Oliveira, L.D.R. Acho, R.D. Morales-Gamba, A.S. do Rosário, J.F.M. Barcellos, E.S. Lima & M.B. Machado. Hypoglycemic effect of the dry leaf extract of *Myrcia multiflora* in streptozotocin-induced diabetic mice. *J. Ethnopharmacol.*, **307**, 116241 (2023). Doi: https://doi.org/10.1016/j.jep.2023.116241
77. E.A. Ferreira, E.F. Gris, J.M. Rebello, J.F.G. Correia, L.F.S. de Oliveira, D. Filho & R.C. Pedrosa. The 2′,4′,6′-trihydroxyacetophenone isolated from *Myrcia multiflora* has antiobesity and mixed hypolipidemic effects with the reduction of lipid intestinal absorption. *Planta Med.*, **77**(14), 1569–1574 (2011). Doi: https://doi.org/10.1055/s-0030-1270956
78. E.A. Ferreira, E.F. Gris, K.B. Felipe, J.F.G. Correia, E. Cargnin-Ferreira, D.W. Filho & R.C. Pedrosa. Potent hepatoprotective effect in $CCl_4$-induced hepatic injury in mice of phloroacetophenone from *Myrcia multiflora*. *Libyan J. Med.*, **5**(1), 4891 (2010). Doi: https://doi.org/10.3402/ljm.v5i0.4891
79. M.S. Baliga, H.P. Bhat, B.R.V. Baliga, R. Wilson & P.L. Palatty. Phytochemistry, traditional uses and pharmacology of *Eugenia jambolana* Lam. (black plum): A review. *Food Res. Int.*, **44**(7), 1776–1789 (2011). Doi: https://doi.org/10.1016/j.foodres.2011.02.007
80. D.K. Paul & R.K. Shaha. Nutrients, vitamins and minerals content in common citrus fruits in the northern region of Bangladesh. *Pakistan J. Biol. Sci.*, **7**(2), 238–242 (2004). Doi: https://doi.org/10.3923/pjbs.2004.238.242
81. C.E. Sobral de Souza, A.R. Pereira da Silva, J.E. Rocha, M.C. Vega-Gomez, M. Rolóm, C. Coronel, *et al.* LC–MS characterization, anti-kinetoplastide and cytotoxic activities of natural products from *Eugenia jambolana* Lam. and *Eugenia uniflora*. *Asian Pac. J. Trop. Biomed.*, **7**(9), 836–841 (2017). Doi: https://doi.org/10.1016/j.apjtb.2017.08.007
82. A. Sharma, V.K. Patel & A.N. Chaturvedi. Vibriocidal activity of certain medicinal plants used in Indian folklore medicine by tribals of Mahakoshal region of central India. *Indian J. Pharmacol.*, **41**(3), 129–133 (2009). Doi: https://doi.org/10.4103/0253-7613.55212
83. J.P. Singh, A. Kaur, N. Singh, L. Nim, K. Shevkani, H. Kaur & D.S. Arora. *In vitro* antioxidant and antimicrobial properties of jambolan (*Syzygium cumini*) fruit polyphenols. *LWT*, **65**, 1025–1030 (2016). Doi: https://doi.org/10.1016/j.lwt.2015.09.038
84. P.M. Shafi, M.K. Rosamma, K. Jamil & P.S. Reddy. Antibacterial activity of *Syzygium cumini* and *Syzygium travancoricum* leaf essential oils. *Fitoterapia*, **73**(5), 414–416 (2002). Doi: https://doi.org/10.1016/S0367-326X(02)00131-4
85. J.M. Veigas, M.S. Narayan, P.M. Laxman & B. Neelwarne. Chemical nature, stability and bioefficacies of anthocyanins from fruit peel of *Syzygium cumini* Skeels. *Food Chem.*, **105**(2), 619–627 (2007). Doi: https://doi.org/10.1016/j.foodchem.2007.04.022
86. M.C. Lingaraju, S. Anand, J. Begum, V. Balaganur, R.R. Kumari, R.A. Bhat, *et al.* Anti-inflammatory effect of dikaempferol rhamnopyranoside, a diflavonoid from *Eugenia jambolana* Lam. leaves. *Indian J. Exp. Biol.*, **54**(12), 801–807 (2016). URL: https://core.ac.uk/download/pdf/297984373.pdf
87. M.C. Lingaraju, S. Anand, V. Balaganur, R.R. Kumari, A.S. More, D. Kumar, B.K. Bhadoria & S.K. Tandan. Analgesic activity of *Eugenia jambolana* leave constituent: A dikaempferol rhamnopyranoside from ethyl acetate soluble fraction. *Pharm. Biol.*, **52**(8), 1069–1078 (2014). Doi: https://doi.org/10.3109/13880209.2014.885060
88. J. Xu, T. Liu, Y. Li, W. Liu, Z. Ding, H. Ma, *et al.* Jamun (*Eugenia jambolana* Lam.) fruit extract prevents obesity by modulating the gut microbiome in high-fat-diet-fed mice. *Mol. Nutr. Food Res.*, **63**(9), 1801307 (2019). Doi: https://doi.org/10.1002/mnfr.201801307
89. S.S. Sisodia & M. Bhatnagar. Hepatoprotective activity of *Eugenia jambolana* Lam. in carbon tetrachloride treated rats. *Indian J. Pharmacol.*, **41**(1), 23–27 (2009). Doi: https://doi.org/10.4103/0253-7613.48888
90. S.B. Sharma, A. Nasir, K.M. Prabhu & P.S. Murthy. Antihyperglycemic effect of the fruit-pulp of *Eugenia jambolana* in experimental diabetes mellitus. *J. Ethnopharmacol.*, **104**(3), 367–373 (2006). Doi: https://doi.org/10.1016/j.jep.2005.10.033

91. K. Ravi, B. Ramachandran & S. Subramanian. Effect of *Eugenia jambolana* seed kernel on antioxidant defense system in streptozotocin-induced diabetes in rats. *Life Sci.*, **75**(22), 2717–2731 (2004). Doi: https://doi.org/10.1016/j.lfs.2004.08.005
92. S. Saha, E.V.S. Subrahmanyam, C. Kodangala, S.C. Mandal & S.C. Shastry. Evaluation of antinociceptive and anti-inflammatory activities of extract and fractions of *Eugenia jambolana* root bark and isolation of phytoconstituents. *Rev. Bras. Farmacogn.*, **23**(4), 651–661 (2013). Doi: https://doi.org/10.1590/S0102-695X2013005000055
93. R.E. Silva-López & B.C. Santos. *Bauhinia forficata* Link (Fabaceae). *Revista Fitos* (Rio de Janeiro), **9**(3), 217–232 (2015). Doi: https://doi.org/10.5935/2446-4775.20150018
94. T.S.D.B. Pinheiro, L.A.P. Johansson, M.G. Pizzolatti & M.W. Biavatti. Comparative assessment of kaempferitrin from medicinal extracts of *Bauhinia forficata* Link. *J. Pharm. Biomed. Anal.*, **41**(2), 431–436 (2006). Doi: https://doi.org/10.1016/j.jpba.2005.12.010
95. N.M. Khalil, M.T. Pepato & I.L. Brunetti. Free radical scavenging profile and myeloperoxidase inhibition of extracts from antidiabetic plants: *Bauhinia forficata* and *Cissus sicyoides*. *Biol. Res.*, **41**(2), 165–171 (2008). Doi: https://doi.org/10.4067/S0716-97602008000200006
96. R.R. Franco, V.H. Mota-Alves, L.F. Ribeiro-Zabisky, A.B. Justino, M.M. Martins, *et al.* Antidiabetic potential of *Bauhinia forficata* Link leaves: A non-cytotoxic source of lipase and glycoside hydrolases inhibitors and molecules with antioxidant and antiglycation properties. *Biomed. Pharmacother.*, **123**, 109798 (2020). Doi: https://doi.org/10.1016/j.biopha.2019.109798
97. E.A. Chávez-Bustos, A. Morales-González, L. Anguiano-Robledo, O.E. Madrigal-Santillán, C. Valadez-Vega, O. Lugo-Magaña, *et al. Bauhinia forficata* Link, antioxidant, genoprotective, and hypoglycemic activity in a murine model. *Plants*, **11**(12), 3052 (20229. Doi: https://doi.org/10.3390/plants11223052
98. P. Gasparini, I.C. Garofolo, M. Marques-Telles, L.M. Oyama, V. de Mello-Veneza, T.A. Moura-Veiga, *et al. Bauhinia forficata* Link extract attenuates insulin resistance by preserving glucose uptake in gastrocnemius muscle. *Nat. Prod. Res.*, **37**(12), 2031–2036 (2023). Doi: https://doi.org/10.1080/14786419.2022.2113875
99. P.A. Palsikowski. *Avaliação de métodos de extração de compostos bioativos das folhas de pata de vaca (Bauhinia forficata subespécie pruinosa).* Ph.D. thesis. Universidade Estadual do Oeste do Paraná (Unioeste). Toledo, PR, 2020; 175 p. URL: https://tede.unioeste.br/bitstream/tede/4880/2/Paula_Palsikowski_2020.pdf
100. E.P. Jung, B.P. de Freitas, C.N. Kunigami, D.d.L. Moreira, N.G. de Figueiredo, L.d.O. Ribeiro & R.F.A. Moreira. *Bauhinia forficata* Link infusions: Chemical and bioactivity of volatile and non-volatile fractions. *Molecules*, **27**(17), 5415 (2022). Doi: https://doi.org/10.3390/molecules27175415
101. A.C.F. Salgueiro, C.Q. Leal, M.C. Bianchini, I.O. Prado, A.S.L. Mendez, R.L. Puntel, *et al.* The influence of *Bauhinia forficata* Link subsp. *pruinosa* tea on lipid peroxidation and non-protein SH groups in human erythrocytes exposed to high glucose concentrations. *J. Ethnopharmacol.*, **148**(1), 81–87 (2013). Doi: https://doi.org/10.1016/j.jep.2013.03.070
102. R.R. Franco, D. da Silva-Carvalho, F.B.R. de Moura, A.B. Justino, H.C.G. Silva, L.G. Peixoto & F.S. Espindola. Antioxidant and anti-glycation capacities of some medicinal plants and their potential inhibitory against digestive enzymes related to type 2 diabetes mellitus. *J. Ethnopharmacol.*, **215**, 140–146 (2018). Doi: https://doi.org/10.1016/j.jep.2017.12.032
103. C.A. Tonelli, S.Q. de Oliveira, A.A. de Silva-Vieira, M.W. Biavatti, C. Ritter, F.H. Reginatto, A.M. de Campos & F. Dal-Pizzol. Clinical efficacy of capsules containing standardized extract of *Bauhinia forficata* Link (pata-de-vaca) as adjuvant treatment in type 2 diabetes patients: A randomized, double blind clinical trial. *J. Ethnopharmacol.*, **282**, 114616 (2022). Doi: https://doi.org/10.1016/j.jep.2021.114616
104. A.P. Gupta, R. Garg, P. Singh, U.K. Goand, A.A. Syed, G.R. Valicherla, *et al.* Pancreastatin inhibitor PSTi8 protects the obesity associated skeletal muscle insulin resistance in diet induced streptozotocin-treated diabetic mice. *Eur. J. Pharmacol.*, **881**, 173204 (2020). Doi: https://doi.org/10.1016/j.ejphar.2020.173204

105. B. Gilbert, L.F. Alves & R.d.F. Favoreto. *Monografias de Plantas Medicinais Brasileiras e Aclimatadas: Volume II*. Editora Fiocruz, Rio de Janeiro, 2022; 191 p. Doi: https://doi.org/10.7476/9786557081778
106. C.C. Cechinel-Zanchett, S.F. De Andrade & V. Cechinel-Filho. Ethnopharmacological, phytochemical, pharmacological and toxicological aspects of *Bauhinia forficata*: A mini-review covering the last five years. *Nat. Prod. Commun.*, **13**(7), 911–916 (2018). Doi: https://doi.org/10.1177/1934578X1801300
107. M.S. Pinafo, P.R. Benedetti, L.B. Gaiotte, F.G. Costa, J.P.F. Schoffen, G.S.A. Fernandes, L.G.A. Chuffa & F.R.F. Seiva. Effects of *Bauhinia forficata* on glycaemia, lipid profile, hepatic glycogen content and oxidative stress in rats exposed to bisphenol A. *Toxicol. Reports*, **6**, 244–252 (2019). Doi: https://doi.org/10.1016/j.toxrep.2019.03.001
108. P. Pereira da Silva-Dias, F.E. Ferreira-Alves, J.D. Oliveira-Alves, K. Pereira da Silva & M.I. Silva-Magalhães. Ação hipoglicemiante do extrato aquoso do caule da *Bauhinia forficata* (Mororó) em modelos experimentais diabéticos. *Revista Interdisciplinar em Saúde* (Cajazeiras), **8**(único), 88–106 (2021). Doi: https://doi.org/10.35621/23587490.v8.n1.p88-106
109. R.H. Fortunato & M.J. Nores. "Cow's hoof" (*Bauhinia* L., Leguminosae): A review on pharmacological properties of austral South American species. *Plants*, **12**(1), 31 (2022). Doi: https://doi.org/10.3390/plants12010031
110. H. Kurose & S.G. Kim. Pharmacology of antagonism of GPCR. *Biol. Pharm. Bull.*, 2**45**(6), 669–674 (2022). https://doi.org/10.1248/bpb.b22-00143
111. L. Rodrigues da Silva, L.D.V. Martins, I. Bantim-Felicio-Calou, M.d.S. Meireles de Deus, P.M.P. Ferreira & A.P. Peron. Flavonóides: constituição química, ações medicinais e potencial tóxico. *Acta Toxicológica Argentina*, **23**(1**)**, 36–43 (2015). URL: https://www.scielo.org.ar/pdf/ata/v23n1/v23n1a04.pdf
112. B.R. Rocha, E.A. Maciel, S.R.M. Oliveira, Y.S. Terence & B.A. Silva. Influência dos alimentos funcionais na incidência das doenças crônicas transmissíveis (DCNT). *Intercont. J. Phys. Educ.*, **3**(1), e2020021 (2021). URL: https://app.periodikos.com.br/journal/ijpe/article/60274ea60e8825b8147e523a
113. H. Ren, S.B. Liu, T. Lou, F.Y. Fu, Q.L. Xu, S.X. Zhang & J.W. Tan. Two new ent-kaurane diterpenoids from the leaves of *Sphagneticola trilobata*. *Phytochem. Lett.*, **49**, 177–181 (2022). Doi: https://doi.org/10.1016/j.phytol.2022.04.001

## HOW TO CITE THIS ARTICLE

A.G.P. de Paula, J.D. de Lima, C. Peitz, R.U. Veiga, R.B. dos Santos-Luz, L.W. Junior, V.H.Q. Bordenowski, A.K. da Fontoura, A.G. Somensi, T.S. Uada, N.P. Fernandes, J.B.B. Maurer & T.T. Braga. Popular Brazilian medicinal plants for therapeutic use in combating Diabetes. *Rev. Colomb. Cienc. Quim. Farm.*, **54**(3), 658–678 (2025). Doi: https://doi.org/10.15446/rcciquifa.v54n3.120983