



A BRIEF OVERVIEW OF *SYZYGIUM CUMINI* AND ITS ACTIVE COMPOUNDS IN THE TREATMENT OF DISEASES

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ABSTRACT

Objective: The present study aimed to identify in the literature the bioactive compounds present in the extracts of leaves, fruits, and seeds of *Syzygium cumini* and their uses as therapy for some diseases.

Theoretical Framework: Phytotherapy, a therapeutic method characterized using medicinal plants, has been widely employed in combating pathogenic microbial agents. Among the naturally occurring compounds used for this purpose is *S. cumini*. Various activities have been described for the compound, including antioxidant, anti-inflammatory, antibacterial, among others.

Method: For this study, articles were searched in the LILACS, MEDLINE, and PUBMED databases, spanning the time frame from 2015 to 2020, using the following descriptors: *Syzygium cumini*; Phytotherapy; Natural Products. Sixteen articles related to the subject were chosen to be included in the study.

Results and Discussion: With the data collection, it was possible to observe that *S. cumini* and its compounds are extensively studied due to their anti-hyperglycemic, anti-hyperlipidemic, antibacterial, antihypertensive, among other activities.

Research Implications: Based on the data found, it was possible to demonstrate that *S. cumini* exhibits excellent phytotherapeutic activities, thus being able to be used for the treatment of various diseases, especially those of metabolic and bacterial origin.

Originality/Value: This study offers a significant contribution to the literature by highlighting the main therapeutic effects of *S. cumini* and its active compounds in treating diseases. Furthermore, this natural product can have a significant impact on public health by offering effective and affordable alternatives for treating a variety of conditions.

Keywords: *Syzygium Cumini*, Jambolan, Phytotherapy, Natural Products.

UMA BREVE CONTEXTUALIZAÇÃO SOBRE O *SYZYGIUM CUMINI* E SEUS COMPOSTOS ATIVOS NO TRATAMENTO DE DOENÇAS

RESUMO

Objetivo: O presente estudo teve como objetivo identificar na literatura os compostos bioativos presentes nos extratos das folhas, frutos e sementes de *Syzygium cumini* e seus usos como terapia para algumas doenças.

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Referencial Teórico: A fitoterapia, método terapêutico caracterizado pelo uso de plantas medicinais, vem amplamente sendo utilizado no combate aos agentes microbianos patogênicos. Dentre os compostos de origem natural utilizados com essa finalidade, tem-se o *S. cumini*. Diversas atividades têm sido descritas para o composto, ação antioxidante, anti-inflamatória, antibacteriana, dentre outros.

Método: Para a realização deste estudo foram buscados artigos nas bases de dados LILACS; MEDLINE; PUBMED, no recorde temporal de 2015 a 2020, usando os seguintes descritores: *Syzygium cumini*; Fitoterapia; Produtos Naturais. Seguindo os critérios de exclusão, foram selecionados dezesseis artigos relacionados ao tema para fazerem parte do estudo.

Resultados e Discussão: Com a coleta de dados foi possível observar que o *S. cumini* e seus compostos são bastante estudados por possuírem atividades anti-hiperglicêmicas, anti-hiperlipidêmicas, antibacterianas, anti-hipertensiva, dentre outras.

Implicações da Pesquisa: Diante dos dados encontrados, foi possível mostrar que o *S. cumini* possui excelentes atividades fitoterápicas, podendo, assim, ser utilizado para tratamento de diversas doenças, principalmente as de origem metabólicas e bacterianas, sendo necessários mais estudos sobre seus benefícios.

Originalidade/Valor: Este estudo oferece uma contribuição significativa para a literatura ao destacar os principais efeitos terapêuticos do *S. cumini* e seus compostos ativos no tratamento de doenças. Além disso, esse produto natural pode ter um impacto significativo na saúde pública, oferecendo alternativas eficazes e acessíveis para o tratamento de uma variedade de condições.

Palavras-chave: *Syzygium Cumini*, Jambolão, Fitoterapia, Produtos Naturais.

BREVE CONTEXTUALIZACIÓN SOBRE *SYZYGIUM CUMINI* Y SUS COMPUESTOS ACTIVOS EN EL TRATAMIENTO DE ENFERMEDADES

RESUMEN

Objetivo: El presente estudio tuvo como objetivo identificar en la literatura los compuestos bioactivos presentes en extractos de hojas, frutos y semillas de *Syzygium cumini* y sus usos como terapia para algunas enfermedades.

Marco Teórico: La fitoterapia, método terapéutico caracterizado por el uso de plantas medicinales, ha sido ampliamente utilizada para combatir agentes microbianos patógenos. Entre los compuestos de origen natural utilizados para este fin, se encuentra *S. cumini*. Se han descrito varias actividades para el compuesto, acciones antioxidantes, antiinflamatorias, antibacterianas, entre otras.

Método: Para realizar este estudio se buscaron artículos en las bases de datos LILACS; MEDLINE; PUBMED, en el registro temporal de 2015 a 2020, utilizando los siguientes descriptores: *Syzygium cumini*; Fitoterapia; Productos naturales. Se eligieron dieciséis artículos relacionados con el tema para formar parte del estudio.

Resultados y Discusión: Con la recolección de datos se pudo observar que *S. cumini* y sus compuestos son ampliamente estudiados por tener actividades antihiper glucémicas, antihiperlipidémicas, antibacterianas, antihiper tensivas, entre otras.

Implicaciones de la investigación: Con los datos encontrados, se pudo demostrar que *S. cumini* tiene excelentes actividades fitoterapéuticas, por lo que puede ser utilizada para tratar diversas enfermedades, especialmente aquellas de origen metabólico y bacteriano, requiriendo mayores estudios sobre sus beneficios.

Originalidad/Valor: Este estudio ofrece una contribución significativa a la literatura al resaltar los principales efectos terapéuticos de *S. cumini* y sus compuestos activos en el tratamiento de enfermedades. Además, este producto natural puede tener un impacto significativo en la salud pública al ofrecer alternativas efectivas y asequibles para tratar una variedad de afecciones.

Palabras clave: *Syzygium Cumini*, Jambolão, Fitoterapia, Productos Naturales.



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1 INTRODUCTION

The use of medicinal plants has been fundamental in medicine since ancient times, and this practice has been passed down through generations. Over the centuries, plant-based products have formed the foundation for treating numerous diseases. Brazil, with its vast plant diversity, has significant potential for developing therapeutic methods based on its unique flora, combining traditional (empirical) knowledge with scientific validation (Pedroso *et al.*, 2021).

Syzygium cumini (L.) Skeels, from the Myrtaceae family, is a plant native to Tropical Asia and is commonly known in Brazil as jambolão, jamelão, black olive, or purple olive. It is widely cultivated in the Southeast, Northeast, and North regions of Brazil (Chagas, 2015). This large tree can reach about 10 meters in height and 3 to 4.5 meters in canopy diameter. Its fruits are fleshy berries, approximately 3 to 4 cm long and 2 cm in diameter, containing a single seed. The taste is sweet and sour with a strong astringency but is considered quite pleasant (Chua *et al.*, 2019).

Given the extensive use of *S. cumini* (L.) Skeels in ethnopharmacology, efforts have been made to confirm its medicinal properties and chemically characterize its compounds. Currently, it is known that various parts of the plant (bark, seeds, leaves, and fruit) exhibit hypoglycemic, astringent, and constipating effects, as well as anti-inflammatory, antioxidant, and diuretic activities (Kumar *et al.*, 2022).

Despite the pharmaceutical industry's past production of a large number of antimicrobials, the issue of microbial resistance has only grown, becoming a public health concern. Future perspectives include the development of new drugs, implementing urgent measures for antibiotic stewardship, and researching new synthetic and natural pharmaceuticals to address this challenge (Lima *et al.*, 2011).

The search for complementary therapeutic options has made traditional pharmacotherapy an important guideline in public health. Today, research on medicinal plants is fundamental to health policies established by government entities, such as the National Policy on Integrative and Complementary Practices of the Unified Health System (Albuquerque *et al.*, 2017).



Several studies have been conducted in recent years to confirm the effectiveness of the antimicrobial activity of plant extracts and phytochemicals, which may have therapeutic significance (Lima *et al.*, 2011). For a population with limited access to medications, like in Brazil, adding scientific guarantees to therapeutic practices using phytochemicals offers various advantages (Albuquerque *et al.*, 2017).

The use of medicinal plants for treating certain diseases has gained support from both the medical community and health programs. There are significant concerns about which therapeutic options to use against infections often caused by microorganisms. The use of crude plant extracts has garnered increased attention from researchers in Brazil and other countries in recent years, as they can inhibit bacterial and fungal growth through various mechanisms compared to conventional antimicrobials (Pereira *et al.*, 2009).

Considering the importance of discovering new bioactive compounds, this review aims to identify the bioactive compounds present in the leaves, fruits, and seeds of *S. cumini* and their effects for use in complementary therapy for certain diseases.

2 METHODOLOGY

This is an integrative review with a qualitative approach on the use of *S. cumini* in phytotherapy, encompassing various stages leading to the creation of the article. The articles used for developing this work were researched in the databases of the Virtual Health Library (BVS-BIRENE), Latin American and Caribbean Health Sciences Database (LILACS), Medical Literature Analysis and Retrieval System Online (MEDLINE), and PUBMED, using descriptors such as Phytotherapy; *Syzygium cumini*; Natural Products.

Included in this study were electronic review articles published between 2015 and 2020 in Spanish, English, and Portuguese that addressed the topic of this work. Theses, editorials, and review articles that did not meet the proposed objectives were excluded after systematic reading.

The methodology of an article outlines the procedures used to conduct the research, including the study type, sample selection, data collection and analysis methods, ethical considerations, and study limitations. A detailed and transparent description is essential to ensure the replicability and reliability of the results, as well as to provide a solid foundation for interpreting and generalizing the findings.



3 RESULTS AND DISCUSSIONS

In the search for scientific articles, 28 articles were found in the MEDLINE, PUBMED, and LILACS databases. Of these, 16 articles were selected according to the established criteria, with those not meeting the inclusion criteria being excluded.

All the identified studies were read systematically and comprehensively, and their key characteristics were presented in tabular format to highlight the main features of each study: year of publication, authors, titles, journals, databases, study type, objective, and key results. Figure 1 illustrates the articles that constituted the sample used in this study, detailing the year of publication, authors, title, journal, and article database.

Figure 1

Articles selected in the integrative review

Nº	Year	Authors	Title	Periodical	Database
01	2015	Chagas <i>et al.</i>	<i>Syzygium cumini</i> (L.) skeels: a prominent source of bioactive molecules against cardiometabolic diseases.	Frontiers in Pharmacology	LILACS
02	2016	Camacho <i>et al.</i>	Correlación del contenido de fenoles y antocianinas con la capacidad antioxidante <i>Syzygium cumini</i> (L.) Skeels, (jambolan).	Revista Cubana de Plantas Medicinai.	LILACS
03	2016	Baldissera <i>et al.</i>	Effects of crude hydroalcoholic extract of <i>Syzygium cumini</i> (L.) Skeels leaves and continuous aerobic training in rats with diabetes induced by a high-fat diet and low doses of streptozotocin.	Journal of Ethnopharmacology	PUBMED
04	2016	Sanches <i>et al.</i>	Polyphenol-Rich Extract of <i>Syzygium cumini</i> Leaf Dually Improves Peripheral Insulin Sensitivity and Pancreatic Islet Function in Monosodium L-Glutamate-Induced Obese Rats	Frontiers in Pharmacology	PUBMED
05	2017	Dos Santos & Vilanova	Estudo etnobotânico de plantas medicinais utilizadas como hipoglicemiantes por usuários do Programa de Fitoterapia da UFMA, Brasil.	Scientia Plena	LILACS
06	2017	Bansode <i>et al.</i>	Comparative evaluation of antidiabetic potential of partially purified bioactive fractions from four medicinal plants in alloxan-induced diabetic rats	AYU	PUBMED
07	2017	Bitencourt <i>et al.</i>	Nanoparticle formulation increases <i>S. cumini</i>	Pharmaceutical Biology	MEDLINE



			antioxidante activity in <i>Candida Albicans</i> - infected diabetic rats		
08	2017	Franco <i>et al.</i>	Evaluation of α -amylase, α -glucosidase and lipase inhibitory activities of some medicinal plants used in type-2 Diabetes Mellitus and its anti-glycation and antioxidant roles.	Journal of Ethnopharmacology	LILACS
09	2018	Chhikara <i>et al.</i>	Bioactive compounds and pharmacological and food applications of <i>Syzygium cumini</i> – a review.	Food & Function	MEDLINE
10	2018	Ezhilarasan <i>et al.</i>	<i>Syzygium cumini</i> extract induced reactive oxygen species mediated apoptosis in human oral squamous carcinoma cells.	Journal of Oral Pathology e Medicine	MEDLINE
11	2019	França <i>et al.</i>	<i>Syzygium cumini</i> Leaf Extract Reverts Hypertriglyceridemia via Downregulation of the Hepatic XBP-1s/PDI/MTP Axis in Monosodium L-Glutamate-Induced Obese Rats.	Oxidative Medicine and Cellular Longevity	PUBMED
12	2019	Chua <i>et al.</i>	Anticancer Potential of <i>Syzygium</i> Species: a Review.	Plant foods for human nutrition	PUBMED
13	2019	Rehman <i>et al.</i>	In vivo assessment of anticoagulant and antiplatelet effects of <i>Syzygium cumini</i> leaves extract in rabbits.	BMC complementary and alternative medicine	MEDLINE
14	2019	Maslachah <i>et al.</i>	Hematologic changes and splenic index on malaria mice models given <i>Syzygium cumini</i> extract as an adjuvant therapy.	Veterinary World	PUBMED
15	2019	Benevides <i>et al.</i>	<i>Syzygium cumini</i> (L.) Skeels improves metabolic and ovarian parameters in female obese rats with malfunctioning hypothalamus-pituitary gonadal axis	Journal of Ovarian Research	PUBMED
16	2020	Hajarnavis & Bulakh	Anticataract effects of <i>S. cumini</i> and <i>A. marmelos</i> on goat lenses in an experimental diabetic cataract model.	Journal of Ayurveda and Integrative Medicine	LILACS

Figure 2 shows the type of study, objectives and expected results, related to the theme, found in the studies selected for the integrative review.


Figure 2

Description of the articles regarding the type of study, objective and expected results

Nº	Type of study	Objective	Expected Results
01	Revisão	Specifically study the cardiometabolic properties of secondary metabolites already identified in this plant species, correlating them with their potential mechanisms of action.	The data showed that some compounds target multiple metabolic pathways, making them potential pharmacological tools.
02	Experimental	To compare the antioxidant capacity of extracts of fruits, pulps and seeds of <i>S. cumini</i> , in relation to the content of polyphenols and anthocyanins.	The phenol content obtained in the methanolic and ethanolic extracts was very similar in the fruits and pulp, while an increase of up to 5 (five) times was observed in the pulp and seeds, correlated with the antioxidant protection effect among the extracts evaluated.
03	Experimental	To evaluate functional capacity, biochemical parameters, oxidative stress and DNA damage in eight weeks of intervention with crude hydroalcoholic extract of <i>S. cumini</i> leaves and continuous aerobic training in diabetic rats.	The results showed a reduction in glucose and triglycerides, a lower rate of DNA damage in the blood, liver, kidney, heart, lung and gastrocnemius muscle and other parameters.
04	Experimental	To characterize the metabolic effects of the hydroethanolic extract of <i>S. cumini</i> (HESc) on obese rats induced by monosodium L-glutamate.	The use of HESc in obese rats showed a twofold increase in lipolytic activity in the periepididymal fat layer, in addition to bringing triglyceride levels in serum, liver and skeletal muscle back to levels close to those found in lean animals.
05	Coleta de dados com Questionários	To carry out an ethnobotanical survey of plants used as hypoglycemic agents by users of the Phytotherapy Program at UFMA, São Luís, Brazil.	Twenty-eight plant species were mentioned for hypoglycemic purposes. The leaves were the most commonly used parts of the plant (45%) and infusion was the most commonly used preparation method by the interviewees (43%).
06	Experimental	To compare the antidiabetic potential of partially purified bioactive fractions isolated from four targeted medicinal plants in diabetic rats.	The results indicate that diabetic rats treated with fractions presented a statistically significant decrease ($p < 0.05$) in serum glucose and an increase in body weight and hepatic glycemia. Among ScTF, FgTF, TcTF and SpTF have better hypoglycemic activity in all models.
07	Experimental	To evaluate the effect of treatments with <i>S. cumini</i> seed extract (ASc) and polymeric nanoparticles loaded with ASc (NPASc) on biochemical parameters in diabetic rats infected with <i>Candida Albicans</i> .	Biochemical and oxidative stress parameters increased in rats with DM and candidiasis. NPASc was more effective than ASc in decreasing glucose (56%), cholesterol (33%), and creatinine (51%) serum levels (16%) and pancreatic AOPP (46%) and renal TBARS (48%) when compared to the DM+C. albicans group.
08	Experimental	To evaluate the antidiabetic potential of some medicinal plants, examining their inhibitory capacities against α -amylase, α -glucosidase and lipase, as well as their antiglycation and antioxidant activities.	The results were positive for enzyme inhibition, antioxidant capacity and antiglycation.
09	Revisão	To explore the nutritional, photochemical and pharmacological potential, as well as its various food uses of <i>S. cumini</i> .	The main bioactive compounds present in the edible part are myricetin, gallic acid, flavonoids, carotenoids and polyphenols, in addition to micronutrients, responsible for numerous benefits.



10	Experimental	To evaluate the cytotoxic effect of <i>S. cumini</i> on the human squamous cell carcinoma (OSCC) cell line.	Treatments with <i>S. cumini</i> caused ketotoxicity of the OSCC cell line and induced intracellular accumulation of ERRO.
11	Experimental	To investigate the molecular mechanisms underlying the antihypertriglyceridemic effect of HESc in MSG-obese rats.	Hydroethanolic extract of <i>S. cumini</i> leaf (HESc) reduces adipose tissue accumulation; improves glycolipid profile; reverses NAFLD and improves liver function; reduces TG content in VLDL particles; reduces ER stress in the liver; inhibits the XBP-1s/PDI/MTP axis in obese rats.
12	Revisão	To discuss the vast potential of <i>Syzygium</i> sp. as a source of natural anticancer compounds due to its abundance, easy acceptance, accessibility and safety for regular consumption.	Plants such as <i>Syzygium</i> sp. are a common base of complementary medicines due to their abundance of bioactive phytochemicals. Numerous natural compounds derived from <i>Syzygium</i> sp., such as phenolics, oleanolic acids, and betulinic acids and dimethyl cardamonins, have been reported to have anticancer effects.
13	Experimental	To examine the effects of methanolic extract of <i>S. cumini</i> on blood coagulation and anticoagulation factors in healthy albino rabbits at different doses.	The results showed significant increase in RBC, hemoglobin, hematocrit, and platelet counts. Whereas, thrombin and bleeding time were also prolonged in a dose-dependent manner, which is highly significant ($p \leq 0.005$) as compared to control. Similarly, highly significant ($p \leq 0.005$) increase in protein C, thrombin antithrombin complex levels was observed at 500 mg/kg dose. Whereas, platelet aggregation and fibrinogen levels were decreased at high doses.
14	Experimental	To determine the efficacy of <i>Syzygium cumini</i> L. as an adjuvant therapy in blood changes and splenic index in rats with malaria.	The leaf and stem of <i>S. cumini</i> increased the number of erythrocytes, decreased the number of leukocytes, lymphocytes and monocytes, yielding results in the treatment of malaria.
15	Experimental	To evaluate the effects of the hydroethanolic extract of <i>S. cumini</i> leaves on female reproductive deficiencies present in the obesity model of neonatal injection of glutamate and L-monosodium.	The results showed that Wista rats had reduced Lee index, retroperitoneal fat pads and restored gluco-insulin axis. The use of <i>S. cumini</i> reduced serum cholesterol levels.
16	Experimental	To evaluate the local effects of extracts of <i>S. cumini</i> seeds and <i>A. marmelos</i> leaves on the antioxidant and anti-cataract properties tested by biochemical and physical parameters.	<i>S. cumini</i> and <i>A. marmelos</i> showed significantly increased activities of the three antioxidant enzymes, preserved total soluble proteins and decreased malandialdehyde. Lens morphology was well preserved with these extracts, with the <i>S. cumini</i> extract performing better than <i>A. marmelos</i> .

The species *Syzygium cumini* is a plant rich in therapeutic properties and has been widely used in traditional medicine for treatments including antidiabetic, antibacterial, anti-inflammatory, antifungal, anti-hyperlipidemic, hypolipidemic, anticataract, anticancer, and others (Chagas *et al.*, 2015; Camacho *et al.*, 2016; Hajarnavis & Bulakh, 2020). Among the plant parts—fruits, leaves, and seeds—are the most studied by researchers and are used empirically, particularly by low-income individuals (Camacho *et al.*, 2016).



According to Maslachah *et al.* (2019), their study found that the use of extracts from the leaves and bark of *S. cumini* in combination with malaria treatment medications (Chloroquine) was effective in controlling malaria development. This demonstrates the antimalarial effects and antioxidant content in the leaf and bark extracts. These effects are attributed to compounds present in the leaf, particularly tannins and saponins, including gallic acid, methyl gallate, campferol, myricetin, ellagic acid, chlorogenic acid, quercetin, nilocetin, β -sitosterol, and betulinic acid. The bark is rich in betulinic acid, friedelin, epifriedelanol, β -sitosterol, eugenin, fatty acid esters, quercetin, campferol, myricetin, gallic acid, ellagic acid, bergenins, flavonoids, and tannins.

Thus, the fruit pulp, seeds, bark, and leaves have medicinal values and are used in the formulation of pharmaceuticals for treating various diseases due to their therapeutic perspectives. According to the literature, flavonoids are considered anticancer, anti-aging, neuroprotective, and have antimicrobial activity against both Gram-positive and Gram-negative bacteria. The seed is the most effective part of the plant for treating diabetes due to the presence of glycosides (Chhikara *et al.*, 2018).

A study by Franco *et al.* (2017) analyzed the antioxidant activities in vitro of ethanol extracts of *S. cumini* (ETOH) and other medicinal plants, finding that ETOH inhibited α -amylase, α -glucosidase, and lipase enzymes, showing its applicability for treating type 2 diabetes mellitus.

França *et al.* (2019) demonstrated that the hydroethanolic extract of *S. cumini* leaves (HESc) restored serum triglyceride levels in rats with hypertriglyceridemia. The authors showed that orally administered HESc contained animal weight gain, improved liver disease, reversed hypertriglyceridemia, insulin sensitivity, and other metabolic parameters.

Chua *et al.* (2019) found that HESc could inhibit the growth of breast and cervical cancer cells in their study on the anticancer potential of *Syzygium* species, including *S. cumini*.

Benevides *et al.* (2019) evaluated the improvement of metabolic and ovarian parameters in obese rats with hypothalamic-pituitary-gonadal axis dysfunction. They showed that HESc administration reduced total and periovarian adiposity, restored serum glucose and cholesterol levels, and significantly improved glucose tolerance and metabolic parameters. The reduction in weight and fat accumulation was attributed to the flavonoid content (myricetin and quercetin).

Chagas *et al.* (2018) reported that diabetic rats induced by streptozotocin, who used the seed extract of *S. cumini* continuously, had reduced blood and urine glucose levels after 30 days of treatment. This was attributed to increased activity of peroxisome proliferator-activated



receptors alpha and gamma. The study also tested the extract for anti-hyperlipidemic action, confirming its ability to lower total cholesterol, LDL cholesterol, and triglycerides while increasing HDL cholesterol levels. The extract also exhibited hypotensive and antihypertensive effects, corroborating findings by Chhikara *et al.* (2018), in a randomized double-blind study. In this study, patients with diabetes and hypertension took 5g of *S. cumini* seed powder before meals, twice a day, for three months, confirming that the seed powder reduced blood pressure and showed hypoglycemic action, improving diabetes symptoms such as polyphagia, polydipsia, and polyuria.

4 CONCLUSION

This study aimed to highlight the benefits of using medicinal plants, which are often utilized by low-income families, emphasizing the importance of understanding their advantages and effects. Based on the data found, *Syzygium cumini* was frequently cited and studied for its various actions in combating certain diseases, due to its bioactive compounds. These compounds are responsible for the regression of diseases, particularly those of metabolic origin.

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