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PHYTOCHEMICAL, PHARMACOLOGICAL AND ANTICORROSIVE ASPECT OF *Mucuna pruriens*: A BRIEF REVIEW

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Abstract: *Mucuna pruriens*(L.) DC (Fabaceae) or picapica, is a species native to India and Southeast Asia and with a wide distribution in the tropics. It is known to have medicinal benefits such as aphrodisiac, antispasmodic, anticataleptic, antiepileptic, antidiabetic, antimicrobial, anti-inflammatory, analgesic and antiparkinsonian, which make it a valuable source of medicinal compounds, among other applications, such as organic extracts of this legume, which has been shown to inhibit corrosion reactions in some metals. This review work shows the analysis of scientific production and web content on the phytochemistry, pharmacological activity and anticorrosive behavior of *M. pruriens*.

INTRODUCTION

Traditional medicine and its different uses are an important part of the culture of people and have been, for centuries, the only system used to restore health, so they play a fundamental role as a means to cure diseases in people. Currently, plants and their extracts represent a source of natural compounds with complex molecular structures and diverse chemical, biological and physical properties. Of the 422,000 plant species documented worldwide, approximately 12.5% have medicinal value and are environmentally acceptable.

M. pruriens it is a leguminous plant belonging to the Fabaceae family.. We can find it in the continents of North and South America, Asia, Africa and Oceania. In various countries such as Australia, India, Nigeria, China, South Africa, Brazil, USA, Venezuela and Mexico. It is considered a climbing weed and commonly known as picapica, mucuna bean, velvet bean, bengal bean, it is also called nescafé. During the last decades, there has been a growing interest in the study of the medicinal properties of this plant, and the antioxidant, antineoplastic, anticancer, antiviral,

analgesic, antimicrobial, anti-inflammatory, antihypertensive, antiparkinsonian, neuroprotective, antidiabetic, antiepileptic power has been reported, cardioprotective and anticorrosive of this legume. It is possible that these effects are due to the content of proteins, amino acids, alkaloids, tannins, phenolic compounds, saponins and flavonoids present in the different organs and tissues of the plant.

On the other hand, derived from the chemical composition of *M. pruriens*, this plant has contributed to the potentialization of research on the corrosion inhibition capacity of naturally occurring compounds known as “green inhibitors”, due to the extracts of Plants have become an excellent alternative to mitigate the corrosion process, so in the future it is expected that they can replace synthetic corrosion inhibitors, since the latter usually trigger health and/or environmental problems due to their toxicity.

In this context, this study began with a review of the literature on the phytochemistry, pharmacological activity and anticorrosive behavior of *M. pruriens*. This work is divided into several sections. Section 1 provides a brief overview on the importance of medicinal properties and chemical composition of *M. pruriens*. Section 2 presents the generalities of *M. pruriens*. Section 3 and 4 describe the phytochemical constituents and pharmacological properties, respectively. Subsequently, a discussion is presented on the use of extracts from this plant as a green corrosion inhibitor as a solution to the problems associated with its conventional counterparts. Finally, the conclusions are presented in section 6.

GENERALITIES OF *M. pruriens*

TAXONOMY.

Mucuna pruriens (L.) DC. belongs to the Domain: *Eukaryota*, Kingdom: *Plantae*, Class: *Magnoliopsida*, Order: *Fabales*, Family:

Leguminosae, Subfamily: *Fabaceae*, Tribe: *Phaseoleae*, Genus: *Mucuna*, Species: *Pruriens* (Duke, 1981, Donati, 2005; Shelley & Arthur, 1955).

PLANT MORPHOLOGY.

This legume has stems approximately 18 meters long, leaflets 5 to 12 centimeters wide and 7 to 15 centimeters long. Its white or purple flowers are self-fertilized and are found in axillary clusters up to 32 centimeters long. The pods are produced in groups, 0.5 to 1 to 2 centimeters wide, 4 to 13 centimeters long, and are covered with fine white or light brown hairs. Each pod contains 2 to 7 seeds, with a width of 0.8 to 1.3 cm and 1 to 1.9 cm long (Brunner et al. 2011, as cited in Anadón Navarro et al. 2016; Duke, 1981). The seeds can be black, white, reddish, brown or mottled (Brunner et al., 2011, as cited in Anadón Navarro et al., 2016; Vázquez Encalada & Segura Campos, 2020). The morphology of the plant is shown in figure 1.



Figure 1. *Mucuna pruriens* (L.) DC (Fabaceae).

COMMON NAMES.

It is considered a climbing weed and is commonly known as picapica, mucuna bean, velvet bean, bengal bean, nescafé (Stevens et al. 2001; Martínez, 1979; Nwaoguikpe et al. 2011; Anaya, 1999).

Geographical distribution.

We can find this plant in tropical regions, on the continents of North and South America, Asia, Africa and Oceania. In various countries such as Australia, India, Nigeria, China, South Africa, Brazil, USA, Venezuela and Mexico (Anaya, 1999; Ashidi et al. 2019; Rai et al. 2020; Fujii et al. 1991; Nwaoguikpe et al, 2011, Fung et al. 2011). In Mexico, it has been reported that this weed is present in the state of Campeche, Chiapas, Oaxaca, Puebla, Quintana Roo, Tamaulipas and Veracruz (Villaseñor and Espinosa, 1998; Anaya, 1999). Figure 2 shows the global distribution of the plant.

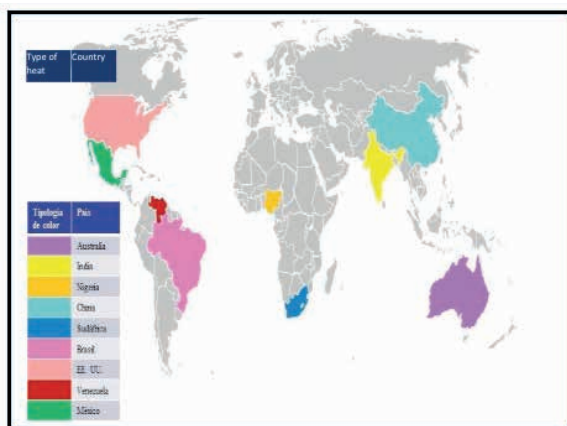


Figure 2. Worldwide distribution of *M. pruriens*. Own source.

PHYTOCHEMICAL CONSTITUENTS PRESENT IN *M. pruriens*.

The biologically active compounds identified in *M. pruriens* are: L-Dopa, adrenaline, phenylalanine, nicotinic acid, tetrahydroisoquinoline, mucunin, mucunadine, mucunadinin, prurienidine, serotonin, nicotine, dimethyl-tryptamine, 5-MeO-dimethyl-tryptamine, oxide dimethyl-tryptamine, saponins, anthraquinones, flavonoids, terpenoids, cardiac glycosides, tannins, inositol, myo-inositol, galactose glycosides, β -sitosterol, glutathione, lecithin,

vernolic acid, gallic acid, stearic acid, oleic acid, linoleic acid, palmitic acid, selenium and magnesium (Adebowale et al. 2005; Bhat et al. 2008; Donati et al. 2005; Hope-Onyekwere et al. 2012; Manyam et al. 2004; Misra and Wagner, 2004; Shelley and Arthur, 1955; Akalezi et al. 2016; Duke, 1981; Turukmane, 2002; Siddhuraju et al. 2000; Sharma et al.

2005; Panikkar et al. al. 1987; Manyam et al. 2004; Misra and Wagner, 2006).

Some of the structures corresponding to the phytochemical constituents of *M. pruriens* are shown in table 1 (Duke, 1981; Turukmane, 2002; Siddhuraju et al. 2000; Sharma et al., 2005; Panikkar et al., 1987; Manyam et al. 2004; Misra & Wagner, 2006).

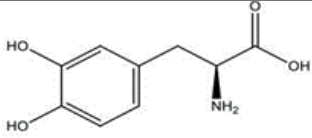
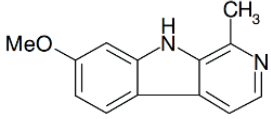
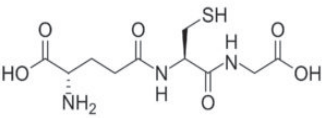
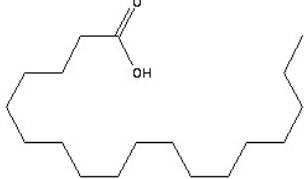
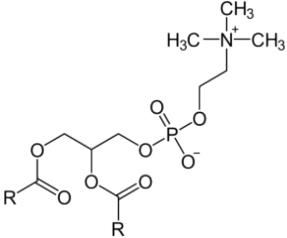
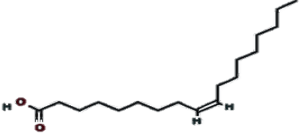
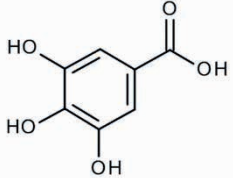
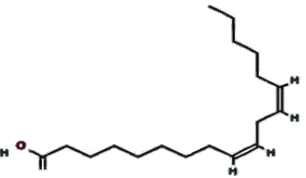
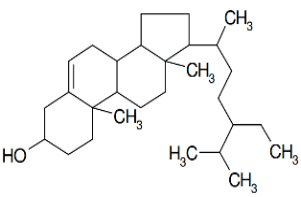
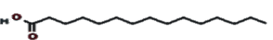
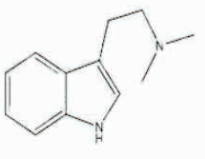
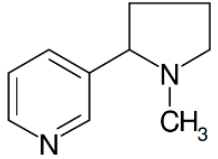
L-Dopa		6-methoxyharman	
Glutathione		stearic acid	
Lecithin		Oleic acid	
Gallic acid		Linoleic acid	
β -Sitosterol		palmitic acid	
Indole-3-alkylamines-N, N-dimethyltryptamine		Nicotine	

Table 1. Structures of the phytochemical constituents present in *M. pruriens*. Own source.

PHARMACOLOGICAL PROPERTIES OF *M. pruriens*.

Various authors claim that different parts of the weed, known as *M. pruriens*, have medicinal properties, for example, Sathiyarayanan & Arulmozhi (2007) state that it is one of the most popular and important medicinal plants in India, because all its parts. They report medicinal properties and are in high demand nationally and in international pharmaceutical markets. Fujii et al. (1991) also report that the seeds and stems of this plant are used as medicine in Africa and China.

In various literatures, *M. pruriens* has been reported as an antioxidant, antineoplastic, anticancer, antiviral, analgesic, antimicrobial, anti-inflammatory, antihypertensive, antiparkinsonian, neuroprotective, antidiabetic, antiepileptic and cardioprotective agent (Adebowale and Lawal 2003; Adepoju and Odubena, 2009; Misra and Wagner, 2004; Majekodunmi et al. 2011; Uma and Gurumoorthi, 2013; Obogwu et al. 2014; Dhawan et al. 1980).

For their part, Nayak et al. (2017) report that the *M. pruriens* seed extract shows potent antihypertensive activity in vitro and in vivo, through the inhibition of the activity of the angiotensin I converting enzyme (ACE), likewise, they report in their literature that This plant has anti-ischemic potential, however, it points out that there is a need to test its clinical effectiveness.

In the research of Sinha et al. (2018) report that *M. pruriens* shows anticancer potential against human breast cancer cells through JAK2/STAT5A signaling. Another activity that is attributed to this fabaceae is that reported in the literature by Turukmane (2002), where they mention that the leaves of *M. pruriens* are considered an excellent blood stimulant, using them in cases of acute blood loss and diseases due to blood deficiency. Likewise, Anosike et

al. (2019), reports that the methanolic extract of *Mucuna pruriens* shows erythrocyte stabilizing capacity, antioxidant potential and could be used for the treatment of sickle cell anemia.

In the work of Ulu et al. (2018) it is reported that *M. pruriens* improves altered inflammation pathways in the kidney of rats fed high fructose.

According to Wijeratne, 1987, as mentioned in Vadivel, V. & Janardhanan, K. (2000), *Mucuna pruriens* is also reported to have activity against arthritis. In the work of Manyam et al. (2004), *M. pruriens* is also reported as a medicinal plant to treat neurodegenerative diseases such as Parkinson's disease, thanks to the extract of levodopa (L-Dopa) extracted from velvet beans. Likewise, L-Dopa also repels insects.

Root and leaf extracts of the plant have been used in the treatment of snakebite and cancer (Alo et al. 2012).

M. pruriens has been shown to increase testosterone levels (Amin et al., 1996, as cited in Nebedum et al. 2010), leading to protein deposition in muscles and increasing muscle mass and strength. (Bhasin et al. 1996). On the other hand, Ashidi et. to the. (2019) report that in male albino rats their reproductive function improved with a dose of 0.75 g of *Mucuna pruriens*.

Mucuna species are aphrodisiac, emetic and poisonous (Duke, 1981; Pathania et al. 2020). The roots are bitter, sweet, thermogenic, emollient, stimulant, purgative, aphrodisiac and diuretic. The leaves are also aphrodisiac (Jayaweera, 1980, as cited in Siddhuraju et al. 2000). The seeds are astringent, laxative, anthelmintic, alexipharmaceutical and tonic (Taylor, 2005, as cited in Nebedum et al. 2010).

It has also been noted that casual skin contact with the pod of this legume produces erythema and pruritic macular lesions, the cause being the protease mucunain (Hope-

Onyekwere, 2012).

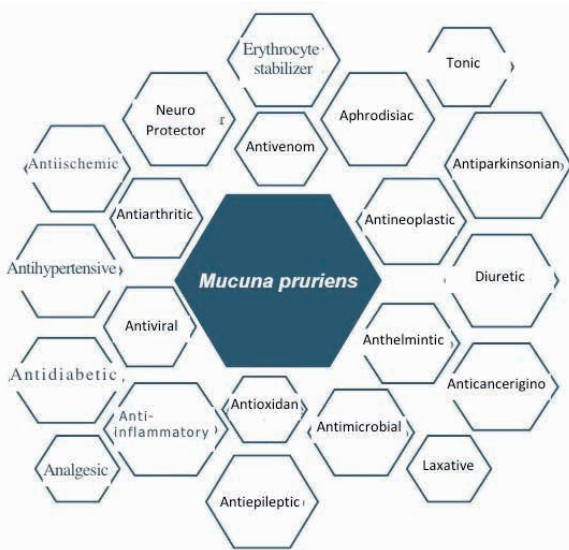


Figure 3. Biological and pharmacological activities of *M. pruriens*. Own source.

***Mucuna pruriens* AS A GREEN CORROSION INHIBITOR.**

Plants represent an interesting source class of chemical compounds that are currently being explored for use in metal corrosion protection in most systems, as a possible replacement for toxic synthetic inhibitors. The various chemical structures present in *M. Pruriens*, have allowed this plant to be studied as a green corrosion inhibitor.

Akalezi et al. (2016), evaluated the ethanolic extract of *Mucuna Pruriens* seeds for the corrosion of carbon steel in a 1 M HCL solution, with the electrochemical techniques of potentiodynamic polarization and electrochemical impedance spectroscopy (EIS), likewise, they used the gravimetric measurement technique. The results obtained by these authors indicate that the maximum inhibition efficiency of 91.01% for electrochemical techniques and 92.89% in gravimetric tests is reached at an optimal concentration of 1000 mg/L.

Mourya et al. (2016), evaluated the inhibition of copper corrosion, using a

3 M HNO₃ solution, using gravimetric techniques, potentiodynamic polarization and electrochemical impedance, whose inhibition efficiencies obtained were 71.6%, 69.2%, and 70.1% at 0.2 g L⁻¹, respectively.

On the other hand, Ahile et al. (2014), evaluated the inhibition of aluminum corrosion, through the ethanolic extract of *M. Pruriens* stems, using a 2 M H₂SO₄ solution, with the gravimetric measurement technique, so that in their results they obtained an efficiency of inhibition of 62.90%, at a concentration of 0.5 g/dm³.

Plant component evaluated	Metal	Medium	Technique	Authors
Seeds	Carbon Steel	HCl 1M	Potentiodynamic Polarization, Electrochemical Impedance Spectroscopy and Gravimetric measurement technique.	Akalezi et al. (2016)
Seeds	Copper	HNO ₃ 3M	Gravimetric Measurements, Potentiodynamic Polarization and Electrochemical Impedance.	Mourya et al. (2016)
Stems	Aluminum	H ₂ SO ₄ 2M	Gravimetric Measurement.	Ahile et al. (2014)

Table 2. Evaluation of *M. pruriens* as a green corrosion inhibitor. Own source.

CONCLUSIONS

This review demonstrated that *M. pruriens* is a valuable medicinal plant based on its numerous therapeutic properties.

The result obtained in this study reported that *M. pruriens* contains an appreciable amount of organic compounds that could be forming chemical complexes, which when adsorbed on the metal surface block the passage of aggressive species from the medium to increase the inhibition efficiency.

This compilation positions *M. pruriens* as an object of study for research groups to

obtain new organic corrosion inhibitors with industrial and technological applications.

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