International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-8, Issue-9; Sep, 2021
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.89.11

# Prospection of antioxidant action of phytochemicals of *Mimosa tenuiflora* (Jurema-Preta)

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Received: 30 Jul 2021,

Received in revised form: 03 Sep 2021,

Accepted: 11 Sep 2021,

Available online: 15 Sep 2021



***Keywords*–Antioxidants, phytochemicals, *Mimosa tenuiflora*. Pharmacology.**

***Abstract*—** *Objective: The objective this work was to observe phytochemical studies and the antioxidant action of extracts and fractions of different parts of Mimosa tenuiflora (Willd) Poir. Methodology: Search in the database: PubMed, SciELO, Medline via BVS, Lilacs via BVS, Science direct and Cochrane, through the scientific descriptors: "Mimosa tenuiflora and antioxidant"; "Mimosa tenuiflora and phytochemicals"; "Mimosa tenuiflora", has published from january 1990 to june 2021. The inclusion criteria used were: 1) phytochemical studies of Mimosa tenuiflora; 2) antioxidant studies of Mimosa tenuiflora in vivo and in vitro models; 3) available in full texts. The exclusion criteria were articles that were not related and relevant to the theme, duplicated articles and those unavailable for full reading. Results: 24 studies identified the phytochemicals of M. tenuiflora, only 5 of these studies showed antioxidant activity in vitro. The compounds present in the extracts and fractions of different parts of the plant were phenolic compounds, flavonoids, flavonols, xanthones, flavones, polyphenols and tannins. Conclusion: The studies showed wide phytochemical variety present in extracts and fractions of different parts of the plant and few studies showing antioxidant activity of phytoconstituents of M. tenuiflora. The phenolic, flavonoids and polyphenols compounds were the major compounds in the studies involving analysis of the antioxidant activity of M. tenuiflora.*

## I. INTRODUCTION

The *Mimosa tenuiflora (Willd.) Poir*., popularly known as "jurema-preta", is a scrubby plant of the Fabaceae-Minosaceae family, native from regions of the Brazilian semi-arid, especially in the caatinga (Albuquerque et al., 2018). In folk medicine, the bark of the stem and root of *M. tenuiflora* are used in the treatment of several diseases, such as inflammation (Martínez-Higuera et al., 2021), wounds and in indigenous and Afro-Brazilian rituals (Grünewald & Azeredo, 2018a, 2018b; Kaasik et al., 2021).

The plants are made up of chemical compounds, known as secondary metabolites, which are formed from products derived from photosynthesis and synthesized by four biosynthesis pathways, the acetate malonate, mevalonic acid, methylerythritol phosphate and shikimic acid pathways (Ahanger et al., 2020; Twilley et al., 2020). The most prevalent phytochemicals in plants are the phenolic compounds (Bresciani et al., 2017; Pasquariello et al., 2020), Many of these fitoconstituents interact with molecules of human organism producing pharmacological action (Li et al., 2020; Wan et al., 2021; Zia et al., 2021)

Studies indicate that phenolic compounds, particularly the flavonoids, are responsible for the antioxidant activity present in the extracts of these plants (Li et al., 2014; Lyu et al., 2020; Sagandykova et al., 2021). It should be emphasized that due to its chemical structure and reducing property, these phytochemicals have the power to eliminate free radicals, inhibit enzymes, in addition to forming molecular complexes and inactivating reactive metal ions, also denominated free radicals (Tahjib-Ul-Arif et al., 2021; Wu et al., 2020).

Free radicals are atoms or molecules with unpaired electrons in the valence layer, extremely reactive, endogenously stemmed from the oxide-reduction reactions of oxygen or nitrogen aerobic metabolism, and or through exogenous sources such as ionizing radiation, X-ray range, ultraviolet light, air pollutants (Liu et al., 2020; Rai et al., 2021). These xenobiotics when not nullified by the antioxidant system, cause acute and cumulative damages, characterized by oxidative stress (Guerra et al., 2021). The oxidation of important biomolecules such as membrane and lipids circulators, proteins and genomic material occur several mechanisms leading to varied dysfunctions e neurodegenerative dissease (Jiang et al., 2016). compounds in *M tenuiflora* extracts proved to be safe and effective in modulating oxidative effects on cell proliferation (Vieira et al., 2021).

The understanding of the phytoconstituents antioxidant profile has been showing therapeutic alternatives in the prevention of degenerative diseases and as adjuvants in curative therapy. The objective of this work was to observe phytochemical studies and the antioxidant action of extracts and fractions of different parts of *Mimosa tenuiflora (Willd) Poir*.

## II. METODOLOGY

This is a systematic review to check the phytochemicals identified in *Mimosa tenuiflora* (*Willd.*) *Poir*. which have antioxidant activity. The systematic review was based on instructions in the Preferred Reporting Items for Systematic Reviews (PRISMA) method (Moher et al., 2009). The date of search for the studies was until June 2021. The selection of the studies was made in the following databases: PubMed, SciELO, Medline via VHL, Lilacs via VHL, Science direct, Cochrane, involving the scientific descriptors: "*Mimosa tenuiflora* and antioxidant"; "*Mimosa tenuiflora* and phytochemicals"; "*Mimosa tenuiflora*".

### 2.1 ELIGIBILITY CRITERIA

The eligibility criteria were considered: 1) phytochemical studies of *Mimosa tenuiflora* 2) antioxidant studies of *Mimosa tenuiflora* in clinical trials, in vivo and in vitro models; 3) available in full texts.

### 2.2 EXCLUSION CRITERIA

After reading the titles and abstracts, articles unrelated to the topic were excluded. In a second moment were removed the duplicated and unavailable full-text articles.

### 2.3 STUDY SELECTION

The individual selection of articles was carried out by two independent evaluators and the divergences resolved after the reflection on the scientific notes pointed out in the proposal of studies for consensus. In the full reading of the articles, the year of publication, the phytochemical analysis and the methodology used to identify the antioxidant activity were considered. Data were grouped in a Microsoft Excel spreadsheet, version 2016.

## III. RESULT

The search for understanding the phytochemicals of *Mimosa tenuiflora* with antioxidant properties was systematized in inclusion/exclusion criteria as sequentially shown in the flowchart of PRISMA model (**Figure 1**).

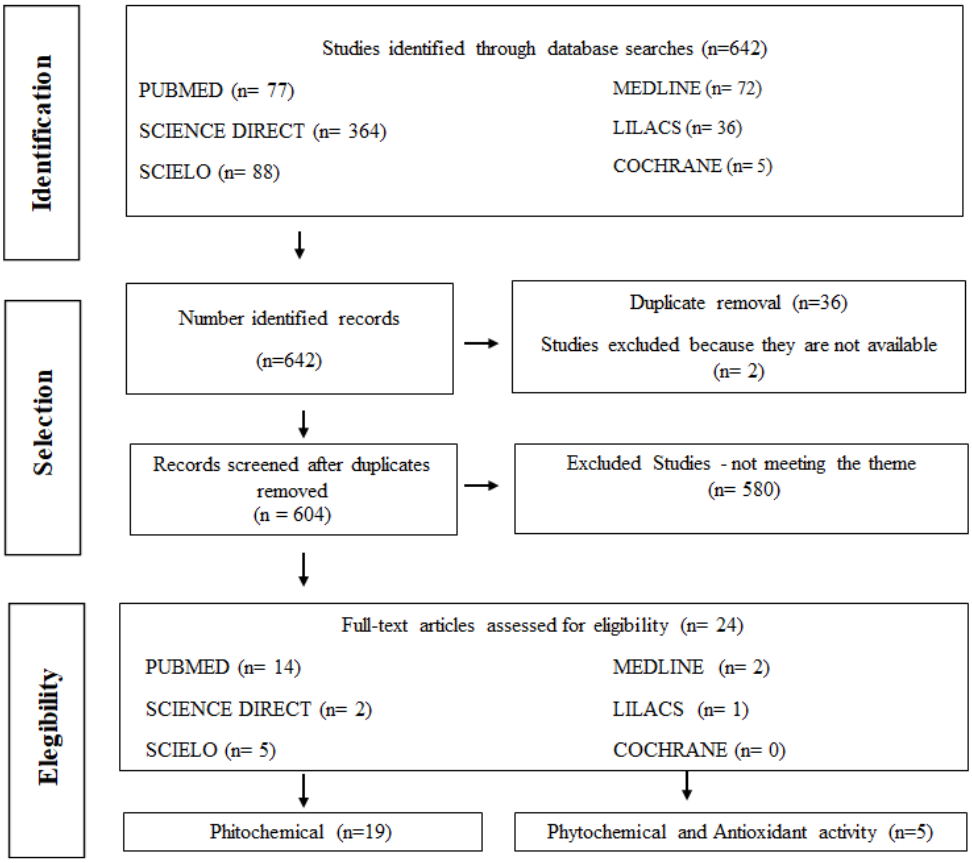


*Fig.1: Schematic representation of the identification, selection and eligibility of articles in the systematic review on the antioxidant action of phytoconstituents of Mimosa tenuiflora.*

When analyzing the studies, only 5 (20.8%) investigated the antioxidant action of phytochemicals (**Figure 2**). The phytochemicals involved in the studies were identified and isolated from various parts of the plant in the form of extracts and fractions. In most of the studies, the barks, leaves and flowers of *M. tenuiflora* were used. The less involved parts in the studies were the root, shoots, heartwood, branches, twigs and seeds (**Figure 3**).

In relation to the qualitative and quantitative studies analyzed, the phytochemistry of *M. tenuiflora* indicated the presence of different groups of secondary metabolites, according to the parts used, such as phenolic acids (Silva, I et al., 2020a; Silva, S. et al., 2020; Vargas-Segura et al., 2020), flavonoids (Bezerra et al., 2011; Cruz et al., 2016; Santisteban et al., 2019; Silva, I. et al., 2020; Silva, S. et al., 2020; Vargas-Segura et al., 2020), flavanones (Bautista et al., 2015; Bezerra et al., 2011), leucoanthocyanidins, catechins (Bezerra et al., 2011), flavonols (Bezerra et al., 2011; Cruz et al., 2016; Silva, S. et al., 2020), flavones (Bezerra et al., 2011; Silva, S. et al., 2020). Some of these studies pointed out the presence of tannins compounds (Almeida et al., 2005; Amariz et al., 2020; Silva, S. et al., 2020) such as condensed tannins (Amariz et al., 2020; Azevêdo et al., 2015; Bezerra et al., 2011; Hernandez et al., 2021; Rivera-Arce et al., 2007), water-soluble tannins (Bezerra et al., 2011), triterpene tannins (Almeida et al., 2005) and quinones (Almeida et al., 2005), alkaloids (Almeida et al., 2005; Bezerra et al., 2011) tryptaminic (Simão et al., 2020) such as *N,N*-dimethyltryptamine (DMT) (Amariz et al., 2020; Gaujac et al., 2012; Meckes-Lozoya et al., 1990; Nicasio Mdel et al., 2005; Vepsäläinen et al., 2005), 5-hydroxytryptamine (Meckes-Lozoya et al., 1990) and harmala alkaloids (Simão et al., 2020). Furfural, phenols (Araújo et al., 2018; de Souza Araújo et al., 2018), phenoxychromones (Bautista et al., 2015; León et al., 2004), triterpenoid saponins (Anton et al., 1993), steroids (Amariz et al., 2020; Anton et al., 1993; Bezerra et al., 2011) and sterols (Vargas-Segura et al., 2020) were also found.

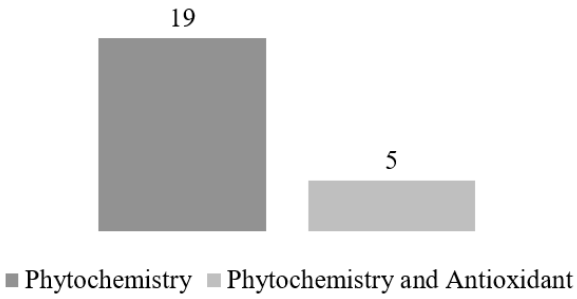


*Fig.2: Phytochemical and/or antioxidant action of phytoconstituents of Mimosa tenuiflora (Willd.) Poir.*

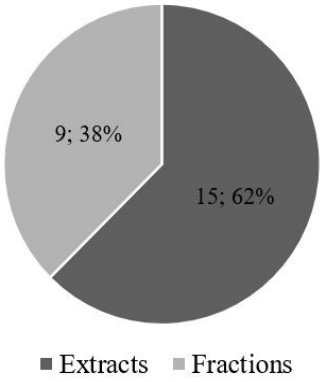


*Fig.3: Parts of the Mimosa tenuiflora. plant. used in the studies.*

The most common phytochemical compounds in the leaves of jurema and flowers were tannins, flavonoids (Bezerra et al., 2011; Cruz et al., 2016; Santisteban et al., 2019), flavanones (Bautista et al., 2015), phenoxychromones (Bautista et al., 2015; León et al., 2004) and DMT (Nicasio Mdel et al., 2005). In the barks they identified the presence of sterols and sugars, flavonoids, cumarins, flavonols, leucoanthocyanidins, catechins, flavonols, xanthones, saponins, tannis, flavones, phenolics, poliphenols, alkaloids, *N,N*-dimethyltryptamine (DMT) and 5-hydroxytryptamine and saponinis (Amariz et al., 2020; Anton et al., 1993; Azevedo et al., 2016; Azevêdo et al., 2015; Bezerra et al., 2011; Cruz et al., 2016; Hernandez et al., 2021; Jiang et al., 1991; Rivera-Arce et al., 2007; Silva, S. et al., 2020; Vargas-Segura et al., 2020).

The studies involved in the review evaluated extracts and fractions of *M. tenuiflora*. Thus, of the 24 studies, 15 articles used extracts and 9 used fractions (**Figure 4**). Regarding to the types of extracts, the most widely used in the studies were the ethanolic (Amariz et al., 2020; Bezerra et al., 2011; Rivera-Arce et al., 2007; Simão et al., 2020; Vepsäläinen et al., 2005) and methanolic extracts (Jiang et al., 1991; Simão et al., 2020; Vepsäläinen et al., 2005). In addition to these, some studies used other solvents for the extracts preparation, such as ethanol-water (Silva, I. et al., 2020; Vargas-Segura et al., 2020), formaldehyde/HCl (Azevêdo et al., 2015), chloroform and ethyl acetate and metanol (Anton et al., 1993).

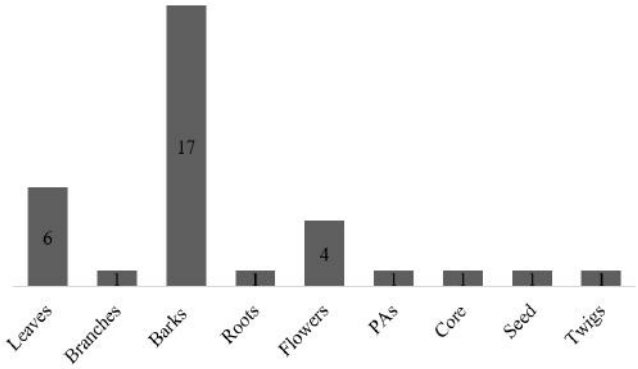


*Fig.4: Studies envolved extracts and fractions of Mimosa tenuiflora (Willd.) Poir*

When analyzing the phytochemicals present in each extract, saponins (Bezerra et al., 2011; Rivera-Arce et al., 2007), tannins (Amariz et al., 2020; Bezerra et al., 2011; Rivera-Arce et al., 2007; Silva, S. et al., 2020) flavones, DMT and hydrocarbons (Amariz et al., 2020), flavonoids (Amariz et al., 2020; Bezerra et al., 2011; I. Silva et al., 2020; Silva, S. et al., 2020) e phenolics (Silva, I et al., 2020; Silva, S. et al., 2020) in the ethanolic extracts are observed. In the methanolic extracts, saponins (Jiang et al., 1991), DMT(Amariz et al., 2020; Vepsäläinen et al., 2005), tryptamimic alkaloids, harmala alkaloids, phenolic compounds were identified (Simão et al., 2020).

In the ethanol-water extract they found the presence of sterols, flavonoids, coumarins, sugars, phenolic acid (Vargas-Segura et al., 2020), polifenóis (León et al., 2004). In the formaldehyde/HCl extracts was determined the presence of condensed tannins (Amariz et al., 2020; Azevêdo et al., 2015). Finally, in the chloroform, ethyl acetate and methanol extract were identified saponins and steroids (Anton et al., 1993).

The fractions used were the hexane, acetone, methanol, ethanol, dichloromethane, hydroalcoholic, ethyl acetate, n-hexane, formaldehyde/HCl and chloroform fractions. In the hexane-ethyl acetate fraction, they found phenoxychromones (León et al., 2004). In the hexane, acetone and ethanol fraction, they identified phenoxychromones and flavanones. The hexane, acetone and methanol fraction found DMT and 5-hydroxytryptamine (Meckes-Lozoya et al., 1990). The ethanol, hexane, dichloromethane, ethyl acetate and butanol fraction found the flavonoids and flavonols (Cruz

et al., 2016). In the ethyl acetate fraction they found flavonoids (Araújo et al., 2018; Santisteban et al., 2019), furfural and phenols (Araújo et al., 2018). In the methanol resuspended fractions and in the n-hexane fractions, the DMT (Gaujac et al., 2012; Nicasio Mdel et al., 2005) was identified.

The five studies that evaluated the phytochemistry and antioxidant activity of phytochemicals correlated this activity with the presence of phenolic compounds, flavonoids, flavones, flavonols, xantones, tannins and the polyphenols. These studies evaluated the antioxidant activity of jurema-preta extracts by using the reduction methods of the phosphomolybdenum complex, reduction of the 2,2-diphenyl-1-picrylhydrazil (DPPH) radical and the discoloration test of the 2,2'-radical cation. azine-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) (**Table 1**). The ethanolic extract presented phenolic compounds such as flavones and flavonoids. It has a strong antioxidant potential by the DPPH methods (in a dose of 17.21 µg/mL) and ABTS (3.57 µg/mL) (Silva, S. et al., 2020).

*Table 1: Antioxidant activity of Mimosa tenuiflora (Willd.) Poir.*

| Parts of plants | Extracts ou fraction | Methods | Phytochemical | Ref. |
|---|---|---|---|---|
| Bark | Ethanolic extracts | DPPH and ABTS | Pyrogalic tannins, flavones, flavonois, xanthones and flavonoids | (Silva, S. et al., 2020) |
| Bark | Ethanolic extracts | DPPH and phosphomolybdenum | Phenolic and flavonoid | (Silva, I. et al., 2020) |
| Leaves, twigs, barks and roots | Ethanolic extracts | DPPH, TLC, ABTS | Phenolic compounds | (Magalhães et al., 2018) |
| Bark | Ethanol-water extracts | DPPH and total polyphenol | Polyphenols | (Rodríguez-León et al., 2019) |
| Bark | Aqueous extract | DPPH | Polyphenols and condensed tannins | Hernandez et al., 2021 |

DPPH: 2,2-diphenyl-1-picrylhydrazil. ABTS: 2,2'-radical cation. azine-bis (3-ethylbenzothiazoline-6-sulfonic acid. TLC: Thin layer chromatography.

In another study, the ethanol extract of M tenuiflora in the flavonoid presence test presented 5.49 µg.ml-1 and in the total phenolics test, using the Folin-Ciocalteau method, it presented 50.58 µg.ml-1. It has significant antioxidant capacities by the two methods, phosphomolybdenum (41.77%) and DPPH (86.08%) (Silva, I. et al., 2020).

The ethanolic extracts of leaves, branches and roots were fractionated by using the hexane, dichloromethane, ethyl acetate, hydroalcoholic, distilled water solvents. Of these fractions, ethyl acetate was the one with good antioxidant activity in both methods, with the lowest values of the concentration at which the drug produces, 50% of its maximum effect (EC50) against DPPH (EC50 = 141.20 ± 0, 02 µg/mL) and ABTS (EC50 = 273.00 ± 0.08 µg/mL) and in the phytochemical triage showed the highest total phenolic content (92.72%) correlated with the antioxidant activity by the DPPH method and ABTS method) (Magalhães et al., 2018).

The ethanol/water extract from the bark of the jurema preta had a high total polyphenol content (425 mg/g). For the DPPH assay, it was observed that for 12.5 mg/L of extract, I obtained 50% of the inhibitory concentration (IC50), similar to the values respectively reported for vitamin C and catechins 46 and 58% (Vepsäläinen et al., 2005). The aqueous extract of the bark of stem showed high antioxidant activity, with an $IC_{50}$ of 10 mg/L, compared with the Trolox, which had an IC50 of 3.5 mg/L (Hernandez et al., 2021).

## IV. DISCUSSION

The *Mimosa tenuiflora* (*Willd.*) *Poir.* is a plant widely used by the population of the caatinga for curative purposes and in drinks during religious rites (Grünewald & Azeredo, 2018a; Kaasik et al., 2021). The systematic review showed that there are few studies that evaluated the antioxidant action of *M. tenuiflora*. In the face of variations in the phytochemical composition of different

parts of plants, vegetables from different regions and of different extraction and isolation techniques used in the studies, a source of investigation emerges directed towards to the antioxidant activity.

The most common phytoconstituents found in the extracts and fractions of the studies selected in the review are phenolic compounds, flavonoids, tannins, saponins and alkaloids. Gurung (Gurung, 2020), performed the phytochemical analysis with the ethanolic extract of the root, stem and leaves of *M. rubicaulis* and also noted the presence of flavonoid compounds, phenol and terpenoids. According Silva et al (Silva, S. et al., 2020) , the presence of tannins and flavonoids in the ethanolic extract is due to the polarity of these compounds, for they are more soluble in polar solvents, the ethanol solvent can cross cell membranes and extract intracellular substances with similar polarity.

In the methanolic extract of the stem was found saponins, tannins and flavonoids. Another study using the aqueous, ethanolic and methanolic extract of leaves, flowers and roots of *M. pudica*, was detected the presence of phenolic and flavonoids compounds (Ahmed et al., 2019). Nascimento et al (Nascimento et al., 2016), using the hydroethanol, hexane and chloroform extract, ethyl acetate and hydromethanol from jurema-preta bark revealed the presence of flavonoids, tannins, xanthones, triterpenes, steroids and phenols, with the highest content of total phenolics found in the ethyl acetate extract and the highest percentage of inhibition of the free radical DPPH 2.2-diphenyl-1-picrylhydrazil was found in hydroethanol extract, ethyl acetate and in the hydromethanol fractions.

Several tudies show the antioxidant action in vivo that portray the antioxidant effects and mechanisms of polyphenol compounds (Cory et al., 2018; Pandey & Rizvi, 2009). On the other hand, Ferreira et al (2016), pointed out that “phenolic compounds are found in several structural forms and act as reducing agents, free radical scavengers, metal chelations or oxygen deactivators”. Thus, it is understood that the presence of phenolic compounds, such as flavonoids and tannins in the extracts indicates that these metabolites can contribute to the antioxidant activity of the compounds of *Mimosa tenuiflora* (Willd) Poir. The pharmacological activities observed may have started by synergistic or antagonistic action of chemical compounds present in medicinal plants. thus, it is necessary to isolate and identify the chemical constituents and pharmacological prospection to the dose response definition. Furthermore, there are few in vivo studies to understand the antioxidant mechanisms (Patro et al., 2016).

## V. CONCLUSION

The studies showed a wide variety of phytochemicals present in extracts and fractions in different parts of *M. tenuiflora*. However, there are few studies showing antioxidant activity of the phytoconstituents of this species. The phenolic, flavonoids and polyphenols compounds were the major ones in the studies involving the analysis of antioxidant activity of *M. tenuiflora*. However, bio-guided studies, with the isolation and identification of phytochemicals and subsequent evaluation of the antioxidant activities of these isolated or associated chemical species, might contribute to the preventive or curative therapeutic action of the phytoconstituents of *Mimosa tenuiflora* (*Willd*.) *Poir*. for pharmacological purposes.

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