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Review Article

Chemical, Botanical and Pharmacological Aspects of the Leguminosae

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ABSTRACT
Leguminosae or Fabaceae belongs to the Fabales order and comprises about 727 genera and 19.327 species. It is the largest family on Brazilian soil. Its biodiversity is present in practically the entire vegetal composition, showing its ecological importance in different ecosystems. It is subdivided into six subfamilies (Caesalpinioideae, Dialioideae, Detarioideae, Cercidoideae, Duparquetia idea and Papilionoideae). It has applications in different areas such as food, reforestation, wood industry, ornamentals, forages and herbal medicine. The secondary metabolites of this family are quite diverse, including the class of flavonoids, phenolic acids, tannins, anthocyanins, coumarins, saponins, phytosteroids and terpenoids, making it the second-largest family to be used with therapeutic resources in the world. Studies reveal important bioactive properties related to species, such as: Antioxidant, antimicrobial, antiproliferative, anti-tumor, anti-inflammatory, anti-leishmania, healing, cardioprotective, hypoglycemic, myorelaxant, antiulcerogenic, serine proteinase inhibition, chemoprotective and anti-wrinkles. In this context, this work aims to present a review on the *Libidibia ferrea* (Mart. ex Tul.) L.P. Queiroz, *Inga edulis* Mart, *Bauhinia purpurea* L. *Hymenaea courbaril* L, *Schizolobium parahyba* var. *amazonicum* (Huber ex Ducke) Barneby, *Parkia multijuga* Benth, *Parkianitida* Miq., *Pterodon emarginatus* Vogel and *Phanera splendens* (Kunth) Vaz species belonging to Leguminosae, approaching its botanical aspects, its occurrence and uses, as well as its chemodiversity and the associated biological activities.
Key words: Biological Activity, Chemical Composition, Ethnobotanical, Fabaceae, Plant metabolites, Plant metabolomics.

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LEGUMINOSAE GENERAL ASPECTS

Leguminosae or Fabaceae, belonging to the Fabales order, is the third-largest family in the plant kingdom. It has a cosmopolitan contribution and covers 727 genera and 19.327 species, including trees, shrubs, lianas and herbs, with different climatic typologies.[1-3] It stands out economically as fruit, timber, ornamental, forage, bee and medicinal plants.[4] In addition to being important candidates for silviculture, being used in the recovery of degraded areas. It comprises six subfamilies (Caesalpinioideae, Dialioideae, Detarioideae, Cercidoideae, Duparquetioideae and Papilionoideae) recently reclassified according to taxonomically comprehensive phylogeny.[5]

Leguminosae species can be found in almost all terrestrial environments, such as coastal areas, mountains, rain forests, deserts, equatorial areas and near the poles. The establishment of this group in different environments is related to different adaptation strategies and chemical evolution, occurring in the Neotropical, Ethiopian, Eastern and Australian regions.[2,3,6]

The Brazilian flora presents species from different groups (Bryophytes, Lycophytes, Ferns, Gymnosperms and Angiosperms), of which angiosperms are the majority, with approximately 92% of the occurrence, being Leguminosae, the family with the largest number of species, followed by Orchidaceae, Asteraceae, Rubiaceae, Melastomataceae, Bromeliaceae, Poaceae, Myrtaceae, Euphorbiaceae and Malvaceae.[7]

This family is very representative of almost all the vegetal composition of the Brazilian territory, mainly in the Amazon and in the Caatinga. Some species can play important interspecific ecological relationships. Its wide and diverse distribution in plant formation shows unquestionable ecological relevance in different ecosystems.[8]

Studies often link part of the family's evolutionary success to a type of association with polyphyletic groups of bacteria called rhizobia.[6,9,10] They induce the formation of nodules, in which atmospheric nitrogen is fixed and, in exchange, plants provide carbon compounds. Because of this, they can colonize nitrogen-poor environments and store the largest amount of nitrogen compounds in their seeds.[2,10]

However, its wide distribution and colonization of anthropized soils are also related to the ability to biosynthesize a great structural diversity of secondary metabolites. Some of them are more restricted to some species and others are widely distributed, such as flavonoids and triterpenes.[11] The predominant metabolites are alkaloids, polyphenols, terpenes,

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cyanogens, polyketides and peptides being associated with climatic typology. Among these metabolites, polyphenols, such as phenolic acids, flavonoids and tannins (hydrolyzable and condensed) stand out.[12]

This metabolic class has great chemical reactivity because it presents in its structures groups of hydroxyls, which can interact with forming hydrogen bonds. In this way, it can complex proteins, DNA and even metal ions. Consequently, many of these polyphenols can act in defense, against insects, pathogens and abiotic stress and in competition, preventing the development of other plants.[13-16] There is evidence that these substances can act in cytoprotection through the chelation of toxic metals enabling the development of species in polluted environments.[16]

Most of the legumes secondary metabolites exhibit some biological, pharmacological, or toxicological activity, being its metabolic profile one of those responsible for making it the second-largest family of medicinal plants used worldwide as a resource for the treatment of various diseases,[17-21] presenting hypoglycemic, anti-inflammatory, anti-tumor, antiproliferative, healing and antimicrobial activity.[22-26]

Secondary metabolites play an important role in plants and are essential for their ecological suitability. Thus, they must be considered as an important feature of the complex process of adaptation and convergent evolution. As a result of the changes that the individual undergoes to adapt itself, in this way, guaranteeing the survival of its species.[11,27,28] In this perspective, this work aims to present a review on the *Libidibia ferrea* (Mart. ex Tul.)] L.P. Queiroz, *Inga edulis* Mart, *Bauhinia purpurea* L. *Hymenaea courbaril* L. *Schizolobium parahyba* var. *amazonicum* (Huber ex Ducke) Barneby, *Parkia multijuga* Benth, *Parkia nitida* Miq., *Pterodon emarginatus* Vogel and *Phanera splendens* (Kunth) Vaz species belonging to Leguminosae, approaching its botanical aspects, its occurrence and uses, as well as its chemiodiversity and the associated biological activities.

SCIENTIFIC ASPECTS AND TRENDS ASSOCIATED WITH LEGUMINOSAE

The study of species belonging to Leguminosae is a task that has been carried out by several research groups, mainly investigations associated with botanical, ecological, economic and medicinal issues. However, the analysis between scientific production and the research trend is scarce in each of these research fronts when related to the chemical composition of these plants and in this sense, bibliometric maps that facilitate the understanding of trends in scientific studies emerge, Figure 1.

An important tool for identifying these connections is the use of the correlation of bibliographic information present in scientific research bases through software, such as VOSviewer, so that it allows to evaluate the flow and trend of studies on the subjects of interest through the use of keywords associated with Leguminosae species to produce bibliometric maps. Figure 1 illustrates the bibliometric map built on Leguminosae information. It involved 40 articles indexed in the *Scopus* database, from 2010 to 2020. The VOSviewer software identified 4 *Clusters*, presenting a total of 29 keywords. The bibliometric map reveals a higher frequency of publications associated with the keywords Fabaceae, chemical composition, Leguminosae and plant extract in mid-2014. This same map has shown in recent years the trend of investigating phytochemical studies, metabolites isolation, antioxidant activity and *in vitro* studies. In these aspects, it can be highlighted the characteristics of the keyword chemical composition, from the connections made, Figure 2.

The bibliometric maps (Figure 2) highlight the connection of the keyword chemical composition as well as the other 19 keywords, in which, over the years, trends in bibliometric map investigations are observed. In mid-2013 to 2014, connections were concentrated in the family (Fabaceae and Leguminosae), in the parts of the plants (root, leaves and flowers), in the ethnobotany (medicinal plant) and less frequently in the secondary metabolites of flavonoid class. Between 2014 and 2015, the term chemical composition was associated with the keywords plant extraction, isolation and purification, phytochemistry, flavonoids, phenolic compounds, antioxidant activity and *in vitro* studies. It evidenced the deepening of investigations on the chemical composition and Legumes' biological activities.

BOTANICAL ASPECTS, USES, DISTRIBUTION AND OCCURRENCE OF LEGUMINOSAE

Libidibia ferrea (Mart. ex Tul.) L.P. Queiroz belongs to Leguminosae, caesalpiniaceae subfamily is popularly known as Jucá or Pau-de-ferro. It presents occurrence through out the Brazilian territory, standing out in the states of Pará, Rondônia, Roraima, Amazonas, Amapá, Ceará and Maranhão, with the Northeast of Brazil having the greatest occurrence,[29] emphasizing that this species can reach 10 to 15 m in height and 40 to 60 cm in diameter.[30] It has composite, opposite, small, alternating, bipinnate leaves, obovate and elliptical blade. Its flowers are hermaphrodites of yellow color distributed in the form of clusters. The fruits are pods of an oblong shape, slightly flattened with 8.3 x 1.8 x 0.8 cm dimensions, they present brown color in the ripe phase. The seeds have a flattened base and a rounded apex, measuring 0.9 x 0.5 x 0.5 cm, they present a uniseriate cross-organization.[31]

In the last years, *Libidibia ferrea* has been the target of several studies aiming at investigating its chemical composition and its bioactive properties, since its fruits, seeds, leaves and bark are widely used in traditional medicine for the treatment of gastrointestinal and pulmonary bronchial disorders, diabetes, rheumatism, uterine problems, diarrhea, congestion, labyrinthitis, flu, expectorant and inflammations.[29,30,32] The species is rich in polyphenols (mainly from the hydrolyzable tannins class), in addition to fatty acids, terpenoids and steroids. Naturally antioxidant, it exhibits other important biological properties such as antifungal, anti-leishmania, anti-tumor, chemoprotective, healing, antimicrobial, anti-inflammatory, antiviral and hypoglycemic.[24,33-38]

Inga edulis Mart. is a fruit tree popularly known as ingácipó. It is restricted to the American tropics and it is originated in the low-lying tropical forests of Brazil and extensions from the north to central Mexico. The species is medium to large-sized and can reach 15 to 40 m in height. The leaves are alternated and composed, their flowers are showy, bisexual, white in color and exhale aromas. The fruit is a longitudinal, green, cylindrical pod that can reach up to 2 m in length. The seeds, in

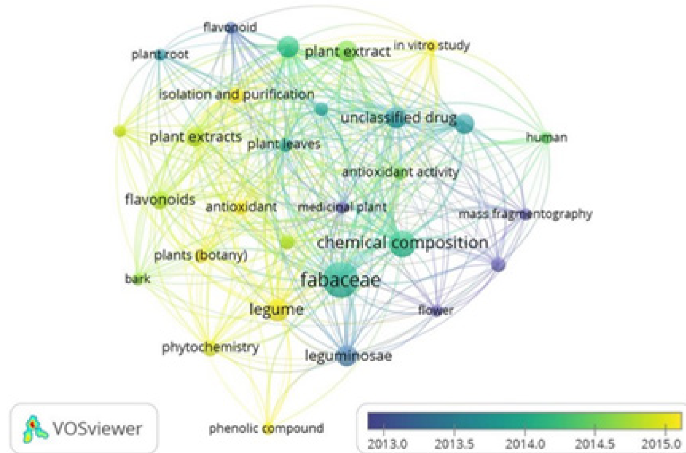

Figure 1: Clustering of the frequency distribution of keywords with the highest occurrence from 2010 to 2020 for Leguminosae with overlapping colors for 2013 to 2020 periods.

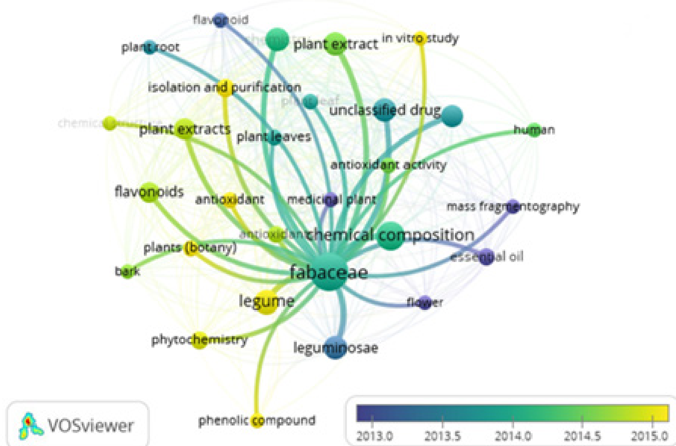

Figure 2: Clustering of the frequency distribution of keywords with the highest occurrence from 2010 to 2020 for Leguminosae with overlapping colors for 2013 to 2020 periods, highlighting the cluster related to the keyword chemical composition.

general, are black, but present mixed colors in green and beige. They are reversed by white, sweet and edible pulp.[16,39,40] It is very nutritious and it is commonly consumed by the Amazonian population.[41]

It is a species used in different economic axes, such as in the recovery of degraded areas, agroforestry, phytotherapy and commercialization of its fruits, making it one of the most important Amazonian genera.[41,42] Its use as a medicinal plant by the indigenous population in the treatment of inflammation, diarrhea, rheumatism and arthritis has aroused interest in the investigation of its chemical constituents and its bioactive properties, studies are pointing the species as rich in polyphenols.[41,43-46] For this reason, leaves, seeds and fruits have shown high antioxidant activity and potential for commercial exploitation.[41,47,48]

Bauhinia purpurea L. is a small to medium-sized arboreal plant popularly known in Brazil as pata-de-vaca. It is native to southern China and Southeast Asia, It has adapted well to the Brazilian climate, reaching up to 17 m in height.[49,50] The leaves are bifoliate with rounded apices and measure approximately 7.5 to 15 cm in length. The flowers present aromas, 5 petals and pink color. The fruits are pods in a linear shape and the seeds have a flattened base, rounded apexes and brown color.[50]

The species is used in the ornamentation of public spaces, its flowers and fruits are part of the diet of some ethnic peoples of India.[51,52] The leaf, bark and root are often used in traditional medicine to treat rheumatism, asthma, fever, diarrhea, body aches, leprosy, ulcers, cough, abscess, dysentery, seizures, jaundice, digestive disorder, furuncle, carminative and septicemia.[50,53-59] In the Amazon region, the species is known mainly for being used in the treatment of diabetes, which is common in its commercialization in open markets.[60] Ethnobotanical studies have boosted the investigation of chemical composition and the biological potential associated with it. It has been reported that the species is rich in flavonoids, in addition to having fatty acids, steroids, tocopherols, saponins and xanthones.[49,61-64] The metabolites present in its composition are responsible for the innumerable biological activities (antioxidant, antiulcer, anticarcinogenic, antimicrobial, hypoglycemic and hepatoprotective) exhibited by it.[65-69]

Hymenaea courbaril L. known as jatoba, it comes from Tupi and means "hard-shelled fruit". It is a species that occurs from Mexico, permeating Central America to São Paulo. On Brazilian soil, it is found in the states of Amazonas, Pará, Maranhão, Rondônia, Goiás, Bahia, São Paulo and Federal District.[70] It is an arboreal species, reaching 15 to 40 m in height and has tolerance and adaptation to different environments. The leaves are alternated and composed, with white and reddish flowers. The fruit is the pod, thick, indehiscent, oblong to cylindrical with 12 x 4.5 x 3.0 cm dimensions and reddish-brown coloring. The pulp presents a yellow coloring, floury-filamentous, dry, edible and sweet flavor. The seeds are flattened and black, with 2.2 x 1.5 dimensions.[70]

It is a species that can be used in the production of varnish, its pulp, in the production of flour, its leaves, roots, bark, resin (obtained from the bark) and fruits are used as herbal resources, but its main economic value is found in the hardwood.[71,72] Jatoba pulp powder is often consumed by the local population due to its nutritional composition, being rich in fibers, carbohydrates and terpenoids.[71,73] It exhibits natural antioxidant properties and has been used, through decoction and infusion, in traditional medicine as an expectorant, relaxing, antiseptic, tonic, sedative, in the treatment of diarrhea, intestinal colic, flu, bronchitis, bladder infections and dewormer.[74,75] In the chemical composition of the species, fatty acids (saturated and polyunsaturated), coumarins, polyphenols and terpenoids were identified.[22,76-78] Terpenoids and polyphenols are the representative secondary metabolites in the chemical constitution of fruits, xylem sap, stem bark and seeds. These metabolites classes are responsible for the bioactive potentials (antioxidant, anti-inflammatory, antifungal and myorelaxant) exhibited by the species.[22,71,79,80]

Schizolobium parahyba var. *amazonicum* (Huber ex Ducke) Barneby, popularly known in the Amazon region asparicá, pinho-cuiabano, faveira and guapuruvu, is a species found in the states of Pará, Amazonas, Acre, Rondônia and Mato Grossoand its distribution is related to primary upland forest, high floodplain and secondary forest.[81-83] It is a large arboreal species, reaching 20 to 30 m and 1,2 in diameter. The trunk has a smooth outer shell of yellowish-gray color with white spots when it is in the adult stage, with lenticels and annular marks resulting from the scar of the leaves. The leaves are composed, bipinnate and their arrangement is alternated and the flowers, showy, with yellow petals. The fruit is a dehiscent, obovate-oblong, flat beige-brown pod in the adult stage. The seeds are smooth, oblong-flat with 2 x 1.3 cm dimensions, hard integument and browncolor.[84]

It is a species that shows rapid growth and sensitivity to low temperatures. It is an important candidate for silviculture and it can be integrated with cattle-ranching, recovery of extensive degraded fields and pastures areas, including its cultivation for wood commercialization.[83,85,86] Its productivity and profitability raised its price in the domestic and foreign markets, where it has been widely cultivated by timber companies in the north and northeast regions of the country.[86,87] Its wood is of low density, malleable and has a thick texture, is easily processed. However, it has low durability, making it vulnerable to attack by xylophagous insects, fungi and termites.[84] Thus, research has been carried out to assess the potential for germination and genetic improvement to obtain individuals more resistant to insect attack and tolerant to temperature variation. Despite its economic and ecological importance, there is no information on its chemical composition nor ethnobotanical knowledge related to it.[88]

Parkia multijuga Benth., popularly called Faveira-Benguê, Benguê, fava-arara-tucupi, visgueiro, is a typical Amazon region arboreal species. In Brazil, it occurs in upland, highland and clay soil forests in the states of Amazonas, Pará, Mato Grosso, Rondônia, Acre Roraima.[89,90] It is large. It can reach 40 m in height and has an intolerance to low temperatures. Its leaves are composed, bipinnate and arranged in a spiraland inflorescences, arranged in globular chapters erect on the foliage, with many hermaphrodite yellow flowers. Its fruits are pods, hard, woody, indehiscent, flat and curved, measuring from 20 to 25 cm. They can store from 10 to 15 wine-colored and coin (rounded) seeds, with oscillating diameters between 3 to 5 cm.[89,91]

The species has an economic potential that is mainly related to the wood sector, being used for the production of paper, frames, toys, cellulose, among others.[90] Its silvicultural characteristics allow the insertion of its planting for the recovery of degraded areas, thus, making it the target of studies which investigate the viability of seed germination to enable quality control by the nurseries for the production of commercial seedlings of the species.[90,91] Besides being a medicinal plant, as some population uses the bark sprayed from its stem on the surface of lesions to aid healing[46] and its fruit presents antioxidant potential which can be used to treat hypoglycemia (type 2 diabetes) and to regulate body weight.[92] These bioactive properties may be related to high levels of essential fatty acids present in the species' chemical composition.[93]

Parkia nitida Miq., popularly known as favaarara-tucupi, faveira and faveira-branca, is widespread, occurring from the south of Panama to the central region of the Amazon, in upland forest and clay soil.[94,95] It is a large species, its height can vary from 20 to 40 m and the diameter, from 40 to 70 cm. Its leaves are composed bipinnate, with opposite or sub-opposite pinna with up to 10 pairs, follicle placed with up to 24 pairs and the flowers present yellow color. Its fruit is a linear, slightly curvedand partly woody pod with 22.5 x 4.5 cm dimensions and 14 to 18 seeds per fruit. The seeds are oblong to slightly elliptical, surrounded by brown epicarp, the white-colored endocarp, immersed in sweet-sour gum.[70,95]

The species can be used as food, in traditional medicine, in the wood industry, in afforestation and recovery of degraded soil.[70,96-98] Its wood can be used for paper manufacture with a good yield of cellulose. Its characteristic and good durability allows its use in plywood manufacture, linings, light packaging, among others. In the immature stage, its seeds are edible[70] and from the stem bark, a large amount of essential oils can be extracted, which is also used for the treatment of diseases such as cough, cold, fever, diabetes and bruises and due to the bark present astringent characteristic, its infusions are used to treat ulcers and dysentery.[92]

Pterodon emarginatus Vogel, also known as sucupirabranca and faveira, is an aromatic arboreal species that occurs frequently in the savannas of central and southern Brazil.[99,100] It is medium in size and it can reach 10 to 15 m in height, its wood is dense, with compact interlocked fabric, with smooth yellowish-white bark. Its root can form expansion or tubers, called sucupira potato. Its compound leaves are pinned. The flowers presenta pink color and it is arranged in terminal inflorescences. The fruit is a rounded, indehiscent and winged pod, containing a single seed attached to a woody capsule reversed by oily substances stored in a spongy structure.[99]

It is a species popularly known due to the wide use of hydroalcoholic infusion and decoction of its fruits and seeds in traditional medicine for the treatment of rheumatic disorders, cough, muscle pain, spinal problems, arthritis, arthrosis and inflammation. It is also used as a fortifier and analgesic.[101-103] Some peoples use the stem bark decoction to treat female genitalia region infection.[103] In recent years, the interest in species concerning its bioactive potential has increased significantly due to numerous studies that indicate a great metabolic diversity in its chemical composition.[100] In which metabolites belonging to the terpenoids, fatty acids, steroids, polyphenols, alkaloids and saponins classes have already been identified. Terpenoids are predominant, mainly in essential oils extracted from the fruit and seed, being responsible for the anti-inflammatory activity presented by the seed.[64,103-106]

Phanera splendens (Kunth) Vaz, popularly known as escada-de-jaboti, escada-de-macaco and unha-de-boi, is a liana (vine) with a flattened stem, twisted, with alternating curves similar to a ladder. It intertwines with other trees using them as support, reaching up to 70 m in height and 15 cm in diameter. Its leaves are non-germinated bifoliolate and its flowers exhibit white color.[52] It is a species native to Brazil, occurring in the states of Amazonas, Rondônia, Roraima, Acre, Amapá, Pará and Maranhão.

The species is commonly used by the local indigenous population in traditional medicine. The decoction of its leaves and stem bark are used for various diseases treatment, such as liver and kidney infection, diarrhea, body pain, gastric disorders, diabetes and for malaria treatment.[107-110]

Carried out investigations indicate that the species has high levels of polyphenols in its chemical composition, in addition to fatty acids and steroids. Polyphenols are the main secondary metabolites responsible for the biological properties (antiseptic and antibacterial) exhibited by the plant.[111,112]

LEGUMINOSAE FAMILY CHEMICAL-STRUCTURAL DIVERSITY ASPECTS

In recent years, the investigation of different chemical constituents biosynthesized in different parts of the plant (leaf, fruit, seed, bark and root) in Leguminosae species has been the subject of numerous researches. When it comes to *Libidibia férrea,* the presence of classes of bioactive substances such as fatty acids (linolenic and linoleic acid), phenolic acids, flavonoids, hydrolyzable tannins (galotanins and ellaganthines), steroids, triterpenes, saponins, anthocyanins, coumarins, quinones and anthraquinones is reported. Among these classes, phenolic compounds are representative, in which gallic and ellagic acid are exaltedly reported as the main *Libidibia ferrea* chemical constituents.[33,35,37,38,113]

For *Inga edulis*, gallic acid, protocatechuic acid, catechin, epicatechin, vicenin-2, quercetin and condensed tannin monomers, proanthocyanidin B1, proanthocyanidin B2, anthocyanins, cyanidin and delphinidin were identified in the leaves.[47,114] At the root, stigmasterol, flavonoids and kojic acid were identified.[115-117] The seeds present in their composition phenolic acids such as p-hydroxybenzoic acid, 4-methoxybenzoic, p-methoxycinnamic, ferulic and caffeic acid, in addition to the high concentration of anthocyanins.[41,114] These substances are mainly responsible for the species natural antioxidant property.[41,47,48,117]

For *Bauhinia purpurea* L, bauhinoxepins from C to J, bauhibenzofurin A, bauhispirorin A, bauhinol E, strobopinine, demetoximatteucinol and bibenzyl were isolated from the root.[49] Bauhiniastatins structures from 1 to 4 were isolated from the leaf, bark and fruit.[118] In the seed oil, fatty acids (palmitic acid, oleic, stearic, elaidic, α-linolenic, γ-linolenic, linolenic, eicosapentenoic acid and high linoleic acid content), phytosterols (Δ5-avenasterol, Δ7-avenasterol, Δ7-stigmastenol, β sitosterol, stigmasterol and campesterol) and tocopherols (β tocopherol and δ Tocopherol) were identified.[62] In the heartwood, kaempferol, taxifoline, 6-butyl-3-hydroxiflavanone, eriodicthiol, quercetin, phytosteroids (βSitosteryloctadecanoate, tetraeicosanoate of 6 (β-Sitosteryl-3-O-β-glucopyranosidyl), 3β-Hydroxystigmast-5-en-7-one and β Sitosteril-3-O-β-glucopyranoside) and terpenoids (lupenone and lupeol) were identified.[61,119]

For *Phanera splendens*, polyphenols, flavone, 5-Methoxy-7,8,3',4'-dimethylenedioxyflavone, 5,7,8-Trihydroxy-3',4'-methylenedioxyflavone, hydroxyl piperonyl flavanone and the bausplendin structure, identified as a characteristic substance ofspecies belonging to the genus *Bauhinia* were identified in the stem bark. Stigmasterol, sitosterol and stearic acid were also identified.[112] Ethyl gallate, quercetin and rutin were identified in the leaves.[111]

Studies reveal that *Hymenaea courbaril* consists mainly of sesquiterpenes, diterpenes, flavonoids, biscoumarins and oligosaccharides.[71] The seed is rich in xyloglucans and coumarins, in the lipid fraction, α-tocopherol, β-tocopherol and linoleic acid were identified. The pulp is rich in carbohydrates, terpenes and presents high levels of essential fatty acids (oleic and linoleic acid).[71,76,77] Essential fatty acids, tocopherol and phytosterol are responsible for the seed and pulp oxidative stability.[120] The stem bark resin is mainly composed of sesquiterpenes, being responsible for some of the species' bioactive properties. The stem bark is rich in polyphenols, such as Astilbin and polymers of condensed tannin class, which give it a reddish color, in addition to saponins and terpene.[22]

In the chemical composition of *Parkia multijuga*, the presence of carbohydrates, proteins (protein fractions of albumin, globulins, prolamines, acidic and basic glutellins) and fatty acids (palmitic, myristic, stearic and linoleic acids) were reported in the seeds, with predominance of unsaturated fatty acids present, in which oleic acid is representative about the lipid composition of the seeds cotyledons.[93]

In the chemical composition of *Pterodon emarginatus*, studies describe the presence of bioactive classes of substances like fatty acids (saturated and polyunsaturated), terpenoids, flavonoids, isoflavones in fruits and seeds, with sesquiterpenes being (*γ*-muurolene, *β*-karyophylene, spatulenol and *α*-humulene) the predominant class of secondary metabolites in the essential oil extracted from the fruit.[121-123] Phytosteroid (β-sitosterol and stigmasterol) sesquiterpenes, polyphenols (vicenin-2, Aglycone B, Schaftoside and Luteolin-7-O-routinide) and saponins were identified in the leaves.[64,103] And flavonoids classes, triterpene saponins in the species stem bark.[105,124] Figure 3 illustrates isolated and identified with biological properties in Leguminosae species substances.

Hymenaea courbaril and *Pterodon emarginatus* species are aromatic, therefore, the great majority of studies are carried out to characterize its essential oils, often obtained from its seeds and fruits, presenting a great concentration and terpenoids diversity. *Libidibia ferrea*, *Inga edulis, Bauhinia purpurea* and *Phanera splendens* species are known for their composition rich in phenolic substances, being described the chemical composition of the leaves, xylem, stem bark, heartwood, stem, root and fruit.

For *Parkia nitida* and *Schizolobium parahyba* var. *amazonicum* species, no records regarding information on their chemical compositions characterization were found in the used database (*SciFinder*, *Science Direct*, *SciELO*, *Google Scholar*, *Springer*, *Scopus* and *Web of Science*). This may be associated with their use for logging purposes and reforestation of degraded areas. Table 1 presents the description of the main substances identified in different botanical structures of *Bauhinia purpurea, Libidibia ferrea*, *Inga edulis*, *Hymenaea courbaril*, *Pterodon emarginatus, Parkia multijuga*, *Phanera splendens* species.

BIOLOGICAL ACTIVITY ASSOCIATED WITH LEGUMINOSAE SPECIES

Several studies carried out to evaluate the potential in ethanol extracts from the fruit of *Libidibia ferrea*, which presented gallic acid and ellagic acid as main chemical constituents, reveal high antiproliferative potential and tumoral inhibition for the treatment of colorectal cancer, besides antioxidant effect, lipid peroxidation inhibition and chemoprotective in healthy cells.[24] These effects may be related to hydrolyzable tannins (gallic and ellagic acid), acting in the inhibition of carcinogenic cells, protection against oxidative damage and lipid proliferation prevention.[125,126]

The species bark extracts (aqueous and acetone/water) showed high levels of polyphenols, with gallic acid and catechin being the main molecules and obtained positive results when evaluated for antimicrobial, anti-inflammatory and analgesic activity.[33] Phenolic substances can play an antimicrobial action through physical-chemical membrane properties modification, nucleic acid synthesis inhibition, pore formation and toxicity.[33,127]

Several studies report the high antioxidant potential of *Inga edulis* and the ability to act in prevention against oxidation of LDL cholesterol.[47,48,117] According to DIB *et al*. (2019), the seeds extract presents antifungal activity against *Candida ssp., C. buinensis* and *C. tropicalis*. In assays carried out with ethanolic extract of leaves in conjunction with antibiotics, they were able to promote a significant reduction in the minimum inhibitory concentration (MIC) of antibiotics in bacterial strains, thus, reducing the side effects risks.[25]

The *Inga edulis* leaf extract (hydroalcoholic extract) was evaluated for *in vivo* antiulcerogenic activity, showing a positive result for the reduction of ulcerative damage, being directly related to the concentration of the dose. Ulcerative lesions showed a stabilization in 250 and 500 mg Kg^{-1} concentration. High phenolic substances concentration, especially tannins, may be responsible for the antiulcerogenic effects.[128]

The chloroformic, methanolic and aqueous extracts of *B. purpurea* leaves showed antioxidant and antiproliferative activity. The extracts inhibited the proliferation of cancer cells without affecting cell viability in normal cell assays.[67] The stem bark extract showed hypoglycemic activity, inhibiting hemoglobin glycosylation in different physiological glucose concentration over a period of 72 hr, decreasing the glucose-hemoglobin complexes formation, thus increasing the free hemoglobin concentration.[69] The species showed antibacterial activity through the biogenic synthesis of magnesium oxide (MgO) nanoparticles using leaf extract from the alkaline precipitation method. The flavonoids present in the extract act as reducing agents in the synthesis of MgO nanoparticles.

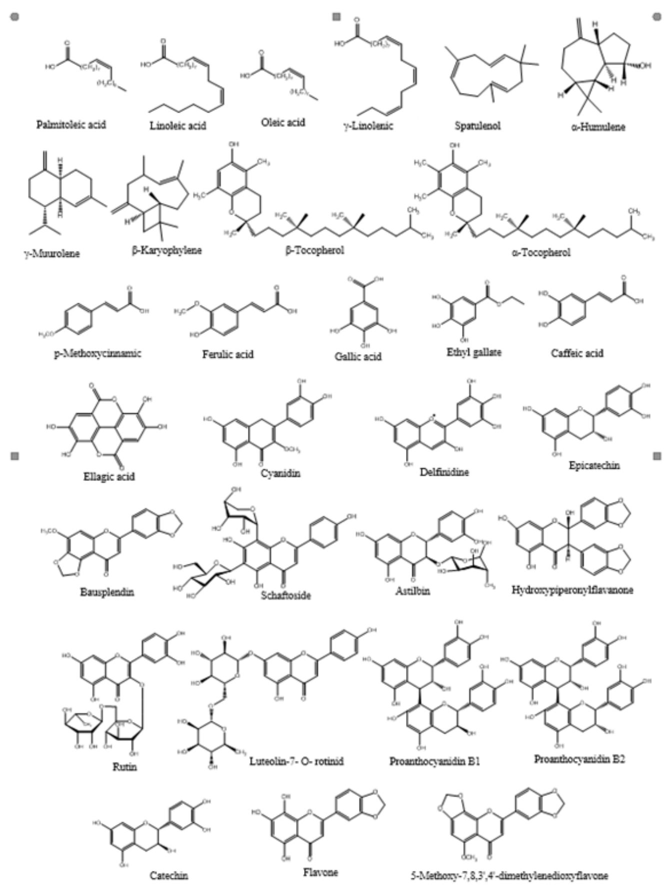

Figure 3: Chemical-structural diversity of the Leguminosae species' bioactive potential.

Table 1: Identified substances in *B. purpurea; L. ferrea, I. edulis, P. splendens, H. courbaril, P. multijugae, P. emarginatus* species.

Species	Substance	Part used	Reference (s)
Saturated and unsaturated fatty acids			
H. courbaril; L. ferrea; P. multijuga; B. purpurea	Linoleic acid	Fr; L; S	[61,62,78, 93,120,129, 130]
H. courbaril; L. ferrea; P. multijuga; B. purpurea	Palmitic acid	Fr; H; L; St. B; S	[61,62,78, 93,120,129, 130]
H. courbaril; L. ferrea; P. splendens; P. multijuga; B. purpurea	Stearic acid	B; Fr; S	[62,78,93, 112,120,129, 131]
H. courbaril; B. purpurea	Eicosanoic acid	S	[62,78,131]
B. purpurea	Eicosenoid acid	S	[62]
H. courbaril	Trans-octadec-9-enoic acid	S	[78]
H. courbaril; P. multijuga; B. purpurea	Myristic acid	S	[78,93,131]
H. courbaril; P. multijuga; B. purpurea	Oleic acid	S	[78,93,131]
H. courbaril	Erucic acid	S	[78]
H. courbaril	Pentadecanoic acid	S	[78]
H. courbaril	Margaric acid	S	[78]
H. courbaril	Caprylic acid	S	[78]
H. courbaril; B. purpurea	Beenic acid	S	[62,78]
B. purpurea	γ-Linolenic acid	S	[62]
H. courbaril	*Cis*-eicos-9-enoic acid	S	[78]
B. purpurea	Eicosapentenoic acid	S	[62]
B. purpurea	*cis*-Tetracosenoic acid	S	[62]
H. courbaril	Lauric acid	S	[78]
L. ferrea; B. purpurea	Elaidic acid	Fr; S	[38,62,129]
H. courbaril; L. ferrea; B. purpurea	Linolenic acid	L; S	[62,78,129-131]
H. courbaril; L. ferrea	Palmitoleic acid	S	[62,78,129]
L. ferrea; B. purpurea	Capric acid	S	[129]
P. emarginatus	14,15-Dihydroxy-14,15-dihydrogeranylgeraniol	Fr	[132]
Tocopherols			
B. purpurea	Racealfatocopherol acetate	L	[130]
B. purpurea	β Tocopherol	L; S	[62,130]
B. purpurea	δ Tocopherol	S	[62]
Terpenoids and Steroids			
P. emarginatus	Citronelila acetate	Fr	[121]
P. emarginatus	*trans*-Nerolidila acetate	Fr	[121]
P. emarginatus	α-Amorphene	Fr	[121]
P. emarginatus	Dauca-5,8-diene	Fr	[121]
B. purpurea	Δ5-Avenasterol	S	[62]
B. purpurea	Δ7-Avenasterol	S	[62]
P. emarginatus	α-cadinol	Fr	[121]
B. purpurea	Campesterol	S	[62]
H. courbaril	*cis*-Caryophyllene	L	[133]
P. emarginatus	Longifolene	Fr	[121]
P. emarginatus	α -Gurjunene	Fr	[121]
P. emarginatus	γ-Gurjunene	Fr	[121]
P. emarginatus	(2*trans*,6*cis*)-Farnesol	Fr	[121]
P. emarginatus	α-Ylangene	Fr	[121]
H. courbaril; P. emarginatus	α-Copaene	Fr; L	[73,121,133]
H. courbaril	(+)-β-Selinene	L	[133]
H. courbaril; P. emarginatus	(+)-δ-Cadinene	Fr; L	[121,133]
H. courbaril	β-Copaene	L	[133]
H. courbaril	(-)-α-Himachalene	S	[134]
H. courbaril; P. emarginatus	(-)-α-Muurolene	Fr; L	[121,133,134]
H. courbaril	(-)-β-Bourbonene	S	[134]
H. courbaril	Selina-4(14),7-diene	S	[134]
H. courbaril	(+)-Calarene	S	[134]
H. courbaril	Ciclosativene	S	[134]
H. courbaril	α-Calacorene	Fr	[73]
H. courbaril	Labdan-13-en-8β-ol-15-oic acid	B; Fr;	[71,135]
H. courbaril	Eperua-7,13-dieno-15-oic acid	B; L	[135]
H. courbaril	Lab-13-en-8β-ol-15-oic acid	B; L	[139]
H. courbaril	(-)-Ozic acid	S	[136]
H. courbaril	(-)-isoozic acid	S	[136]
H. courbaril	(-)-kolavenic acid	S	[136]
H. courbaril	Methyl (5S*,8S*,9S*,10R*)-cleroda-3,13*E*-dien-15-oate	S	[80,136]
H. courbaril	Methyl (-)-kovalenate	S	[80]
H. courbaril	(5R*,8S*,9S*,10R*)-cleroda-3,13*E*-dien-15-oic acid	S	[80,136]
H. courbaril	Methyl (-)-eperuate	B	[137]
H. courbaril	Methyl (-)-isoozate	B	[137]
H. courbaril	Methyl (-)-ozate	B	[137]
H. courbaril	Methyl (-)-kolavenate	B	[137]
B. purpurea	Ergosterol peroxide	St. B	[61]
B. purpurea	Ergost-5-eno-3-ol acetate	L	[130]
H. courbaril	Methyl (-)-zanzibarate	B	[137]
H. courbaril	(13*R*)-2-Oxo-13-hydroxy-1 (10), 14- *ent*-halimadien-18-oic acid	B; Br; L	[138]

H. courbaril	Labdan-8-β-ol-15-oic acid	B; Fr	[71,135]
H. courbaril	(13*R*)-13-Hydroxy-1(10), 14- *ent*-halimadien-18-oic acid	B; Br; L	[138]
H. courbaril	(2*S*,13*R*)-2,13-Di-hydroxy-1 (10), 14- *ent*-halimadien-18-oic acid	B; Br; L	[142]
H. courbaril	Spathulenol	Fr	[71]
H. courbaril	Crotomachlin	Fr	[71]
H. courbaril	Labd-13*E*-en-8-ol-15-oic acid methylester	S	[71]
H. courbaril	(13*trans*)-Labd-7,13-dien-15-oic acid	L; S	[71]
H. courbaril	Labd-8 (17),13*trans*-dieno-15-oic acid	S	[71]
H. courbaril	(-)-*trans*-Caryophillene	Re	[139]
H. courbaril; P. emarginatus	Caryophyllene oxide	Re; Fr	[121,139]
H. courbaril	Zanzibaric acid	Fr	[73]
B. purpurea	Betulinic acid	St. B	[61]
H. courbaril	Caryolane-1,9β-diol	Fr	[73]
H. courbaril; P. emarginatus	(+)-Bicyclogermacrene	Fr; L	[73,121,103]
H. courbaril	*cis*-Muurola-3,5-diene	Fr	[73]
H. courbaril; P. emarginatus	(+)-δ-Amorphene	Fr	[73,121]
H. courbaril	(+)-7-*epi*-Sesquithujene	Fr	[73]
H. courbaril	1-*epi*-Cubenol	Fr	[73]
H. courbaril	*trans*-Cadina-1,4-diene	Fr	[73]
H. courbaril	Amorfa-4,7(11)-diene	Fr	[73]
H. courbaril	*trans*-Muurola-4(14),5-diene	Fr	[73]
H. courbaril	Camphoric acid	Fr	[73]
H. courbaril	Amorpha-4,9-dieno-2-ol	Fr	[73]
H. courbaril	(+)-α-Ylangene	Fr	[73]
H. courbaril	*trans*-Cadina-1(6),4-diene	Fr	[73]
P. emarginatus	Germacrene A	Fr	[121]
H. courbaril	Germacrene B	Fr	[73]
H. courbaril	Selin-11-en-4-α-ol	Fr	[73]
H. courbaril	*epi*-α-Muurolol	Fr	[73]
H. courbaril	α-Muurolol	Fr	[73]
H. courbaril; P. emarginatus	Humulene epoxide II	Fr	[73,121]
H. courbaril	α-*trans*-Bergamotene	Fr	[73]
H. courbaril	δ-Elemene	Fr	[73]
H. courbaril	β-*cis*-Farnesene	Fr	[73]
H. courbaril	α-Cadinene	Fr	[73]
H. courbaril; P. emarginatus	(±)-γ-Cadinene	Fr	[73,121]
H. courbaril; P. emarginatus	*allo*-Aromadendrene	Fr	[73,121]
H. courbaril	Salvial-4(14)-en-1-one	Fr	[73]
H. courbaril	*trans*-Calamenene	Fr	[73]
H. courbaril	β-Copaeno-4α-ol	Fr	[73]
H. courbaril	Mustakone	Fr	[73]
H. courbaril	(+)-Aromadrendrene	Fr	[73]
H. courbaril; P. emarginatus	(-)-Globulol	Fr	[73,121]
H. courbaril	(-)-Cyperene	Fr	[73]
H. courbaril	Levomenol	Fr	[73]
H. courbaril	(-)-Copalic acid	Re	[140]
B. purpurea	Oleanolic acid	St. B	[61]
H. courbaril	(5S, 9S, 10R)-*ent* -Labd-8(17) -en-15 ethyl acetate	Re	[140]
H. courbaril	Copalic acid [5-(2-methylene-5,5,8a-trimethyl-(1*R*,4a*R*,8a*R*)-decahydronaphthalen-1-yl)-3-methylpent-2*E*enoic Acid	Re	[140]
H. courbaril, P. emarginatus	γ-Muurolene	Fr	[73,121]
H. courbaril; P. emarginatus	(-)-α-Cubebene	Fr; L	[73,121,133]
P. emarginatus	β-Cubebene	Fr	[121]
H. courbaril	(±)-β-Humulene	L	[133]
B. purpurea	β-Sitosterilhexadecanoate	H	[119]
B. purpurea	β-Sitosteriloctadecanoate	H	[119]
B. purpurea	6'-(β-Sitosteroyl-3-*O*-β-glucopyranosidyl) hexadecanoate	B; H	[61,119]
B. purpurea	6'-(β-Sitosteryl-3-O-β-glucopyranosidyl) tetraeicosanoate	H	[119]
B. purpurea	β-Sitosteroyl-3-*O*-β-glucopyranoside	H; St. B	[61,119]
H. courbaril	(-)-α-Selinene	L	[133]
P. emarginatus	9-*epi*-*trans*-Caryophillene	Fr	[121]
B. purpurea	5,7-Di-hydroxychromone	St. B	[61]
P. emarginatus	14-Hydroxy-*trans*-caryophillene	Fr	[121]
P. emarginatus	*trans*-Caryophyllene	S	[122]
P. emarginatus	β-caryophillene	Fr	[141]
H courbaril; P. emarginatus	Germacrene D	S	[73,122]
P. emarginatus	Spathulenol	Fr; S	[121,122]
H. courbaril; P. emarginatus	α-Humulene	Fr; L	[122,133]
B. purpurea	Δ7-Stigmastenol	S	[62]
P. emarginatus	γ- Muurolene	Fr; L	[103,121]

H. courbaril; P. emarginatus	β-Elemene	S	[73,122]
P. emarginatus	Hederagenin-3-O-rhamnosyl galactosyl glucuronide	L	[64]
B. purpurea	Lanosterol	L	[130]
L. ferrea ;B. purpurea	Lupenone	Fr;H	[38,119]
P. emarginatus	(*trans*, *trans*)-Geranillinalool	Fr	[121]
P. emarginatus; B. purpurea	Lupeol	Fr; H; L	[119,130,142]
P. emarginatus	14,15-Epoxygeranylgeraniol	Fr	[143]
P. emarginatus; P. splendens; B. purpurea	Stigmasterol	B; H; L; S; St. B	[62,103,112, 109]
I. edulis	7,22-Stigmastedien-3β-ol	R	[61,62, 119,144]
B. purpurea	6'-(Stigmast-5-en-7-one-3-O-β-glucopyranosidyl) hexadecanoate	St. B	[61]
I. edulis	7,22-Stigmastedien-3-β-ol glycoside	R	[144]
B. purpurea	Stigmast-5-ene-3-ol	L	[130]
I. edulis	Stigmasterol 3-O-β-D-glucopyranoside	B	[145]
B. purpurea	6α-Hydroxystigmast-4-en-3-one	St. B	[61]
B. purpurea	6β-Hydroxystigmast-4-en-3-one	St. B	[61]
B. purpurea	3β-Hydroxystigmast-5-en-7-one	H; St. B	[61,119]
B. purpurea	6β-Hydroxystigmast-4,22-dien-3-one	St. B	[61]
B. purpurea	3-*p*-(E)-Coumaroyloleanolic acid	St. B	[61]
P. emarginatus	6 α,7β-Dihydroxy-vouacapan -17β- oic acid	Fr	[123]
P. emarginatus	Salvial-4(14)-en-1-one	Fr	[121]
P. splendens	Sitosterol	B	[112]
L. ferrea	γ-Sitosterol	Fr	[38]
P. emarginatus; B. purpurea	β-Sitosterol	H; L; S; St. B	[61,62, 103,119]
B. purpurea	14α-Taraxeran-3-one	St. B	[61]
P. emarginatus	Soyasaponin Be	L	[64]
P. emarginatus	Soyasaponin Bb	L	[64]
P. emarginatus	Aglycone B-3-O-rhamnosyl galactosyl glucuronide	L	[64]
P. emarginatus	Hederagenin-3-O-rhamnosyl galactosyl glucuronide	L	[64]
PhenolicAcids			
I. edulis	Caffeic acid	S	[114]
I. edulis	p-Methoxycinnamic acid	S	[114]
I. edulis	p-Hydroxybenzoic acid	S	[114]
I. edulis	4-Methoxybenzoic acid	S	[114]
I. edulis	Ferulic acid	S	[114]
I. edulis	Protocateuic acid	L	[114]
I. edulis; L. ferrea	Gallic acid	B; Fr; L; RF	[33,34,37, 114,116, 146,147]
L. ferrea	Methyl gallate	Fr; RF	[147,148]
B. purpurea	Isotacioside	H	[119]
B. purpurea	3-(4-Hydroxy-3-methoxyphenyl)-1,2-propanediol	St. B	[61]
B. purpurea	2-(4-Hydroxy-3-methoxyphenyl)-1,3-propanediol	St. B	[61]
P. splendens	Ethyl gallate	L	[149]
B. purpurea	Alkyl diacetate caffeate	St. B	[61]
L. ferrea	2-(2,3,6-Trihydroxy-4-carboxyphenyl) ellagic acid	Fr	[150]
L. ferrea	Ellagic acid	B; Fr	[37,150]
L. ferrea	3,4-Dimethylbenzadehyde	Fr	[38]
L. ferrea	Di-2-ethylhexylphthalate	Fr	[38]
B. purpurea	Vanillic acid	H	[119]
Chalcones			
L. ferrea	Pauferrol A	B	[151]
L. ferrea	Pauferrol B	B	[152]
L. ferrea	Pauferrol C	B	[152]
B. purpurea	2,4'-Dihydroxy-4-methoxy-dihydrochalcone	St. B	[63]
Coumarins			
H. courbaril	Ipomopsin	S	[76]
H. courbaril	Hymenain	S	[76]
H. courbaril	Hymenain 7- O -β-glucopyranosyl-(1′→2′) -O-α-apiofuranosyl-(1′→2′) - O-α-galactopyranoside	S	[77]
H. courbaril	Hymenain 7-O -β-glucopyranosyl-(1′→ 2′)-O-α-apiofuranoside	S	[77]
Polyphenols			
I. edulis	Apigenin C-di-hexoside	L	[47]
B. purpurea	Chrysin	St. B	[61]
L. ferrea	Catechin	B	[33,37]
H. courbaril	Astilbin	B; L	[22]
P. splendens	Dimethylenedioxyflavone	B	[112]
B. purpurea	Bauhinoxepin C	R	[49]
B. purpurea	Bauhinoxepin D	R	[49]
B. purpurea	Bauhinoxepin E	R	[49]

B. purpurea	Bauhinoxepin F	R	[49]
B. purpurea	Bauhinoxepin G	R	[49]
B. purpurea	Bauhinoxepin H	R	[49]
B. purpurea	Bauhinoxepin I	R	[49]
B. purpurea	Bauhinoxepin J	R	[49]
B. purpurea	Bauhibenzofurin A	R	[49]
B. purpurea	Bauhispirorin A	R	[49]
B. purpurea	Bauhinol E	R	[49]
B. purpurea	Bauhiniastatin-1,5,7,3',4',5'-Pentamethoxyflavone	St. B	[63]
B. purpurea	6-Butyl-3-hydroxyflavanone	H	[153]
B. purpurea	6-(3"-Oxobutyl)taxifolin	H	[153]
B. purpurea	Bauhiniastatin 1	B; Fr; L; St. B	[63,118]
B. purpurea	Bauhiniastatin 2	B; Fr; L	[118]
B. purpurea	Bauhiniastatin 3	B; Fr; L	[118]
B. purpurea	Bauhiniastatin 4	B; Fr; L	[118]
B. purpurea	Bis[3',4'-dihydroxy-7,8-furano-5',6'-monomethylallyloxy]-5-C-5-biFlavonyl	L	[154]
B. purpurea	Bibenzil	R	[49]
B. purpurea	Demethoxymatteucinol	R	[49]
H. courbaril	Fisitinediol	X	[79]
H. courbaril; B. purpurea	Taxifolin	H; X	[79,119]
H. courbaril	Fustin	X	[79]
H. courbaril	Fisetin	X	[79]
H. courbaril	3-O-methyl-2,3-*trans*-fustin	X	[79]
B. purpurea	Kaempferol	St. B; Ce	[63,119]
H. courbaril ; I. edulis; L. ferrea;	Epicatechin	B; L	[37,47, 116,155]
B. purpurea	Eriodictiol	H	[119]
I. edulis	Procyanidin B1	L	[116]
I. edulis	Procyanidin B2	L	[116]
B. purpurea	Preracemosol B	St. B	[63]
B. purpurea	Isoliquiritigenin 2'-methyl ether	St. B	[63]
I. edulis	2-Rhamnopyranosyl-4,6-dihydroxyphenyl gallate	RF	[114]
I. edulis	Delphinidin	L	[116]
I. edulis	Quercetin-3-O-α-L-rhamnopyranoside	L	[116]
I. edulis	Myricetin-3-O-a-L-rhamnopyranoside	L	[116]
I. edulis	Myricetin-O-hexose-deoxyhexose	L	[47]
I. edulis	Myricetin-O-deoxyhexose	L	[47]
P. emarginatus	Myricetin-3-O-glucoside	L	[64]

P. emarginatus	Myricetin-3-O-acetylglucoside	L	[64]
P. splendens	Bausplendin	B	[112]
P. splendens	5-Methoxy-7,8,3',4'-dimethylenedioxyflavone	B	[112]
P. splendens	Flavone	B	[112]
P. splendens	5-Hydroxy-7,8,3',4'-dimethylenedioxyflavone	B	[112]
B. purpurea	4'-Hydroxy-7,3'-dimethoxyflavan	St. B	[63]
B. purpurea	2,4'-Dihydroxy-4-methoxydihydrochalcone	St. B	[63]
B. purpurea	(4'-Hydroxy-7-methyl-C-α-L-rhamnopyranosyl) -5-C-5- (4'-hydroxy-7-methyl-3-C-α-D-glucopyranosyl) biflavonoid	L	[154]
P. splendens	5,7,8-Trihydroxy-3',4'-methylenedioxyflavone	B	[112]
P. splendens	7-Benzyloxy-5,8-dihydroxy-3 ', 4'-methylenedioxyflavone	B	[112]
P. splendens	7-Benzyloxy-5-hydroxy-3',4'-methylenedioxyflavone	B	[112]
P. splendens	Hydroxypiperonylflavanone	B	[112]
P. splendens	Diaroylmethane	B	[112]
P. splendens	5,7-Dihydroxy-3',4'-methylenedioxyflavone;	B	[112]
B. purpurea	5,7-Dihydroxy-6,8-dimethylflavone	St. B	[61]
I. edulis	5,4,4'-Trihydroxy-6,8-dimethylflavone	R	[144]
I. edulis	5,7,3',4'-Tetrahydroxy-3-methoxyflavone	R	[144]
I. edulis	6,3',4'-Trihydroxyaurone	R	[144]
I. edulis	Cyanidin	L	[116]
I. edulis; L. ferrea; P. splendens; B. purpurea	Quercetin	H; L	[111,116, 119,146]
I. edulis	Ingacamerounol	L	[145]
I. edulis	Myricetin	L	[116]
B. purpurea	3-Metoxi-5,7,3',4'-tetra-hydroxyflavone	H	[119]
P. splendens	Rutin	L	[111]
P. emarginatus	Lucenin-2	L	[64]
I. edulis P. emarginatus	Vicenin-2	L	[47,64]
P. emarginatus	Schaftoside	L	[64]
P. emarginatus	Schaftoside-2"-O-rhamnoside	L	[64]
P. emarginatus	Chrysoeriol-8-C-glucosyl-2"-O-Glucuronide-6-C-arabinoside	L	[64]
B. purpurea	(-)-Strobopinin	R	[49]
P. emarginatus	Luteolin-7-O-rotinid	L	[64]

P. emarginatus	Luteolin 8-C-glucosyl-6-C-arabinoside	L	[64]
B. purpurea	Strobochrysin	St. B	[61]
P. emarginatus	Aglycone B	L	[64]
Carbohydrates			
B. purpurea	Bornesitol	H	[119]
L. ferrea	D-mannose	S	[156]
L. ferrea	D-galactose	S	[156]
Alkaloids			
P. emarginatus	Chrysoeriol-8-C-glucosyl-2″-O-glucuronide-6-C-arabinoside	L	[64]
Saponins			
P. emarginatus	Oleanane-typesaponins	L	[64]
Other classes			
I. edulis	Kojic acid	R	[144]
B. purpurea	Alkane	St. B	[61]
B. purpurea	Glycerol	H	[119]
I. edulis	Glycerol 1-tetracosanoil	B	[145]
I. edulis	Glycerol 1-24-hydroxytetracosanoil	B	[145]
B. purpurea	2,3,3-Dihydroxypropyl hexadecanoate	H	[119]
B. purpurea	Methylhexadecanoate	H	[119]
P. emarginatus	n-Hexadecanol	Fr	[121]
B. purpurea	Squalene	St. B	[61]
B. purpurea	Phytol	L	[130]
P. emarginatus	6-Methyl-2-heptanol	Fr	[121]
B. purpurea	1-Glyceryl monoalkanoate	St. B	[61]
B. purpurea	2,3-Dihydroxypropyl octadecanoate	H	[119]
B. purpurea	Methyloctadecanoate	H	[119]
B. purpurea	2,3-Dihydroxypropyl oleate	St. B	[63]
B. purpurea	Glyceryltrilinoleate	St. B	[61]

Legend: L: Leaf; S: Seed; Fr: Fruit; Fl: Flower; St.B: Stem bark; B: Bark; R: Root; Br: Branch; X: Xylem Sap; H: Heartwood.

The results showed high inhibition against *S. aureus* at low doses (250 µg / ml).[65,118]

The *Hymenaea courbaril* chemical composition is quite varied, presenting several bioactive properties, among them, studies show that *in vivo* (isolated trachea from rats) bioassays carried out to evaluate the myorelaxant, anti-inflammatory and antioxidant properties of ethanolic extract and of an isolated flavonoid (astilbine), both obtained from the stem bark, exhibited activities. However, the isolated substance showed higher activity about the ethanolic extract astilbine.[22] The species has shown to be able to induce relaxing effects in trachea rings, the antioxidant potential presented by the species can act on the airway hyper responsiveness presented in the asthmatic process and inhibition in the expression of pro-inflammatory cytokines, eliminating lymphocyte, macrophage and migration cell function.[22,157]

Studies report the presence of serinoproteinase inhibitors in extracts of leaves and seeds of *Parkia multijuga*, showing positive results for inhibition on trypsin and chymotrypsin. Itexpresses the potential

Table 2: Activities associated with the biological potential of Leguminosae species.

Species	Biological activity	Kind of study	Part used	Reference
	Antioxidant	*in vitro*	Fl; L	[58,63, 67,164]
	Antimicrobial	*in vitro*	L; S	[58,130, 165,166]
	Antimalarial	*in vivo*	R	[49]
	Antifungal	*in vitro*	R	[49
	Anti-inflammatory	*in vivo; in vitro*	St. B; L; R	[49,69, 167-169]
	Cytotoxicity	*in vivo*	R	[49]
	Hepatoprotective	*in vivo; in vitro*	L; S	[170,171]
B. purpurea	Hypoglycemic	*in vivo; in vitro*	St. B; L; R	[69, 172-174]
	Antimicrobial	*in vitro*	St. B; Fl; L; R	[49,65, 175,176]
	Anticarcinogenic	*in vivo*	L	[68]
	Antiulcer	*in vivo*	L	[59,66,177]
	Antihyperlipidemic	*in vivo*	St. B; L	[178,179]
	Antineoplastic	*in vivo*	L	[118]
	Antileishmanial	*in vivo*	-	[180]
	Antipyretic	*in vivo*	L	[168]
	Anti-obesity	*in vivo*	St. B	[3,177]
	Antiproliferative	*in vitro*	L	[67]
L. ferrea	Anti-microbial	*in vitro*	St. B; Fr	[33,148, 181,182]
	Antiproliferative	*in vitro*	Fr	[24]
	Anticarcinogenic	*in vitro*	Fr	[24]
	Antioxidant	*in vitro*	Fr; L	[24,146]
	Chemoprotector	*in vitro*	Fr	[24]
	Antifungal	*in vitro*	F	[34]
	Anti-inflammatory	*in vivo*	St. B; Fr	[33,38,183]
	Antinociceptive	*in vivo*	St. B; Fr; S	[33,129,183]
	Antileishmanial	*in vivo; in vitro*	Br; Fr; L	[35]
	Antiviral	*in vitro*	S	[156]
	Healing	*in vivo*	Fr	[36]
	Anti-wrinkle	*in vitro*	St. B; Fr	[23]
	Anti-whitening	*in vitro*	St. B; Fr	[23]
	Inhibition of aldose reductase	*in vitro*	Fr	[184]
	Cardioprotector	*in vivo; in vitro*	St. B	[185]
	Hypoglycemic	*in vivo*	St. B	[37,150]
I. edulis	Antioxidant	*in vitro*	Fr; L; S	[41,43,47,48, 117,186]
	Antifungal	*in vitro*	S	[187]
	Antimicrobial	*in vitro*	L	[25]
	Cytotoxicity	*in vitro*	L	[47]

H. courbaril	Antioxidant	*in vitro*	Fr. P; Fr; L; H; S; St. B	[22,76,188-190]
	Anti-inflammatory	*in vivo*	St. B; Fr	[22,71]
	Myorelaxant	*in vivo*	St. B	[22]
	Antiviral	in vitro	L	[191]
	Larvicide	*in vitro*	B; Fr	[73]
	Antifungal	*in vitro*	X	[79]
	Cytotoxicity	*in vivo*	Fr. P; L; S; X	[79,188]
	Antibacterial	in vitro	S	[136]
P. emarginatus	Anti-inflammatory	*in vivo*	Fr; S; St. B;	[105,106, 122,123,192]
	Antimicrobial	*in vitro*	Fr; L; S; St. B	[103,124, 160]
	Antinociceptive	*in vivo*	L; S	[64,123, 193]
	Antioxidant	*in vivo; in vitro*	L; S	[194,195]
	Antileishmanial	*in vitro*	S	[160]
	Healing	*in vivo*	S	[196]
	Hypoglycemic	*In vivo*	Fr	[192]
	Antitumor	*in vivo; in vitro*	Fr	[143]
	Antiulcerogenic	*in vivo*	S	[197]
	Larvicide	*in vivo*	Fr	[198]
	Cytotoxicity	*in vivo*	S	[149]
P. splendens	Antinociceptive	*in vivo*	B; L;R; St. B	[149]
	Antibacterial	*in vitro*	L	[163]
P. multijuga	Inhibition of serinoproteinases	*in vitro*	L	[159]

Legend: L: Leaf; S: Seed; Fr: Fruit; Fl: Flower; St. B: Stem Bark; B: Bark; R: Root; Br: Branch; Fr. P: Fruit Peel; X: Xylem Sap; H: Heartwood.

for future application of assays for bioactivities such as antifungal, antimicrobial and insecticide.[158,159] The prospect of obtaining molecules with bioactive properties reveals the relevance of information concerning their chemical composition. However, the description of its chemical constituents has not been investigated yet.

Several studies have been carried out to evaluate the bioactive potential of *Pterodon emarginatus,* mainly associated with its essential oil. This oil, extracted from the seed, has antibacterial properties, as it can inhibit the growth of *Staphylococcus aureus*, a micro-organism responsible for pneumonia, meningitis, septicemia, abscesses and pyoderma.[160]

The stem bark showed anti-inflammatory activity, which is associated with triterpenes (lupeol and betulin) isolated from the ethanolic extract.[105] Lupeol presented anti-inflammatory property, acting in pro-inflammatory cytokines neutralization. In this way, it can obtain efficient control of inflammation, which may cause a systemic inhibition of the inflammatory state.[105,161] Betulin is an effective substance in inflammation treatment, as it can inhibit the phospholipase A2 enzyme and the prostaglandin E2 generation.[105,162] The leaves' hydroalcoholic extract showed antinociceptive properties, which may be attributed to the flavones and hederagine derivatives identified in the species.[64]

In vitro assays were performed on *Phanera splendens* to evaluate the antibacterial properties of leaf extracts (Dichloromethane and ethyl acetate), in which presented the activity to inhibit Gram-positive and Gram-negative bacteria. Exhibiting activity against *Salmonella typhimurium* at different concentrations (1,25-3,75 mg). Dichloromethane extracts also presented activity against *Staphylococcus aureus* and *Streptococcus* sp., for 2,5 mg/disc concentration, the inhibition zones were 18 and 26, respectively.[163] The extract with higher polarity was more efficient in inhibiting bacteria. Table 2 presents the main biological activities, the type of study (*in vivo* or *in vitro*) and the part of the plant used in the assays.

Table 2 displays an overview of the main *in vitro* and *in vivo* biological activities presented by species (*Libidibia ferrea*, *Inga edulis, Bauhinia purpurea* and *Phanera splendens*, *Hymenaea courbaril* and *Pterodon emarginatus*).

The assays focused mainly on extracts obtained from the stem bark, leaf, fruit and seed. The extracts that showed the most activity had high polyphenols and terpenoids concentration. No records on biological activity assays performed for *Parkia nitida* and *Schizolobium parahyba* var. *amazonicum* were found in the current databases (*SciFinder*, *Science Direct*, *SciELO*, *Google Scholar*, *Springer*, *Scopus* and *Web of Science*).

CONCLUSION

Leguminosae is the largest family in the kingdom Plantae present in the Brazilian territory and its wide biodiversity is present in almost all national flora. The knowledge of its chemical constituents, its botanical and evolutionary aspects and its applications put Brazil in a strategic position to obtain bioactive molecules in a sustainable way from this family. This review described the metabolites identified in *Libidibia ferrea*, *Inga edulis, Bauhinia purpurea, Hymenaea courbaril*, *Schizolobium parahyba* var. *amazonicum*, *Parkia multijuga*, *Parkianitida*, *Pterodon emarginatus* and *Phanera splendens* species, as well as its mechanism of action and its biological properties (*in vivo* and *in vitro*), to present theoretical subsidies for new research.

Several studies have investigated the chemical composition and biological properties of *Libidibia ferrea*, *Inga edulis*, *Hymenaea courbaril*, *Pterodon emarginatus* and *Phanera splendens* species. This interest may have been aroused due to the high amount of ethnobotanical studies on these plants frequently used in traditional medicine. On the other hand, studies on the chemical composition and biological properties of *Schizolobium parahyba* var. *amazonicum*, *Parkia multijuga* and *Parkia nitida* species are scarce, probably due to the widespread use of these plants in the timber industry and the recovery of degraded areas.

Hymenaea courbaril and *Pterodon emarginatus* are aromatic plants and feature a wide description of the chemical composition of their essential oil. *Libidibia ferrea*, *Inga edulis, Phanera splendens* and *Hymenaea courbaril* are plants rich in phenolic substances and this secondary metabolic class is responsible for innumerable biological activities presented by them. *Schizolobium parahyba* var. *amazonicum*, *Parkia multijuga* and *Parkia nitida* have a large volume of research aimed at evaluating the potential for germination and genetic improvement, as they present silviculture characteristics.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

DNA: Deoxyribonucleic Acid; **LDL:** Low Density Lipoproteins; **MgO:** Magnesium Oxide; **MIC:** Minimum Inhibitory Concentration.

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