An ethnopharmacological review of *Hyptis suaveolens* (L.) Poit

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**Abstract**

This review aimed to provide a comprehensive overview of ethnobotanical uses, chemical constituents, posology, and toxicology of *Hyptis suaveolens*, and to address the significant medicinal benefits in order to promote its application. An extensive and systematic review of the literature was undertaken and all relevant abstracts and full-text articles analyzed and included in the review. A wide range of traditional uses are cited in the literature, ranging from uses for malaria, constipation, stomach problems, renal inflammation to external uses in repelling insects and treating injuries such as lacerations and burn-related damage to skin and tissues. To date, pharmacological studies have demonstrated the significant activities of this plant that support uses such as antimicrobial, antidiabetic, antiulcer, and anti-inflammatory. Numerous important phytochemicals, including 6 triterpenes, 8 diterpenes and 1 flavonoid have been isolated, identified and reported. The extracts and phytochemicals isolated from the plants show considerable potential for medicinal exploitation and utilization, including antimitotic, antiproliferative, cytotoxic, antioxidant, anti-inflammatory, antibacterial, antifungal, antiviral, anti-secretory, hepatoprotective, insecticidal, and acaricidal activities. As a medicinal plant, *H. suaveolens* is endowed with immense exploitation and utilization value and is widely used worldwide Therefore, further studies to fully elucidate its medicinal potential are warranted.

**Keywords:** *Hyptis suaveolens* (L.) Poit, Ulcer Antimicrobial Inflammation, Diterpenes, Traditional medicine, Ethnopharmacology, Lamiaceae

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**INTRODUCTION**

Species of the family Lamiaceae, which are largely herbaceous and of economic importance, are found mostly in tropical, subtropical, and temperate parts of the world. *Hyptis suaveolens* (L.) Poit is belonging to the genus *Hyptis* and family Lamiaceae that includes 775 species worldwide, which are primarily found in South America. Plants of the *Hyptis* genus have been highlighted for numerous medicinal properties such as tumorigenic, antifertility, antimicrobial, mycotoxic, and phytotoxic activities [1]. Among these plants, *Hyptis suaveolens* (L.) Poit is an important traditional medicinal plant that was originally native to tropical America and is currently considered as a weed worldwide.

*H. suaveolens* (Fig. 1) is a fast-growing perennial and aromatic herb that is 0.4–2 m high with a
quadrate stem that bears hair. The leaves are either ovate or obovate, generally measuring 3–5 cm long and 2–4 cm wide with serrulate margins and a long stalk while its petioles are up to 3 cm long. The plant starts flowering early at an age of 2–3 months and produces copious blue flowers in small cymes along branches that end with reduced leaves. The flowers are pollinated by numerous pollinators leading to enormous seed production [2-3].

_H. suaveolens_ is commonly distributed in dense clumps along roadsides, in over-grazed pastures, and around stockyards throughout the tropics and subtropics, but is normally restricted to places where the soils have been profoundly disturbed. The plant is characterized by a strong minty smell when crushed. Most parts of this plant are used in medicine formulations for treating numerous ailments such as respiratory and gastrointestinal infections, indigestion, colic, stomachache, colds, fever, burns, wounds, cramps and various skin complaints and it is used as an anti-rheumatic and antisuporific bath [4-6].

The plant has different names in various countries (Table 1, Table 2, and Table 3). For example, it is locally known as _Bushmint, alfazema-brava, bamburreal, or tapeira velha_ in Brazil [7]; _chinginguaste_ in El Salvador [8]; Chanor Picnut in Nicaragua [9]; _Chia_ or _Chan_ in Mexico [10]; _Shan Xiang_ or _maolaohu_ in China; _gros, baumes, or hiptis à odeur_ in French; _Indischer, Andorn, Wohlruechender Andorn, or Buschminze_ in German; _bilati tulsi_ or _ganga tulsi_ in Hindi; _lampesan, jukut bau, or mangkamang_ in Indonesian; _nioi-niga-kusa_ in Japanese; _malabar, hutan, or pokok kemangi_ in Malaysian; _chio gorda_ or _chia grande_ in Mexico; _amotan, suob-kabayo, or loko-loko_ in Filipino; _bamburreal or mentrasto-grande_ in Portuguese; _isserp_ in Russian; _oregano, or cimarron_ in Spanish; and _kara or maeng lak kha_ in Thai [11].

_H. suaveolens_ also has numerous synonyms, such as _Gnoteris cordata_ Raf., _Hyptis congesta_ Leonard., _Hyptis graveolens_ Schrank, _Marrubium indicum_ Blanco, _Schaueria graveolens_ (Blume) Hassk. Or _Schaueria suaveolens_ (L.) Hassk [12]. Over the past years, few studies have focused on reviewing _H. suaveolens_ in the literature and we did not find any comprehensive reviews of _H. suaveolens_, although its growing regions, phytochemistry, toxicity, and food and medicinal uses have been summarized to a certain extent [2,3,10,12]. To acquire provide additional knowledge on the considerable applicability and usefulness of this plant, here, we present a review of _H. suaveolens_ that include its characteristics, uses, chemical constituents, posology, phytochemistry and toxicology to facilitate the development and utilization of _H. suaveolens_.

**METHODS**

This review involved literature search on _H. suaveolens_ (L.) Poit (Lamiaceae) using databases such as PubMed (http://www.ncbi.nlm.nih.gov/pubmed), ScienceDirect (https://www.sciencedirect.com), and Web of Science (http://apps.webofknowledge.com) as well as search engines such as Baidu Scholar (http://xueshu.baidu.com) and Google Scholar (http://scholar.google.com). In confirming relevant entries, we considered publications up to the end of March 2020. Searches undertaken were found to be written in English, Portuguese, or Chinese.

**FINDINGS**

**Weed characteristics**

_H. suaveolens_, considered to be a weed worldwide, is currently ranked according to the importance of its use in different areas (Table 4). For instance, it is considered a serious weed in Brazil, a principal weed in Peru and Tanzania, but is a common weed in Australia, India, Micronesia, Philippines, Taiwan, and Thailand. This species is found in Cambodia, Ceylon (Sri Lanka), Congo-Kinshasa, Colombia, Costa Rica, Benin, Fiji, Ghana, Indonesia, Jamaica, Lebanon, Malaysia, Mauritius, Melanesia, Mexico, Netherlands, New guinea, Nicaragua, Panama, South Africa, Senegal, the US, Venezuela, and Vietnam, where it is also considered a weed, but of unknown ranked status. In China, the species is known to exist among the flora of the country,
but confirmatory evidence of its weed status is needed [13].

**Distribution**

*H. suaveolens* is found across more than 50 countries in over the seven continents (Figure 2), including South American areas such as Brazil, Polynesi, Ecuador, French Guiana, Peru, Colombia, and Venezuela; Central American regions such as Belize, El Salvador, the Caribbean, Guatemala, Costa Rica, and Nicaragua; Latin American countries such as Honduras; North American areas such as Puerto Rico, Jamaica, Mexico, Panama, Trinidad and Tobago, Curacao, and the US; African countries such as Tanzania, Congo, Benin, Ghana, South Africa, Mauritius, Senegal, Nigeria, Burkina Faso, Guinea-Bissau, and Kenya.

In addition, it is also found in Oceanian countries such as Australia and New Guinea; Asian countries such as India, Bangladesh, Cambodia, Thailand, Indonesia, Lebanon, Malaysia, Vietnam, and China; Western Pacific countries including Micronesia and the Philippines; areas around the Indian Ocean such as Ceylon; Pacific regions such as Melanesia and Fiji; and European areas including the Netherlands. The literature survey revealed that only 22 developing countries among those listed here recorded the medicinal uses of this plant. *H. suaveolens* is more commonly used as a folkloric herbal medicine in developing countries [2].

**Traditional medicinal uses**

The different traditional medicinal uses of various parts of *H. suaveolens* in over 23 countries are summarized in Table 1, Table 2 and Table 3, where they are arranged by frequency of the same use in different countries. Five of these countries are located in Central America, four in Asia (Bangladesh, China, India, and Thailand), four in Africa (Tanzania, Nigeria, Burkina Faso, and Kenya) two in the Caribbean (Jamaica and Curaçao), and one in South America (Brazil). A wide range of traditional medicinal uses of this plant are reported in the literature. These applications range from *in vivo* use for conditions affecting the respiratory system, gastrointestinal tract, and gynecological system to *in vitro* conditions affecting the skin [53]. This plant appears to be most commonly reported to be used in the treatment of fever and headache (reported in fourteen countries), as an insect repellent, for stomach disorders, skin conditions, injuries (five countries each), weakness (two countries), abnormal leucorrhrea, renal disorders, dysentery, and malaria (three countries each). In addition, the plant is also less frequently reported to be used for male disorders and menorrhagia (two countries each).

**Posology**

For headaches and colds, a decoction is prepared from 6–12 g of *H. suaveolens* for oral administration with a decoction of the fresh plant used to wash the body. In Bangladesh, 2 g of the seeds of *H. suaveolens* are soaked in water with mishri (crystalline sugar) for a whole day and then consumed for treating underweight [26]. In Bidar District of Karnataka in India, a spoonful (10 g) of the seed extract is administered orally once a day for 3 days as a remedy for leucorrhoea and temporary male infertility. Documentation of traditional knowledge of medicinal plants used in Bidar District and Karnataka reports that in Seshachalam Biosphere Reserve Forest of Chittoor District and Andhra Pradesh India, 4–7 g of the leaf powder is rolled in beedi leaves, which is then smoked to relieve colds and nasal congestion [36]. With an iron-deficient diet and high incidences of blood-sucking helminths, people in Bastimentos and Panama struggle with iron deficiency anemia. Consequently, a black drink prepared from *H. suaveolens* is the ethnopharmacological treatment for these pathologies, including iron deficiency anemia that is widely used in Bastimentos and unique to this community [54].

**Phytochemistry**

Research on the phytochemistry of *H. suaveolens* are has revealed that extracts of its different plant contain alkaloids, flavonoids, terpenoids, and tannins [55,56]. The saponin content of the leaves and stems is 6.10% ± 0.074% and 10.50% ± 0.79 %, respectively, while saponins have not been found in the roots. The contents of alkaloids, flavonoids, and tannins in the leaves are 2.80 ± 0.28, 1.90 ± 0.14, and 5.50 ± 0.074 %, respectively. Compared to the stem, the contents of alkaloids, flavonoids, and tannins are 1.60 ± 0.00, 0.30 ± 0.14, and 0.23 ± 0.07 %.

**Chemical constituents**

Over the past years, the chemical constituents of *H. suaveolens* have been investigated widely in different the countries, and numerous new compounds have been isolated from this plant and their structures identified. In this paper, the dominant compounds isolated from different parts of *H. suaveolens* collected from various regions are summarized in Table 5 and Table 6. The structures of these compounds are mostly terpenoids including sesquiterpenes, diterpenes, and...
triterpenes, and β-sitosterol. Most studies of the chemical constituents reported that they were mainly accumulated in the essential oil of the plant, but little attention has been focused on other extracts of *H. suaveolens*.

**Toxicity**

Extracts of *H. suaveolens* have shown effective insecticidal activity because of their toxicity to plant pests. The explanation for this biomechanism may be that the volatile oil of the extracts, which are characterized by a strong odor, can reduce the appetite of insects for the plants. The toxic effects of *H. suaveolens* are summarized in Table 7.

**Table 1: Ethnomedicinal uses of *Hyptis suaveolens* (L.) Poit (contd.)**

| Country     | Ethnomedical use                              | Plant part(s) | Preparation                                      | Reference |
|-------------|-----------------------------------------------|---------------|--------------------------------------------------|-----------|
| Bangladesh  | Acidity, flatulence, gastric troubles          | Seed          | Sherbet® (int⁴)                                  | 14        |
|             | Boils                                         | Seed          | Maceration (applied around 15 boils)             |           |
|             | Boils                                         | Root          | Paste (ext³)                                     | 16        |
|             | Cancer, constipation, liver diseases           | Seed, leaf    | Not stated                                        | 17        |
|             | Constipation                                  | Leaf, bark    | Not stated                                        | 18        |
|             | Cooling agent, kidney disease, urinary tract   | Seed          | Sherbet® (int⁴)                                  | 19        |
|             | dysuria, infections, laxative.                |               |                                                  |           |
|             | Gonorrhea                                      | Seed          | Along with other herbs                            | 20        |
|             | Headache                                      | Whole plant   | Crush (applied topically to forehead)           | 21        |
|             | Insect repellent                              | Whole plant   | Dried and powdered whole plant                   | 21        |
|             | Itching                                       | Root          | Extract                                          | 16        |
|             | Leucorrhea in women, low sperm density in men.| Root          | Sherbet® (int⁶)                                  | 22        |
|             | Loss of libido, to keep body cool             | Seed          | Sherbet® (int⁶)                                  | 15        |
|             | Malaria                                       | Whole plant   | Crush (int⁶)                                     | 21        |
|             | Physical weakness, sense of hotness in head   | Seed          | Powdered seeds are mixed with sugar              | 23        |
|             | Stomach ache in children                      | Stem          | Juice obtained from crushed stems is mixed with sugar | 24        |
|             | Stomach problems                             | Seed          | Raw (int⁶)                                       | 25        |
|             | To clear objects from eyes                    | Seed          | Application of fruit to eyes                     | 25        |
|             | Underweight                                   | Seed          | Sherbet® (int⁶)                                  | 26        |
| Brazil      | Diarrhea, digestive system, headache          | Whole plant   | Tea, syrup and infusion                          | 27        |
|             | Inflammation of the uterus and ovaries        | Bark          | Tea                                              | 28        |
|             | Inflammatory, ulcer                           | Whole plant   | Tea, bath                                        | 29        |
| Burkina Faso| Cold, cough                                   | Leaf          | Not stated                                       | 30        |
|             | Insect repellent, itchy skin                  | Leaf, stem    | Not stated                                       | 31        |
| China       | Athlete's foot                                | Leaf          | Pound (ext³)                                     | 32        |
|             | Cold                                          | Whole plant   | Decoction (int⁶)                                 | 33        |
|             | Diabetes, diarrhoea                           | Seed          | Boiled (int⁶)                                    | 32        |
|             | Eczema, dermatitis                            | Whole plant   | Decoction (wash affected area)                   | 32        |
|             | Eliminate toxin in the body                   | Leaf (fresh)  | Stew or Decoction                                | 33        |
|             | wholeplant                                    |               |                                                  |           |
|             | Infertility                                    | Root          | Stew with chicken (int⁶)                          | 33        |
|             | Lobar seepor, pleurisy                        | Whole plant   | Stew with pig lung or lean (int⁶)                | 33        |
|             | Lymphoma                                      | Root (fresh)  | Stew with green-shell duck (int⁶)                 | 32        |
|             | Snakebite                                     | Leaf (fresh)  | Pound (ext³)                                     | 32, 33    |

**Figure 2:** The distribution of *Hyptis suaveolens* in the world
### Table 2: Ethnomedical uses of *Hyptis suaveolens* (L.) Poit. (contd.)

| Country     | Ethnomedical use                                           | Plant part(s)       | Preparation  | Reference |
|-------------|------------------------------------------------------------|---------------------|--------------|-----------|
| India       | Blood purifier                                            | Root                | Not stated   | 34        |
|             | Boil, cuts, wounds                                        | Leaf                | Not stated   | 34        |
|             | Chest pains, cough, wound healing                         | Whole plant         | Not stated   | 35        |
|             | Cold, fever and nasal congestion                          | Leaf                | Beedi (inhalation) | 36      |
|             | Cough                                                     | Leaf                | Eaten raw    | 37        |
|             | Menorrhagia, leucorrhoea, temporary male sterility        | Seed                | Extract (intb) | 38       |
|             | Skin disease                                              | Leaf                | Not stated   | 35        |
|             | Smoothing agent                                           | Seed                | Sherbet⁴     | 39        |
|             | Wounds                                                    | Leaf                | Juice (extc) | 40        |
| Nigeria     | Boils                                                     | Leaf                | Juice (extc) | 41        |
|             | Control the vector, mosquito                              | Whole plant         | Smoke (smoking) | 42      |
|             | Facilitate, childbirth, repel malaria-causing insects     | Leaf (fresh)        | Extract (intb) | 43       |
|             | Headache                                                 | Whole plant         | Tied around the head until the ache stops | 42        |
|             | Headache, mosquito repellant                             | Leaf (fresh)        | Juice        | 44        |
|             | Malaria                                                   | Leaf                | Not stated   | 45        |
| Philippines | Mosquito repellent                                        | Whole plant (fresh) | Raw          | 42        |
|             | A stimulant if employed in rheumatism                     | Root                | Decoction    | 46        |
|             | Antirheumatic and antisuporific                           | Leaf and top        | Baths        | 47        |
|             | Antispasmodic                                             | Leaf and top        | Not stated (intb) | 47    |
|             | Appetizer                                                 | Root                | Decoction    | 46        |
| Senegal     | Expectorant                                               | Stem with flower and seed | Infusion (intb) | 48        |
|             | Headache and cold                                         | Flower              | Introduced into the nostrils | 48        |
|             | Migraine                                                  | Powdered plant part | Not stated | 48        |
|             | Tonic                                                     | Stem with flower and seed | Decoction (intb) | 48       |
| Tanzania    | Abdominal pains and general body weakness                | Leaf, stem          | Vapours from boiling leave (inhalation) | 49        |
|             | Epileptic cases, psychosomatic                            | Leaf                | Ashes (the leaves stems are burned and ashes applied over scarifications on the body) | 49       |
|             | Leukorrhoea                                               | Root                | Decoction (intb) | 49       |
| Thailand    | Anti diarrhoeal                                           | Seed                | Not stated   | 50        |
|             | Constipation                                              | Seed                | Dessert (intb) | 50       |
|             | Fever, fatigue                                            | Whole plant         | Decoction    | 50        |
| Trinidad    | Colds, constipation, fever, flu, malaria, fever,          | Leaf                | Tea          | 51        |
|             | menorrhagia, yellow fever                                 |                     |              |           |
|             | Common cold & cough                                       | Leaf                | Infusion or crush and inhaled | 52       |

a sherbet = Seeds are soaked in water in which mishri (crystalline sugar) has been dissolved and taken as a drink; bint = internal use; ext = external use

### Table 3: Ethnomedical uses of *Hyptis suaveolens* (L.) Poit. (contd.)

| Country     | Ethnomedical use                                           | Plant part(s)       | Preparation  | Reference |
|-------------|------------------------------------------------------------|---------------------|--------------|-----------|
| Trinidad    | Fever                                                     | Leaf                | Infusion or crush and inhaled | 52        |
|             | Flu                                                       | Leaf                | Bath         | 51        |
|             | Cooling/cleanser                                          | Leaf                | Infusion or crush and inhaled | 52        |

### Table 4: Posology of *Hyptis suaveolens* (L.) Poit.

| Ailment                             | Preparation and usage                                                                 | Dosage | Region                  |
|-------------------------------------|---------------------------------------------------------------------------------------|--------|-------------------------|
| Headaches and cold                  | Decoction is drunk with decoction of fresh plant washing body                         | 6 - 12g | Bangladesh              |
| Underweight                         | Seeds are soaked in water with mishri (crystalline sugar) for awhile day and then taken | 2 g    | Bangladesh              |
| Leucorrhoea and temporary male sterility | Seeds extract is taken internally once a day for 3 days                                   | 10 g   | Karnataka of India      |
| Cold and nasal congestion           | Leaf powder is kept in beedi leaves and being smoked                                   | 4-7 g  | Chittoor District and Andhra Pradesh India Bastimentos and Panama |
| Iron deficiency anemia              | Black Drink                                                                           | Not stated |            |
Table 5: Chemical constituents isolated from *Hyptis suaveolens* (L.) Poit (contd.)

| Dominant compounds                                                                 | Isolated part               | Plant source             | Reference |
|----------------------------------------------------------------------------------|-----------------------------|--------------------------|-----------|
| L-Fuco-4-O-methyl-D-glucurono-D-xylan                                              | Seed-coat mucilage         | Not stated               | 57        |
| 1, 8-Cineole, -caryophyllene, -Copaene, -Phellandrene, -elemene, eugenol         | Essential oil              | Darwin, Australia        | 58        |
| sabinene, trans-a-bergamotene, β-caryophyllene, terpinen-4-ol, β-pinene          | Essential oil              | Nigeria                  | 59        |
| sabinene, β-caryophyllene, trans-alpha-bergamotene                                | Essential oil              | Mali                     | 60        |
| Sabinene, limonene, bicyclogermacrene, β-phellandrene, 1,8-cineole               | Essential oil              | Brazilian Cerrado        | 61        |
| Spathulenol, 1,8-cineole, (E)-caryophyllene                                       | Essential oil              | Brazilian Cerrado        | 62        |
| β-caryophyllene, β-elemene, trans-α-bergamotene, spathulenol, bicyclogermacrene  | Essential oil              | Tanzania                 | 63        |
| α-pinene, sabinene, p-cymene, terpinen-4-ol, terpinolene, 1,8-cineole, β-pinene, | Essential oil              | Nigeria                  | 64        |
| Fenchone-fenchol-chemotype, 1,8-cineole, α-pinene, β-terpinene, β-caryophyllene, | Essential oil              | El Salvador              | 65        |
| abietane-type diterpenoid endoperoxide, 13α-epi-dioxiaib-8(14)-en-18-ol terpenes  | Leaves                     | southeastern Nigeria      | 67        |
| Sabinene, β-caryophyllene                                                        | Essential oil              | Brazil                   | 68        |
| 5-caranal, α-humulene, allo-aromadendrene, Ermeophilene, cis-sabinol, camphor     | Essential oil              | Togo                     | 69        |
| sabinene, 1,8-cineole, γ-terpinene, fenchone, fenchol, the sesquiterpene β-caryophyllene | Essential oil              | South India              | 70        |
| β-caryophyllene, α-phellandrene, caryophyllene oxide                              | Essential oil              | El Salvador              | 71        |
| β-caryophyllene, trans-α-bergamotene, caryophyllene oxide, 6-hydroxy carvotanacetone, bicyclogermacrene | Essential oil              | Nigeria                  | 72        |
| Essential oil                                                                    | Essential oil              | Benin                    | 73        |
| Essential oil                                                                    | Essential oil              | Brazil                   | 74        |

Table 6: Chemical constituents isolated from *Hyptis suaveolens* (L.) Poit (contd.)

| Dominant compounds                                                                 | Isolated part               | Plant source             | Reference |
|----------------------------------------------------------------------------------|-----------------------------|--------------------------|-----------|
| Monoterpene hydrocarbons, sesquiterpene hydrocarbons, oxygenated monoterpenes, oxygenated sesquiterpenes | Essential oil              | Pisa, Italy              | 75        |
| Sabinene, β-caryophyllene, terpinolene, β-pinene, limonene, 4-terpinol           | Essential oil              | Pisa, Italy              | 76        |
| Isouaveolic acid, 8,9-epoxy suaveolic acid, 14-O-methyl suaveolic acid            | Whole plant                | Nakhon Ratchasima, Thailand | 77       |
| A-phellandrene, limonene, 1,8-cineole, fenchone, E-caryophyllene, germacrene D   | Leaves and flowers         | Arauca, Colombia         | 78        |
| Suaveolic acid                                                                   | Whole plant                | Bangladesh               | 79        |
| 11S globulin (Hs11S)                                                             | Seed                        | Colima City, Mexico      | 80        |
| 1,8-cineole, E-caryophyllene, sabinene, terpinolene, bicyclogermacrene           | Essential oil              | Uttarakhand, India       | 81        |
| Galactoglucon, galactoglucomannan                                                | Seed mucilage              | North of Thailand        | 82        |
| Caffeic acid, rutin, quercetin                                                    | Aqueous extract            | Ghana                    | 83        |
| Citric acid, ferulic acid, gluconic acid 3-O-beta-D-glucopyranoside, apigenin, sorbilfolin, quercetin, kaempferol, genkwanin, rosmannic acid, methyl rosmarinate, podophyllotoxin, picrododophyllotoxin | Whole plant                | China                    | 84        |
Table 7: Toxic effect of *Hyptis suaveolens* (L.) Poit.

| Toxic part            | Toxicity                                      | Value                                  | Application                      | References |
|-----------------------|-----------------------------------------------|----------------------------------------|----------------------------------|------------|
| Aqueous leaf extract  | Inhibit root growth of *Allium cepa*          | EC_{50} value of 1.92%                 | As herbal insecticides/pesticides | 85         |
| Ethanolic extract     | Toxic effect on larvae of *Aedes aegypti*     | LD_{10} value of 0.01 ppm, LD_{50} value of 0.60ppm, LD_{90} value of 1.45ppm |                                | 86         |
| Essential oil         | Toxic and repellent activity against *Sitophilus granarius* (L.) | At the lowest dose (2×10^{-4} µL oil per cm²) |                                | 75         |
| Essential oil         | Toxic effects on *Drosophila melanogaster* and *Artemisia salina* | LC_{50} value of 15.5 and 49.72 µg/mL, respectively |                                | 87         |

CONCLUDING REMARKS

*H. suaveolens* is an important medicinal plant used in various indigenous herbal medicines for treating numerous diseases, as is clearly shown in the above-mentioned summary of its ethnobotanical, chemical, posology, and toxicological properties. Although there are numerous reports on the chemical composition and pharmacological properties of *H. suaveolens*, most studies were conducted on its essential oils. Therefore, more new compounds from other parts of this plant still need to be isolated and identified because the specific constituents mediating the pharmacological activities have not been identified. Safety assessments of *H. suaveolens* suggest that it has acute or chronic toxicity against grain pests, which suggests that it could be used as a herbal insecticide or pesticide. In addition, to further explore and exploit the therapeutic potential of *H. suaveolens*, quality control protocols are urgently needed to standardize this plant.

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