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Review Article

Bioinsecticidal and Pharmacological Activities of the Essential Oil of *Pogostemon cablin* Benth Leaves: A Review

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ABSTRACT
The plant species *Pogostemon cablin* (Blanco) Benth (Lamiaceae; Synonyms: *Patchouli*, *Oriza*) It is an herb widely used around the world. In traditional medicine it is used in the treatment of inflammation, tumors, in the prevention of oxidative states related to aging, and its ioinsecticidal activities are exploited against insects and microorganisms. For this review, publications from the previous ten years collected in PubMed, Web of Science, Springer, and Scopus were examined. Currently, studies report insecticidal activity in its essential oil (EOPC). However, to better understand the ioinsecticidal activity of EOPC, it is necessary to understand its phytochemistry, which is responsible for its therapeutic activities. Thus, this review aims to describe the phytochemical profile of EOPC, ethnopharmacological uses, and some biological activities of EOPC that are described in this article, but with greater emphasis on its bioinsecticide potential.
Keywords: Insecticide, Patchouli, Lamiaceae, Phytochemistry, Medicinal Plant, Phytotherapy.

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INTRODUCTION

Plants have been used for therapeutic purposes since the beginning of the existence of humankind,[1] among them is the Lamiaceae *Pogostemon cablin* (Blanco) Benth, popularly known as Patchouli, Oriza and Guanghuoxiang (in China) is spread worldwide for its pharmacological potential that made it famous in the traditional and folk medicine,[2] as well as in the cosmetic industry.[3]

Chen *et al.*[1] showed the growing interest in this plant, as a considerable number of researchers have studied potential drug candidates from *Patcholli*.[4] In traditional medicine, *P. cablin* is used as a tincture or tea from the aerial parts of the plant for the treatment of colds, nausea, fever, headache, and diarrhea.[5] The main by-product used is its essential oil, known as Patchouli oil.

In the essential oil from *P. cablin*, the main components related to pharmacological activities already reported in the literature are the patchouli alcohol, pogostone, α-guaiene, δ-guaiene, β-caryophyllene, trans-caryophyllene, α- patchoulene, β-patchoulene, and β-elemene.[6] Sesquiterpenes are the most abundant compounds and are responsible for most of the pharmacological activities attributed to the plant, among them the major compound is Patchouli alcohol.[7] Highlighting this class of secondary metabolite mentioned above can act as anti-inflammatory, anti-aging, antitumor, antioxidants, and insecticides.[8]

The compounds derived from the essential oil of *P. cablin* are potential substances for the formulation of natural insecticides. Insecticides are formulations with substances used to kill insects, including their eggs, larvae, and other stages of the insect. The natural insecticidal active principles can be derived from the whole plant or parts of it, they can be the plant material itself, usually grounded till a powder or products derived by aqueous extraction or with organic solvents, such as extracts and essential oil.[9]

In this scenario, the essential oil of *P. cablin* has been showing promising potential for the development of ioinsecticidal products, since the bioactive compounds of this plant have selective toxicity, with little impact on higher living organisms, as well as over the environment. Unlike synthetic products, which are toxic, have been becoming a growing emergent pollutant, and the insects are becoming increasingly resistant,[10] making it necessary to develop ioinsecticidal agents obtained from renewable resources, which are quickly degradable, as they have several substances that act simultaneously, causing that the development of insect resistance to these substances occurs very slowly.[11] Therefore, this review aims to update the knowledge about the chemical composition of *P. cablin*, together with an overview of its pharmacological activities, emphasizing its ioinsecticidal potentials.

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MATERIALS AND METHODS

The present study is an analysis of data about the ioinsecticidal potential of *P. cablin* essential oil, through a narrative review,[12] which aimed to evaluate published studies on the plant in association with insecticidal pharmacological activities, published in the period from 2011 to 2021. To better contextualize the theme, searches were performed in the electronic databases PubMed, Web of Science, Springer, and Scopus, using the descriptors previously consulted in the DECs (Descriptors In Health Sciences) "*Pogostemon cablin*", "insecticide", "phytochemistry", AND "essential oil" and its correspondents in Portuguese, "*Pogostemon cablin*", "inseticida" "fitoquímica" AND "óleo essencial" and, in Spanish, "*Pogostemon cablin*", "isecticida", "fitoquímica" and "Aceite esencia"".

After reading the titles and abstracts, articles that fit the proposed theme and addressed theioinsecticidall potential of *P. cablin* essential oil were included. As exclusion criteria, articles that did not present any aspect of the proposed theme or that were written in languages other than those mentioned above or that presented thesis and dissertation results were adopted, due to the large size of these publications.

BOTANICAL DESCRIPTION

The Lamiaceae family presents approximately 300 genus and 7,500 species, and over 232 species occur in Brazil. Among the genus of this family, the genus *Pogostemon* is composed of 80 to 90 species including subshrubs and aquatic herbs, highlighting they are not native, instead, they were introduced into Brazil.[13-15] The word"*cabli*" is derived from"cabala" which is also a local name for the patchouli plant in the Philippines and these are synonyms.[16] The species *Pogostemon cablin* is a dicotyledonous plant, with an erect and branched structure, elongated, oval leaves, and abaxial trichomes. Its inflorescence can be terminal or axillary, dense, and has small, irregular, bisexual, white to purple flowers. Its height can range from 0.5 m to 1.0 m.[17]

P. cablin has ancestry from Southeast Asia, currently it grows in several parts of the world, but it is easily found in China, India, Malaysia, Indonesia and South America. The ideal temperature for its growth is around 24°C and 28°C, with a relative humidity of 75%; 2,000 to 3,000 mm of annual rainfall and an altitude of 0 to 1,200 m.[17-18] Its propagation is usually carried out by cuttings, as it is a species that easily adapts to this process.[19]

ETHONOBOTANIC RELEVANCE

Ethnobotany is part of the study of the relationship between people and plants and the environment in which they occur, allowing us to discover solutions to current environmental and human problems related to environmental preservation, the discovery of new medicines, production of fibers, food security, cultural and national sovereignty, among others.[20] The popular knowledge of medicinal plants is culturally transmitted and without many foundations, its use can provide the discovery of some medicines used in traditional medicine.[21-22]

History and Cultural Usage

Patchouli was known in ancient Greece as *Phyllon indikon* (Indian leaf) and sometimes as Malabathron. In China, they called it "guang huo xiang" to differentiate it from the "huo xiang" of the North, the *Agastache rugosa* species. In South America, it is cultivated in Paraguay and Brazil, known as *Oriza*, drawing attention for having an essential oil with a characteristic, persistent, and camphoraceous odor.[23]

The species was first mentioned by the botanist Pelletier-Sautelet, in the Philippines, which led the plant to have Felipine ancestry. In 1941 it was introduced in Indian literature, where it was mentioned due to various uses with other medicinal plants, including for religious rituals in prehistoric times.[24] Ethnobotanical surveys carried out around the world register high use of medicinal plants for the treatment of skincare, the plant *P. cablin* is among the most cited plants.[25]

Oil can be extracted from the dried leaves of *Pogostemon cablin*, which is among the 18 most commercially important essential oils used in the perfume industry.[1] The essential oil of *P. cablin* (EOPC) is used to help reduce tension, insomnia, as well as anxiety, the essential oil also acts as an aphrodisiac and helps sharpen intelligence and improve concentration.

In the field of spirituality, it is used in incense sticks because it helps in creating a relaxing atmosphere. In normal adults, the effects of fragrance inhalation on sympathetic activities were studied by measuring the amount of catecholamine content in the serum and monitoring fluctuations in blood pressure, resulting in a decrease of plasmatic levels of catecholamine and blood pressure after fragrance inhalation in normal individuals.[26]

Scripture's evidence the use of aromatic substances in Chinese Medicine 4500 years ago, as well as in spiritual and medicinal rituals in Egypt, and also during the Middle Ages to prevent infections and plagues. Patchouli oil is used in aromatherapy to relieve symptoms such as stress, calm the nerves; and for illnesses such as depression, in addition to controlling appetite and improving sexual interest.[27]

Although it is not a dominant source of fragrance, in the cosmetics industry, EOPC is used as a perfume base due to its high value to its oriental notes and strong fixing properties.[1] In turn, the most relevant properties are the ability to mix with other essential oils, resulting in a strong base, with lasting character, fixing properties, in addition to helping to prevent evaporation, promoting tenacity. For this reason, the oil is widely used in the manufacture of soaps, scents, body lotions, and detergents.[28-29] The food industry uses EOPC in alcoholic drinks and to improve unwanted smells and tastes.[30]

In this context, it appears that the popular knowledge of plants (such as Patchouli) helps in scientific development and contributes to the health of the population, they also have great importance in Integrative and Complementary Practices, in addition to reinforcing the importance of knowledge about the flora location.[25]

Use in the Traditional Medicine and Pharmacological Features

Phytotherapy has been identified as the practice with the highest adherence in patients with different pathologies. Plants with therapeutic properties used in health care traditionally constitute an important source of new biologically active compounds. Essential oils are one of the most used natural products and EOPC is among the most consumed worldwide.[31-33]

The use of the patchouli plant as a medicinal resource is of Chinese origin, being recommended for the treatment of inflammatory diseases, fungal infections, colds, headaches, nausea, vomiting, diarrhea, abdominal pain, insect and snake bites.[34-35] Its essential oil has significant gastroprotective effects against gastric ulceration, as well as treating gastrointestinal diseases for thousands of years in many East Asian countries.[36]

EOPC has proven antimicrobial activity, being a resistant pharmacological agent against *H. pylori in vitro* and *in vivo*, a Gram-negative bacterial species. Patchouli oil blocks the maintenance of the urease protein, inhibiting its reactions.[37]

Antifungal properties are evidenced in some studies,[38-41] the EOPC also presented reports of efficacy to treat specific opportunistic infections caused by *Candida albicans*, *Cryptococcus neoformans*, methicillin-resistant *Staphylococcus aureus*, and Herpes simplex type I and II found in patients with AIDS.[42]

Regardingioinsecticidall pharmacological properties, Brazil has a great interest in natural insecticides, as it is one of the countries with the largest agricultural producers and exporters in the world and, in order to have quality in the production, it is necessary to have pest control. In this context, EOPC has an insecticidal effect against agricultural pests, preventing significant production losses due to insects.[2]

Some of the efficacy of a few biological and pharmacological activities related to the EOPC are antibacterial,[43] antioxidant,[44-45] analgesic,[46] anti-inflammatory,[46] antiplatelet,[47] aphrodisiac,[27] antidepressant,[48] antimutagenic,[1] antiemetic,[27] fibrinolytic,[2] antithrombotic,[29] cytotoxic,[48] antiviral[49] and antihypertensive.[50]

P. CABLIN ESSENTIAL OIL AND ITS PHYTOCHEMISTRY

Due to its application in the pharmaceutical and cosmetic industry, the essential oil of *P. cablin* – ISO No. 3757:2002,[51] has high commercial importance.[2] It is a pale-yellow liquid with an intense aroma. *P. cablin* has an essential oil yield ranging from 1.5 to 4.6%,[17,52-54] this difference is due to several factors, such as the location and time of harvest, drying, processing, and extraction method.[55-56]

Some important characteristic chemical components of this essential oil include patchouli alcohol, β-patchoulene, patchoulene epoxide, pogostone, and pachypodol.[57-58] However, research demonstrates that patchoulol and α-patchoulene are the components that are primarily related to the pharmaceutical power attributed to the plant.[29,2]

Although most studies chemically describe volatile compounds,[6,45,47] there are also studies involving the characterization of non-volatile compounds.[7,57,59] So far more than 50 non-volatile compounds have been identified and determined through different analytical methods,[2] which include the class of terpenoids, flavonoids, glycosides, aldehydes, organic acids, and lignins according to their chemical structures. Among these compounds, Pachypodol is of great importance due to its biological actions,[58,60] in addition to other compounds that also stand out such as retusine, ombuin, apigenin, β-Sitosterol, stigmasterol, isocrenatoside, tilianin, 3-oMethylcrenatoside, dibutyl phthalate, and tschimganical.[31-32]

Considering volatile compounds, Santos *et al.*[61] identified 29 volatile compounds from *P. cablin*, with the following major compounds: Patchouli alcohol (33.25%), Seyshellene (6.12%), α-bulnesene (4.11%), Pogostol (6.33%), and Norpatchoulenol (5.72%). An amount of approximately identified compounds were found by Liu *et al.*[62] who identified 23 compounds, with its main constituents being Patchouli alcohol (41.31%), pogostone (18.06%), alpha-bulnesene (6.56%), caryophyllene (5.96%), and sequelene (4.32%).

Many other studies have identified the compounds present in the essential oil of *P. cablin*,[6,9,45] adding up to more than 150 compounds already identified,[57] in which they differ due to environmental factors and plant genotypes, promoting the diversification of the components present, as well as their quantities.[63] Junren *et al.*[57] listed the new compounds identified in the essential oil of *P. cablin* in the last five years, as well as their pharmacological activity, shown in Table 1, which was modified with the inclusion of three new compounds of the type cadina, cyperan and cariolan.

The main classes of EOPC constituent compounds are sesquiterpenoids,[67,68-70] triterpenoid,[69] steroids,[57,69] flavonoids,[71] and phenylpropanoids.[2,67] Most of the reported sesquiterpenoids are patchoulol, α-patchoulene, β-patchoulene, pogostone, paquipodol, and guaiane derivatives,[58,62,70,71] which are the main compounds related to the Patchouli therapeutic potential.

The chemical composition of the constituents present in Patchouli can vary depending on the location of their habitats.[63] Data from different Patchouli extraction sites in Guangdong province in China were compared. The results statistically confirmed the difference between the plants grown in each location.[55] It is important to emphasize the effectiveness of quality control and research on *P. cablin*, since soil composition, climatic conditions, and growth management in different growing regions can affect the properties and quality of its constituents.[56,63]

BIOINSECTICIDAL ACTIVITIES FROM THE ESSENTIAL OIL OF *P. CABLIN*

The control of several vectors and pests is a great challenge, especially in developing countries. As an alternative for chemical control, there is the use of natural products, such as plants and their derivate withioinsecticidall properties. The use of insecticides to control populations of vector mosquitoes, insects, and other pests, in their adult form (adulticides) and in their larval form (larvicides) can be done through focal and perifocal treatment and aerospace spraying of insecticides in an ultra-low volume (ULV).[9] Repellents can be applied to the individua"s skin in order to repel vectors and prevent stings.

Plants can protect them-self against insect action by synthesizing an astonishing diversity of proteins and secondary metabolites with toxicity to insects through different metabolic pathways.[11] These entomotoxic substances of plant origin have aroused the interest of several researchers in the search for alternative strategies for the chemical control of different vectors.[61]

The study of theioinsecticidall activities of compounds extracted from *P. cablin* has been an alternative to synthetic products for vector and pest control (Table 2). The larvicides considered effective are those with LC_{50} values (lethal death concentration of 50%) less than 100ppm.[72] Ga'al *et al.*[73] evaluated the larvicide activity of *P. cablin* essential oil against *Aedes albopctus*, finding a larval toxicity of 47.88 ppm LC_{50}. A similar study was conducted by Astriani and Widawati,[74] who studied the larvicide potency of plants from Indonesia, including *P. cablin*, which showed larvicidal potential with an LC_{50} of 46.40 ppm.

Another study that reported larvicidal action in lower concentrations was the one connected by Hazarika *et al.*[75] who evaluated three essential oils, in which the highest larvicidal activity was observed in patchouli oil against *Aedes aegypti* larvae with an LC_{50} of 25.14 mg /L. A study similar to that carried out by Santos *et al.*[61] who determined the LC_{50} at 28.43 µg·mL-1, and far above the standard was the concentration found by Paulraj[76] who analyzed ten essential oils, and the patchouli essential oil presented an LC_{50} of 254, 79 ppm.

The toxicity of a chemical substance is not necessarily associated with the death of insects, as other aspects may be linked to this action, such as repellency, deterrence, and antibiosis (adverse effect on their biology). To be considered a good insecticide or "ideal insecticid", several factors must be considered, such as efficacy at low concentrations, absence of toxicity against higher mammals and animals, absence of phytotoxicity, easy obtainment, handling and application, economic viability, and no cumulative effect on man and animals.[87]

Several studies confirm the insecticidal activity of essential oils and plant extracts of *P. cablin* for controlling different insect species associated with the transmission of diseases.[61,78,80-81,83] Gokulakrishnan *et al.*[77] evaluated the pupicidal and repellent activity of the compounds γ- patchoulene, patchouli alcohol, α-bulnesene, β - patchoulene and α-guaiene isolated from *P. cablin*, among such compounds the maximum repellent activity was observed in patchouli alcohol at 2 mg / cm2 concentration and provided 100% protection up to 280 min. In pupicidal activity, patchouli alcohol was considered the most effective.

According to the bibliographic survey carried out by Lima *et al.*[88] several plants of the Lamiaceae family produce essential oil with insecticidal

Table 1: The chemical properties and pharmacological activities of novel compounds.

Compound name	Plant part	Type of compound	Bioactivity	References
Cablinosides A	Leaves	Glycosides	α-glucosidase inhibitory activity (IC_{50}=278.4±2.8 μM)	[64]
Cablinosides B	Leaves	Glycosides		[64]
14-nor-β-patchoul-1(5)-ene-2,4-dione	Leaves/Stem	Sesquiterpenoids	-	[62]
2β-Methoxy-14-nor-β-ioinsectl-1(5)-ene-4-one	Leaves/Stems	Sesquiterpenoids	-	[62]
14-nor-β-patchoul-1(5),2-diene-4-one	Leaves/Stems	Sesquiterpenoids	Cytotoxic activities against NCIH1975 (IC_{50}=49.9μM)	[62]
14-nor-β-Patchoul-1(5)-ene-4-one	Leaves/Stems	Sesquiterpenoids	-	[62]
Pocahemiketals A	Aerial parts	sEsquiterpenoids	-	[65]
Pocahemiketals B	Aerial parts	Sesquiterpenoids	Vasorelaxant activity (EC_{50}=16.32 μM)	[65]
Patchouliguaiol A	Aerial parts	Sesquiterpenoids	-	[66]
Patchouliguaiol B	Aerial parts	Sesquiterpenoids	Neuroprotective effect (50μM)	[66]
Patchouliguaiol C	Aerial parts	Sesquiterpenoids	asorelaxant activity against PHE-induced contraction (EC_{50}=5.4 μM) Antifungal activity against Candida albicans (MIC=500 μM)	[66]
Patchouliguaiol D	Aerial parts	Sesquiterpenoids	-	[66]
Patchouliguaiol E	Aerial parts	Sesquiterpenoids	-	[66]
Patchouliguaiol F	Aerial parts	Sesquiterpenoids	Vasorelaxant activity against PHE- induced contraction (EC_{50}=1.6 μM) Vasorelaxant activity against KCl- induced contraction (EC_{50}=24.2 μM) Antifungal activity against Candida albicans (*MIC*=300 μM)	[66]
Patchouliguaiol G	Aerial parts	Sesquiterpenoids	Neuroprotective effect (50μM)	[66]
7-epi-chabrolidione A	Aerial parts	Seco-guaianes	Neuroprotective effect (50μM)	[66]
1,7-di-epi-chabrolidione A	Aerial parts	Seco-guaianes	Neuroprotective effect (50μM)	[66]
(+)-(1S,4R,6S,7R,10S)-1-hydroxycadinan-12-ene-5-one	Aerial parts	Sesquiterpenoids	-	[67]
11-dehydroxy-cinnamosin A	Aerial parts	Sesquiterpenoids	-	[67]
1-methoxy-senecrassidiol	Aerial parts	Sesquiterpenoids	-	[67]

Source: Author, 2022.

Table 2: Bioinsecticide activities of *P. cablin*.

Activity	Against	LC_{50}	Sample	Reference
Pupicide	*Aedes aegypti* *Anopheles stephensi* *Culex quinquefasciatus*	NA	Essential oil	[77]
Pupicide	*Aedes Albopictus*	NA	Essential oil	[73]
Larvicide	*Culex pipiens pallens*	NA	Essential oil	[78]
Larvicide	*Aedes Albopictus*	47.88 ppm	Essential oil	[73]
Larvicide	*Aedes aegypti*	46,40 ppm	Essential oil	[74]
Larvicide	*Aedes aegypti*	25,14 mg /L.	Essential oil	[75]
Larvicide	*Aedes aegypti*		Essential oil	[61]
Larvicide	*Aedes aegypti*	254,79 ppm	Essential oil	[76]
Larvicide	*Aedes Aegypti*	NA	Essential oil	[79]
Larvicide	*Spodoptera exigua* (Lepidoptera: *Noctuidae*)	NA	Essential oil	[80]
Adulticide	*Tribolium castaneum* (Herbst	0,123% v/v	Essential oil	[81]
Repellent	*Tribolium castaneum* (Herbst	NA	Essential oil	[81]
Repellent	*Culex pipiens*	NA	Essential oil	[82]
Repellent	*Blattella germanica*	NA	Essential oil	[83]
Repellent	*Camponotus melanoticus, Camponotus novo-granadensis* and *Dorymyrmex thoracicus.*	NA	Essential oil	[84]
Repellent	*Aedes aegypti*	NA	Lotion	[85]
Repellent	*Aedes aegypti* *Anopheles stephensi* *Culex quinquefasciatus*	NA		[77]
Repellent	*Aedes aegypti*	NA	Lotion	[86]

Source: Author, 2022; NA: not available.

activity, such as peppermint, oregano, thyme, and sage. Among the compounds with insecticidal activity, we can mention the terpenoid menthol, found in plants of the *Mentha* genus, which is a potent insecticide with inhibitory action over larval growth. In addition to the phenolic monoterpenoids, thymol and carvacrol that have antioxidant and insecticidal activity.

The essential oil of *P. cablin* also showed efficient repellent activity and did not present mutagenic and irritant risk to human skin.[89] Adms *et al*.[85] evaluated the repellency of 10 essential oils through the audiovisual test methodology against the *Culex pipiens* vector. The *P. cablin* essential oil ranked in the position 8th in the analysis of the repellent repulsion velocity constant. The effectiveness of the repellent activity of *P. cablin* essential oil was also proven in the study by Albuquerque *et al*.[84] who analyzed the repellent activity of three species of urban ants. The essential oil of *P. cablin* was strongly repellent to the three ant species at all concentrations tested (0.01% and 1% v / v). Considering the potential toxicity and repellency of *P. cablin* essential oil to urban ants, future studies may investigate the practical application of this oil in the control of these insects.

In general, vector control researches have identified the presence of chemical compounds as monoterpenes and sesquiterpenes as presenting significant toxicity against insects, but negligible toxicity to animals.[90] The chemical composition of *P. cablin* essential oil has important compounds that act synergistically and enhance bioinsecticidal activity.[56-57]

The constituent pogostone found in *P. cablin* essential oil (LC_{50} ¼ 8.51lg per adult) showed stronger acute toxicity than patchoulol (LC_{50} ¼ 207.62lg per adult) and caryophyllene (LC_{50} ¼ 339.90lg per adult)) against cockroaches.[83] Widawati and Riandi[85] understood the synergy present in the biological activity of essential oil which may be related to different chemical constituents, and from this insight, they tested the repellency of a topical lotion based on patchouli oil associated with betel oil, against *Aedes aegypti*. The efficacy of the lotion was determined based on the rejection of the yellow fever mosquito to prick human arms, which was analyzed using the percentage of protection. Percentage protection analysis showed that the modified Patchouli leaf lotion had more than 90% protective power for 6 hr.

The essential oil-based repellent lotions have been an alternative formulation to synthetic insecticides with high efficacy. Runadi *et al*.[86] determined the activity of the ethanol extract and evaluated the residual from the distillation of patchouli oil as a repellent lotion against the *Aedes aegypti* mosquito. The result showed that the ideal concentration of extract for the formulation of repellent lotion against the *Aedes aegypti* mosquito is a lotion containing 7% of the extract.

Due to the vast chemical composition of *P. cablin* essential oil, there is still a lack of studies that prove which chemical constituent is directly related to insecticidal activity, therefore, the mode of action of EO regarding the bioinsecticidal activity needs further clarification. One hypothesis[91] suggested is that inhaling EO can kill insects. Another hypothesis[92] is that monoterpenes act on cytochrome $P4_{50}$. There are also reports that some terpenoids have the property of inhibiting the activity of acetylcholinesterase. But the further investigation will lead to an understanding of the real mechanism of action of *P. cablin* essential oil.[93]

CONCLUSION

The studies listed in the course of this bibliographical review were able to verify the larvicidal, pupicide, adulticide, insecticide and repellent potential of the essential oil *P. cablin*, in the control of several hosts. The diversity in the chemical composition of the species is the most relevant factor associated with biological actions, proven by research that directs and supports the action of the major compounds in isolation or together (synergy). The compounds found demonstrated the absence of toxicity against mammals and higher animals, absence of phytotoxicity, in addition, *P. cablin* is a plant of easy cultivation, obtainment, manipulation and adaptation, being economically viable and without cumulative effect on man and animals.

The most comprehensive study should be approached to verify the ovicidal, pupicide, and adulticidal potential against vectors and pests since there is still a lack of research that evidences these biological actions. In this context, the perspectives point to new tests using samples with lower concentrations in order to verify which may be suitable for the formulation of herbal medicines, such as repellents that can serve as a natural alternative for the control and reduction of diseases transmitted by vectors and pests.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

EOPC: Essential Oil of *Pogostemon cablin;* **ULV:** ultra-low volume; **ISO:** International Organization for Standardization; **LC_{50}:** Lethal Concentration with 50% mortality.

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