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Review on *Hyptis suaveolens* (L.) poit (Lamiaceae) - A potential plant

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Abstract:

Plant kingdom is a treasure house of potential drugs and in the recent years , there has been an increasing awareness about the importance of medicinal plants. Drugs from plant sources are easily available, less expensive, safe, and efficient and rarely have side effects. Preliminary screening of phytoconstituents is a precious step in the identification and detection of bioactive principles present in medicinal plants and may lead to novel environmentally friendly bioherbicides and drug discovery. The plant Hyptis suaveolens (L.) Poit; [Lamiaceae] is reported to possess antifertility, anti- inflammatory and antiplasmodial properties. Traditionally, the plant extracts were used to cure swellings, abscesses haemorrhoid sand also as memory aid. It has been used as a medicinal tea in many places in Asia and as a food and source of essential oil in South America. Plant Parts were used as analgesic and decongestant, and also to avoid fever and to fuel blood circulation with a sour, minty and sweet-smelling flavour. The English therapeutic journalism shows that it is efficient against bacteria and fungi but there has not been much research yet on its viral effectiveness. Hyptis suaveolens is an important source of essential oils, alkaloids, flavonoids, phenols, saponins, terpenes, and sterols, for example diterpenes: suaveolic acid, suaveolol, methyl suaveolate, two steroids: β-sitosterol, ursolic acid, two phenolic constituents: rosamarinic acid and methyl rosmarinate along with some other important constituents oleanoic acid, 3β-hydroxy lup-12-en-28-oic acid, urs-12-en-3β-ol-27-oic acid, 1,19a- dihydroxy-urs-2(3),12-dien-28-oic acid and 3β-hydroxyl lup-20(29)-en-27-oic acid. For this reason and pursuant to the medicinal importance of the plant, this review is an effort to assemble all the information reported on its phyto-pharmacological activities, and information will lend a hand in generating attention towards the plant, and consequently, may be useful in emergent new remedies which may be more effectual and have better curative properties.

Keywords: *Hyptis suaveolens*, Lamiaceae, antifertility, anti- inflammatory, and antiplasmodial , antispasmodic, anti-rheumatic and antisoporific.

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INTRODUCTION

Hyptis suaveolens is a very common plant in India. The plant may be collected in large quantities from the wild as well as from those cultured as a crop by the Indians. Indians used to call it "Chan/Wilaiti tulsi" and the morning soup made by mixing it with corn is called "Bate" meaning memory aid. Its aromatic phytoconstituents are destroyed by gastrointestinal secretions, but the mucilaginous property may be essentially increased. Tea made from the roots of H. Suaveolens is used to purify the blood, and it is also used as a remedy for the “diseases” of women. It has been used as a medicinal tea in many places in Asia,[1] and as a food and source of essential oil in South America (Gentry et al 1990).[2]

Scientific Classification:

Kingdom	:	Plantae
Clade	:	Angiosperms
Order	:	Lamiales
Family	:	Lamiaceac
Genus	:	Hyptus
Species	:	H. suaveolens

Distribution:

Hyptis suaveolens(L.) Poit., a member of the Lamiaceae or Labiatae family is a common weed of roadsides and waste grounds. The *H. suaveolens* (pignut) is generally described as annual, perennial forb or herb or subshrub or vine. This Dicot (dicotyledonous) is native to tropical America, is an annual herb that occupies roadsides, rail tracks, wastelands, watercourses,pastures and open forests where the soil is well drained. It can form dense thickets

in all areas of growth It is found in French Guiana, Brazil, Venezuela, Ecuador in Southern America; United States in North America; Bangladesh, China and India in Asia; Benin, Kenya, Nigeria, Sudan, and Cameroon in Africa. Originally native to tropical America, Hyptis suaveolens is considered a weed worldwide.

Morphology:

From the botanical point of view, H. suaveolens is an herbaceous plant with opposing crossed leaves and entire blades. Th e semi-woody quadrangular stems are abundantly branched laterally. The stem is woody hairy and bears glandular dots. Hyptis is a strong-scented herb, which grows up to 2 m in height, with quadrate hairy stems and ovate to obviate leaves (3-5 cm long and 2-4cm wide). It is an erect and strappingly aromatic annual herb reproducing by seeds. The margins of the leaves are serrulate and the lower surface is densely hairy. The petioles are up to 3 cm long. The flowers grow in small cymes along branch ends with reduced leaves. The calyx is 5mm long in flower and 10 mm long in fruit and is ribbed; corolla is blue in colour. Th e flowers are small and clustered into axillary infl orescences, hermaphrodite, pentamer, strongly zygomorphous and bilabiate Nutlets (a small nutlike fruit or seed) are about 1.2-1.5 mm long and slightly notched at the end. Seeds are dispersed through the movement of water,animals, and vehicles. It has a wide range of pollinators and, hence, seed production is enormous. The seed can remain dormant for many years and the plant can sprout vigorously from rootstocks following rains. Morphologicallyitsfeatures resembles with Ocimum species.[3]

Hyptis suaveolens plant

Vernacular names:

Horehound, Pignut, Wild spikenard, Gros baume, Hyptis a odeur (French), Alfavaca-brava, Betonica-brava (Portuguese, Brazil), Chao, Hierba de las muelas, hortela do campo (Spanish), Wilaiti tulsi (Hindi), bhustrena, darp tulas, jungli tulas (Marathi), sirna tulasi (Telugu), bilati tulas (Bengali), Ganga tulasi (Oriya), bhustrena(Sanskrit).[4,5]

Traditional values:

Hyptis suaveolens has both medicinal individuality as well as insecticidal properties. Hyptis literature indicates that leaf extracts cure swellings, abscesses and haemorrhoids. In India the plant is considered to be stimulant, carminative, sudorific and lactogogue. Infusion is used in infections of the uterus; leaf juice is taken in cases of colic and stomach ache.[6] The shoot tops

of the plant are edible and also used for flavouring purpose. Leaves are used in the preparation of mint flavoured beverages. Roots are chewed with betel nuts as a stomachic and its decoction is used as an appetizer [7] while some parts of the plant are used for the treatment of headache. Indians used to take it in the morning soup which is made by mixing it with corn. Tea made from the roots of *H. Suaveolens* is used to purify the blood, and is also used as a remedy for the "diseases" of women. In Indonesia, the plant infusion is used to treat catarrhal (inflammation of mucous membranes, especially of the nose and throat) conditions, affections of the uterus, parasitic cutaneous diseases while the leaves are used as stomachic. In Philippines, the leaves are used for the antispasmodic, anti-rheumatic and antisoporific. In West Africa, the leaves of *Hyptus suaveolens* are employed as antifertility agent.[3,6-8] In case of a burning sensation when passing urine (Dysuria) and other urinary complains, dry seeds of *H.suaveolens* are soaked overnight in a glass of water and taken in the morning on an empty stomach along with small amounts of sugar for about a week.[9] The very strong aromatic mint/thyme-like smell leads to the use of the plant as an insectifuge. As its English name bush tea implies, *H. suaveolens* serves in West Africa as an acceptable substitute in infusion for tea. It is carminative, sudorific (causing or increasing sweat), lactogenic, anti-catarrhal and antiparasitic.[3] The plant has been reported to possess antifertility, anti-inflammatory and antiplasmodial properties.[6, 10-11]

Ethnobotanical uses:

Tumor, Malaria, Head Ache, Cancer, Expectorant, Fever, Stomach Ache, Cold, Yellow Fever, Rheumatism, Analgesic, Spasm, Antispasmodic, Constipation, Urethritis, Liver Stimulant, Antisudorific, Depurative, Stomachic, Aperitifs, Dyspepsia, Menorrhagia, Sudorific, Be´chic (relieving a cough), Epistaxis, Nausea, Tea, Bilious, Pacifier, Palsy, Carminative, Flu, Poison (Veterinary), Repellent(Insect) LactogogueCatarrh.

2. PHYTOCONSTITUENTS:

The phytochemical investigation shows that the plant *"Hyptis suaveolens"* contains essential oils as major components mainly in leaves, shoots and seeds. However, the oils from H. suaveolens differ in compositions according to geographical origin of plants. *Hyptis suaveolens* is an important source of essential oils, alkaloids, flavonoids, phenols, saponins, terpenes, and sterols, for example diterpenes: suaveolic acid, suaveolol, methyl suaveolate, two steroids: β-sitosterol, β- sitosterol glycoside two phenolic constituents: rosamarinic acid and methyl rosmarinate along with some other important constituents, Oleanolic acid or oleanic acid, ursolic acid, 3β-hydroxy-lup-12-en- 28-oic acid, urs-12-en-3β-ol-27-oic acid, 1,19adihydroxy-urs-2(3),12-dien-28-oic acid and 3β-hydroxyl lup-20(29)-en-27-oic acid.[12-15] *H.suaveolens* contains many diverse phytochemicals like α-Phellandrene (12), which is a monocyclic terpene with a pleasing aroma, α-pinene(18) a terpene having very reactive four membered rings, 4,11,11-Trimethyl-8-Methylene-Bicyclo{7.2.0}-Undec-4-ene(16),α-Caryophyllene(16b),3-cyclohexen-1-carboxaldehyde (17), 5α- androst-2,11-dione (19), 5α-androst-9(11)-en-12- one (20), 4-methyl-1-(1-methylethyl)-3-cyclohexen-1-ol (22), Thujane (13), 1,8-cineole (14), 3,7-dimethyl-1,6-octadien-3-ol(15),2,5-dimethyl-3-methylene-1,5-heptadiene (25),1,3,3trimethylbicyclo [2.2.1] heptan-2-ol (24),α-cymene (26), elemene (21). Iwu et al identified the presence of thirty two terpenoids with the help of GC-MS analysis. Limonene (11); thujane (13); α- pinene (18); α-phellandrine(12);4-methyl-l-(lmethylethyl)-3-cyclohexen-l-ol(22);3-cyclohexen-1 carboxyaldehyde (17) ; elemene(21); 4, 11, 1l-trimethyl-8-methylene bicycle [7.2.0] undec-4-ene (16); octahydro-1, 4-dimethylazulene (23); 5α, 8β, h-9β, h-10a- labd-14-ene; 5α-androst-9(l l)-en-12-one (20) and 5α-androstan-2,11-dione (19) were the major components identified.[16] .A further study was done on chemical composition of the essential oil of Hyptis suaveolens

collected from Darwin (Northern Territory, Australia) in 1997 by Peerzada et al, and they concluded that the presence of 1, 8-cineole (14) and β-caryophyllene (1) as main constituents with minor concentration of β-Pinene (18b), Sabinene (6), Fenchol (5), 4- terpinenol (7), eugenol (3), α-copaene (2), β- elemene, α-Humulene (16b), α-Bergamotene (8), aromadenedrene (9), γ-cardinene, δ-cadinene, α phallandrene (12), myrcene (12b), linalool (13b), α-terpinolene, γ -terpinene (28). They reported the absence of α-Terpinene (27), p-Cymene, Limonene (11), α-terpinene, Cimenenol, δ- Elemene.[17]Previous, preliminary investigation done by Azevedo et al in 2001 reported the presence of sabinene (6), limonene (11), bicycogermacrene (49), β-phellandrene and 1,8-cineole as the principal constituents. The investigation also indicated geographic variation in essential oil composition, that the sesquiterpenes are mainly produced in the samples grown at lower latitudes.[18] Rivas et al 2002,has reported the presence of 1,8-cineol, fenchone (51) and β-pinene (18b) as most abundant constituents of the oil.[19] .

Malele et al 2003concluded that H. suaveolens originated in Eastern Coast of Tanzaniacontains the sesquiterpene hydrocarbons β-caryophyllene (1), β-elemene (21b), trans-α-bergamotene (8) and bicycle-germacrene (49), together with the sesquiterpene alcohol spathulenol (50) represented the most abundant components. Of these, only β-caryophyllene and trans-α-bergamotene have been reported to occur abundantly. Among the monoterpenes, limonene (11), camphene (53), terpinolene (52) and α-teipineol were found. Unlike previous reports, sabinene was only found in very small amounts. But the study shows the absence of 1, 8-cineole, germacrene D (54) and germacrene B (55).[20]Manchard et al and Prawatsri et al isolated three diterpenes: suaveolic acid, suaveolol, methyl suaveolate, two steroids: β-sitosterol

(34), oleanolic acid (37), ursolic acid (36), two phenolic constituents: rosamarinic acid (32) and methyl rosmarinate (33) from the plant.

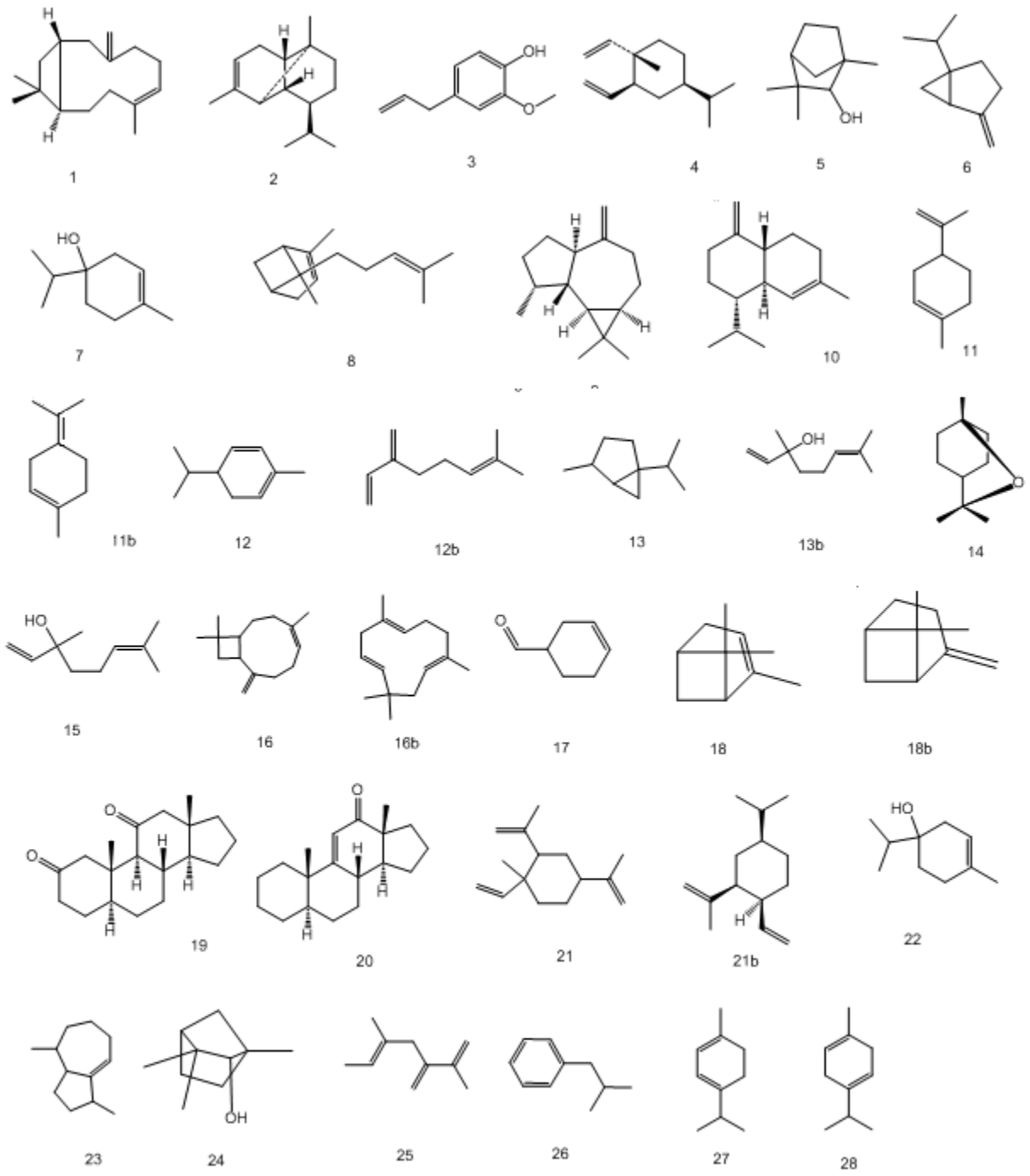

Figure-1: Structures of Phytoconstituents of Hyptis suaveolens(1-28)

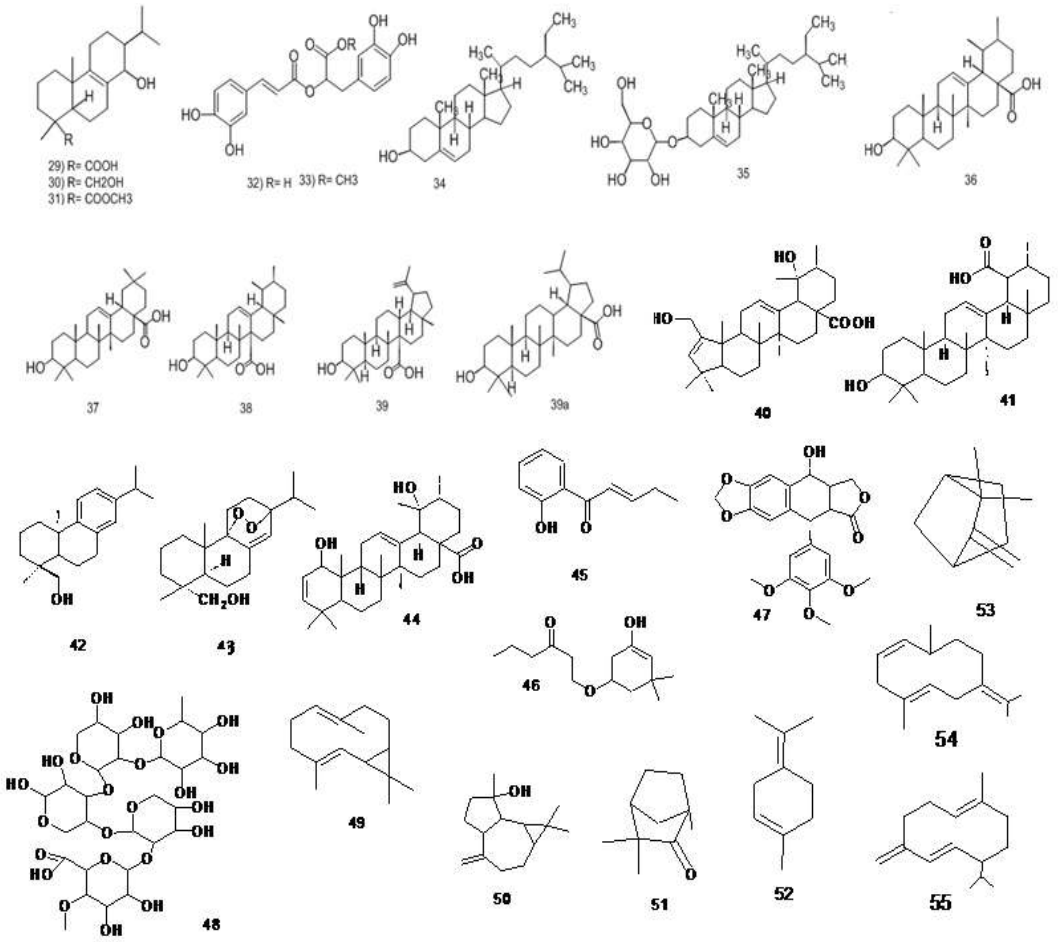

Figure -2: Structures of Phytoconstituents of Hyptis suaveolens (29-55)

Later chemical analysis of the plant also lead to the separation and isolation of the two main diterpenoid compounds which confirms the presence of suaveolic acid(29) and suaveolol (30). The same study also reported that sualveolic acid present in leaves and stems of Hyptis suaveolens Poit., Lamiaceae, which on further treatment converted to methyl suaveolate (31).[12,21]On the other hand, earlier investigations done by Mishra et alresulted in the identification of β- setosterol (34), oleanoic acid (37), 3β- hydroxy lup-12-en-28-oic acid (39a), urs-12-en- 3β-ol-27-oic acid (α-peltoboykinolic acid, 38) and3β-hydroxyl lup-20(29)-en-27-oic acid (39).They alsoreported the isolation of an unidentified pentacyclic triterpene from the roots of Hyptis suaveolens. [13,22] Mukharjee et alfound the presence of a new pentacyclic triterpene

established as urs-12-en-3β-29-oic acid (41).[23] Raja et al[14]isolated hyptadienic acid identified as A(1)-1,19α-dihydroxy-urs-2(3),12-dien-28-oic acid (44) from the Hyptis suaveolens, while, after the examination of seed-coat mucilage[24] identified a novel highly branched acidic polysaccharide L-fuco-4-O-methyl-D-glucurono-Dxylan (48). They proposed a structure having a 4- linked β-D-xylan back bone carrying side chains of single 4-O-methyl-α-D-glucuronic acid residues at O-2 and 2-O-L-fucopyranosyl-D-xylopyranose units at O-3. Ziegler et al[15] isolated Dehydroabietinol (42) from *Hyptis suaveolens* (L.) Poit. Chukwujekwu et al isolated an abietane-type diterpenoid endoperoxide, 13α-epi-dioxiabiet-8(14)-en-18-ol (43) through bioactivity-guided fractionation of the petroleum ether extract of the leaves of Hyptis suaveolens which differs only in the substitution of the endoperoxide group on the aromatic ring of Dehydroabietinol (42). [10] Raja et al, During recent investigation isolated two novel compounds from *Hyptis suaveolens* and identified as (2E)-1-(2-Hydroxyphenyl) pent- 2-en-1one (45) and 1-[(3-Hydroxy-5, 5-dimethyl cyclohex-3en-1yl) oxy] Hexane-3-one (46).[25].

In a similar analysis, leaves of H. suaveolens have been reported to contain flavonoids 1.90%± 0.14%, alkaloids 2.80%±0.28%, tannins 5.50%±0.074%, saponins 6.10%±0.42%, while stems has flavonoids 0.30 ±0.14%, alkaloids 1.60%±0.00%, tannins 0.23%±0.07%, saponins 10.50%± 0.79%. Cyanogenic glycoside contents were found to be 44.18%±1.39 mg for 100g leaves and 52.04 % ± l.39mg for 100g stems. Proximate analysis of leaves gave protein 0.24% ± 0.01%, fat 2.0%± 0.0%, fibre 5.63% ±0.53%, ash 11.40% ±0.57% and carbohydrates 55.72% ±0.64%, while proximate analysis of stem gave protein 8.75% ±0.00%, Fat 2.0 %, fibre 7.35% ± 1.63%, ash 9.58% ±0.3% and carbohydrates 38.13% ±0.53(table-1).

Calcium oxalate crystals occurred mostly within the ground tissue of the leaves, stems and roots. The presence of crystals within the ground tissue of leaves stems and roots suggest

that these crystals might have storage and supportive functions.[26-28] A recent phytochemical analysis of Hyptis suaveolens by H.O. Edeoga* et al(2006),estimated Percentage of major mineral elements which are important as human nutrition; the plant contains Potassium (K),Calcium (Ca), Phosphorus (P), Nitrogen (N), Magnassium (Mg), Sodium (Na).(Table 2)

Table-1: Analysis of leaves and stems of H. suaveolens

Part of plant	Category	Amount
Leaves	Alkaloids	2.80% ±0.28%
	Tannins	5.50%±0.074%
	Saponins	6.10%±0.42%
	Flavonoids	1.90%± 0.14%
	cyanogenic glycoside	44.18% ±1.39 mg for 100g leaves
	protein (%)	0.24±0.01%
	fat	2.0 %
	fibre(%)	5.63% ±0.53%
	Ashcontent(%)	11.40% ±0.57%
	Carbohydrate(%)	55.72% ±0.64%
Stem	Alkaloids	1.60% ±0.00%
	Tannins	0.23% ±0.07%
	Saponins	10.50% ± 0.79%
	Flavonoids	0.30 ±0.14%
	cyanogenic glycoside	52.04 % ± l.39mg for 100g stems
	protein	8.75% ±0.00%
	Fat	2.0%,
	Fibre	7.35% ±1.63%
	Ashcontent	9.58% ±0.3%
	Carbohydrate	38.13% ±0.53%

Table-2:mineral elements in Hyptis suaveolens

% K	1.80
% N	2.28
% Ca	1.06
% Mg	0.67
% Na	0.46
% P	0.79

3. PHARMACOLOGICAL PROFILE:

Antioxidant activity:

The antioxidant activity of the methanol extract of the leaves of *Hyptis suaveolens* has been evaluated in vitro by 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity using gallic acid; a potent free radical scavenger and butylated hydroxyanisole (BHA); a known antioxidant, as reference standards. [29] The antioxidant activity was expressed as IC50 value, which is the concentration of sample required to inhibit 50% of the DPPH free radical. The IC50 value was calculated using log dose inhibition curve. Lower absorbance of the reaction mixture indicated higher free radical activity, showed that Hyptis suaveolens exhibited strong antioxidant radical scavenging activity with IC50 value of 14.04µgmL-1. This value was comparable to those obtained for gallic acid and BHA (0.4 and 1.15µgmL-1), thus proving that HSME is a potent DPPH free radical scavenger. The percent DPPH scavenging effect was calculated using the equation: **DPPH scavenging effect (%) = 100 x A1/A0**

Where A0 was the absorbance of the control reaction and A1 was the absorbance in presence of the standard sample or the methanol extract of Hyptis suaveolens.Asekun OT et al.,(1999) determined the antioxidant activity of aqueous extract the Hyptis suaveolens was

determined by mean of the 1,1-diphenyl-2- picrylhydrazyl (DPPH) radical scavenging test. The results were again in favour that H.Suaveolens exhibit strong antioxidant radical scavenging activity. **Javed Ahmad et al.,(2013) evaluated antioxidant activity of** methanolic extract of Hyptis suaveolens roots using DPPH method . The DPPH assay was done according to the method of Brand-Williams, Cuvelier, and Berset with some modifications. The scavenging activity was estimated based on the percentage of DPPH radical scavenged using the following equation: **Scavenging effect (OD of control absorbance-OD of sample absorbance)/OD of control absorbance×100:** EC50 value is the effective concentration that could scavenge 50% of the DPPH radicals. Ascorbic acid was used as standard.

Antifungal activity:

Evandro Leite de Souza et al(2010) conducted antifungal activity of the essential oil from Hyptis suaveolens (L.) leaves against Aspergillus parasiticus ATCC-15517, A. flavus ATCC- 16013, A. fumigatus ATCC-40640, A. ochraceus ATCC-22947 and A. niger ATCC-1004 test microorganisms. The essential oil revealed an interesting anti-Aspergillus property characterized by a Minimum Inhibitory Concentration and Minimum Fungicidal Concentration of 40 and 80 μL/mL, respectively. The oil at 80 and 40 μL/mL strongly inhibited the mycelial growth of A. fumigatus and A. parasiticus along 14 days. In addition, at 10 and 20 μL/mL the oil was able to cause morphological changes in A. flavus as decreased conidiation, leakage of cytoplasm, loss of pigmentation and disrupted cell structure suggesting fungal wall degeneration. These findings showed the interesting anti-Aspergillus property of H. suaveolens leaves essential oil supporting its possible rational use as alternative source of new antifungal compounds to be applied in the aspergillosis treatment. Indra Rai et al(2015), evaluated antifungal activity of H. suveolens seed oil against two fungal species Candida albicans (MTCC 227), and Candida

tropicalis (MTCC 227) by using and Disc diffusion method (Bauer et al. 1959) and dilution broth method. The essential oil from H. suaveolens exhibited pronounced antifungal activity (94% inhibition of growth) against the toxigenic strain Saktiman 3NSt of A. flavus at 1 μ L mL-1 (Jaya et al.,2011).

Antimicrobial activity:

Indra Rai et al.,(2015) reported antimicrobial activity of H. suveolens seed oil against Gram positive bacterial species Staphylococcus aureus (MTCC 737), Enterococcus fecalis (MTCC 439), Staphylococcus fecalis (MTCC 3378), Lactobacillus plantarum (MTCC 2621), Lactobacillus leishmanii (MTCC 911), Gram negative bacterial species Escherichia coli (MTCC 443), Salmonella typhi (MTCC 531), Shigella flexneri (MTCC 1457), Vibriovulnificus (MTCC 1145), Pseudomonas aeruginosa (MTCC424) using Disc diffusion method (Bauer et al. 1959) and dilution broth method. The seed oil exhibited moderate to appreciable antimicrobial activities against all the bacteria tested, except E. fecalis and S. fecalis. Javed Ahmad et al., (2013) evaluated antimicrobial activity of methanolic extract of Hyptis suaveolens roots Klebsiella pneumoniae , B.cereus, E.aerogens, B.substilus, S.epidermidus. Antimicrobial activity was evaluated by measuring the zone of inhibition against the test plant extract. Each experiment was carried out in triplicates. Methanolic leaf extract is active against X. campestri and is more effective than Kanamycin and Neomycin (De Britto and Gracelin, 2011).

Anti-Tumor Activity:

The plant is also known for its anti-tumor and anti-cancer activities. The leaf is a potent anticancer agent in traditional medicine (Kingston et al., 1979). Recently 1, 3-Propanediamine N

(3- Aminopropyl)- N-Methyl isolated from Hyptis suaveolens has proved its anticancer potentials in Ehrlich Ascites Carcionoma Cell Line (Gurunagarajan and Pemaiah, 2011).

Antifertility activity:

Garg SK(1976)The anti-fertility effects of the petroleum ether, alcohol, and aqueous extracts of Hyptis suaveolens were studied in pregnant rats. The alcoholic extracts of Hyptis suaveolens (leaves) showed a 100 % anti-fertility action at doses of 150 mg/kg and 125 mg/kg, respectively.

Antiplasmodial activity:

Odugbemi TO et al., (2007) proposed Hyptis suaveolens as, Hyptis suaveolens is widely used in traditional medicine for malarial treatment and increased interest ledto the identification of theconstituent responsible for this activity.Dehydroabietinol isolated from Hyptis suaveolens (L.) Poit. was found to inhibit growth of chloroquine-sensitive as well as chloroquineresistant strains of Plasmodium falciparum cultivated in erythrocytes in vitro (IC50 26 - 27 μ M).

Wound Healing Activity:

The effect Ethanolic, petroleum ether, alcoholic and chloroform, water extract of leaves was evaluated in excision, incision and dead space wound healing models using Albino wistar rats. Among the extracts, petroleum ether extracts showed significant wound healing activity on all three wound models compared to other extracts by calculating the parameters, percentage closure of excision wound, period of epithelization, tensile strength, dry weight granulation tissue, breaking strength of granulation tissue and hydroxyproline content.Histopathological study of the granulation tissue of the petroleum ether extract treated group evidenced increased collagenation when compared to control group of animals (Shenoy et al., 2009). The activity

may be due to free radical scavenging action of the plant and enhancing level of antioxidant enzymes in granuloma tissue (Shirwaikar et al., 2003).

Gastro Protective Activity:

Suaveolol obtained from ethanolic and aqueous extracts have gastro protective activity(Prabhat et al., 2009) (Vera-Arzave et al., 2012). The aqueous extract of the plant Hyptis suaveolens showed potent activity than ethanolic extract, concluding that the plant Hyptis suaveolens increases healing of duodenal ulceration and prevents the development of experimentally induced duodenal ulceration inrats.(Das PK et al.,(2005)

Hepatoprotective Activity:

The leaf aqueous extract protects liver tissues against oxidative damages andacetaminophen induced toxicity (Babalola et al., 2011).Methanolc extract of H. suaveolens was evaluated for hepatoprotective activity against CCl_4 induced oxidatice stress, hepatotoxicity in albino wistar rats(HS Prakash et al., 2012)

Toxicity: The extract of leaves exhibits low acute toxicity (Santos et al., 2007). The effect of water extract in Wistar rats reveals the trivial effect of the extract at given doses in rats (Attawish et al., 2005).

Anti-Inflammatory Activity:

H. suaveolens contains tannins which are used as anti-inflammatory agents and also used topically for treatment of burns. Suaveolol and methyl suaveolate inhibits of croton oil-induced dermatitis of the mouse ear due to topical anti-inflammatory activity which is only two to three times lower than that of the reference drug Indomethacin (Grassi et al., 2006).

Anti-diabetic activity:

The anti-diabetic study of the extracts in alloxan-induced diabetic rats, showed significant ($p<0.05$) reduction in the blood glucose concentration and the result tends to suggest that the methanolic extract of H. suaveolens leaves possess anti-diabetic activity in alloxan-induced diabetic rats. (Danmalam et al., 2009).

Insecticidal and Larvicidal Activity:

The phytochemicals from H. suaveolens can act as larvicide, insect growth regulators, and repellent and ovipositor attractant. Bush mint produce a very strong aromatic mint/thyme-like smell when the leaves are crushed lead to use of the plant as a powerful insect repellent (Oparaeke et al., 2002) and the fumes of dried leaves are used to repel mosquitoes and control insect pests of stored grains(Alok et al., 2010;Okigbo et al., 2010). It is active against cowpea weevil, Callosobruchus maculates (Jayakumar and Ganesh, 2012)and cow pea borer, Maruca testulalis. The aqueous extract with a lower dose of insecticides can control cotton bollworms and is active against stem borer Sesamia calamistis (Adda et al., 2011). The spraying of the aqueous extract of H. suaveolens on maize plants at weekly intervals, may have acted as an inhibitor that stopped the development of different stages of S. calamistis. Hyptis suaveolens has been reported to be biologically effective against lepidopteran pests (Prakash et al. 2008).

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