

Review Article



Review on the Medicinal Uses and Pharmacological Aspects of *Plectranthus tenuiflorus* from the Labiatae Family of Saudi Arabia

Dr. Fazil Ahmad^{1*}, Dr. Abeer Mohammed Al-Subaie², Dr. Mohammed Gayasuddin^{3,4}, Dr. J. Muthu Mohamed⁵, Dr. V. Krishnaraju⁶

1. Assistant Professor, Department of Anesthesia Technology, College of Applied Medical Sciences in Jubail, Imam Abdulrahman Bin Faisal University, P.O. Box 4030, Jubail, Saudi Arabia.

2. Assistant Professor, Department of Clinical laboratory Sciences, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, P.O. Box 1982, Dammam, Saudi Arabia.

3. College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Al-Ahsa, Saudi Arabia.

4. King Abdullah International Medical Research Center, Al-Ahsa, Saudi Arabia.

5. Department of Pharmaceutical Technology, Bharathidasan Institute of Technology, Anna University, Tiruchirappalli 620024, Tamilnadu, India.

6. Department of Pharmacology, College of Pharmacy, King Khalid University, Guraiger, Abha, 62529, Saudi Arabia.

*Corresponding author's E-mail: fmahmad@iau.edu.sa

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ABSTRACT

Plectranthus tenuiflorus belong to the Lamiaceae family also known as *P. aegypticus*. It is widely used in various disorders; eardrop for ear ache, sore throat, inflammation of middle ear, respiratory system infections, and abdominal disorders. The main objectives of this review are to summarize the phytochemical, medicinal uses and pharmacological activities of *Plectranthus tenuiflorus*. The current works related to *Plectranthus tenuiflorus* were reviewed from numerous books, Journals and internet source (Science Direct, PubMed, Google Search engine, and abstracts). Phytochemical studies on fresh leaves of *Plectranthus tenuiflorus* showed the presence of thymol, the essential oil (62.53%), which is the major constituent, triterpenoids, coumarins and hydrolysable tannins, while flavonoids, alkaloids, steroids, anthraquinones, condensed tannins, cardiac and anthraquinone glycosides are absent. The Paper chromatography separation technique reported that the leaf contains 7 protein amino acids represented by Ala; His; Phe; Asn; Asp; Glu and Leu. Pharmacological activities such as, Antiplasmodial, Antitrypanosomal, Antileishmanial, Cytotoxicity, Antioxidant, Antischistosomal, Antimicrobial, Antiphytoviral and Wound healing activity have been reported. Further scientific investigations on *Plectranthus tenuiflorus* are needed to explore toxicity and clinical efficacy and as well as to explore the therapeutic effects of major secondary metabolites of *Plectranthus tenuiflorus*.

Keywords: *Plectranthus tenuiflorus*, Lamiaceae, Antimicrobial activity, Antioxidant, Thymol.

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INTRODUCTION

Medicinal plants are currently in great demand for treatment of various ailments. As per the reports of WHO, approximately 70-80% of world population are using herbal medicines for their therapy of various ailments. Natural products are mainly made from herbal, minerals and animal, have remained the source for the treatment of various human ailment. The Plants and ethnobotanicals have been utilized in the beginning of mankind are as yet utilizing all through the world for treatment of ailment and health advancement. The natural and plants sources structure the premise of the present modern medication and to a great extent contribute today for the commercial drug preparations. Worldwide about 25% of medications recommended are derived largely from plants sources.¹ Traditional medicinal system is based generally on animals and plants species for primary health

care. Developing countries have a significant medicinal value for the herbal medicines in social, cultural and divine use in tribal and rural.² Worldwide approximately 50,000-80,000 of flowering floras are practiced by the peoples for medicinal objectives. Different types of indigenous systems such as Allopathy, Ayurveda, Siddha and Unani are using numerous plant species to treat diverse ailments.^{3,4} Due to toxicity and various side effect of allopathetic medicines, these types of medicinal plants are more popular. Herbal medicinal practices are continuing today because of their biomedical benefits as well as socio-cultural beliefs in all over the world and have made a major involvement in continuing human health.⁵

The strong understanding of the herb's possible risks and benefits, as well as, a plain patient diagnosis is important for the physician to effectively and safely advice patients as to choices in the herbal usage.⁶ Also, it is important to separate active elements from the remedial plants in pure procedure, is very important, that can be likely to clarify its uses and method of action. Thus, phytochemistry investigation and characterisation of phytochemical constituent from the plant, will establish their exact chemical formulae.⁷

Plectranthus tenuiflorus also known as *P. aegypticus*. It belongs to the Lamiaceae family which contains several types



of genera: basil, mint, and sage (*Salvia*) with a rich decent variety of ethnobotanical use. *Plectranthus tenuiflorus* has a significant role and a good source of therapeutics and aromatic of commercial important. *Plectranthus* is a largest genus, which contains nearly 300 species found in Australia, Asia and Tropical Africa. Of the total 300 plant species, nearly about 62 *Plectranthus* species described to be utilizes as ornaments, medicines, fodder, foods & flavours.⁸ The present brief review is carried out on *Plectranthus tenuiflorus* about phytochemical, medical uses and pharmacological finding of this significant species.

Plant Description

Kingdom: Plantae

Subkingdom : Tracheobionta

Superdivision : Spermatophyta

Division : Magnoliophyta

Class : Magnoliopsida

Subclass : Asteridae

Order : Lamiales

Family : Lamiaceae

Genus : *Plectranthus* L

Synonyms : *P. aegypticus*



Figure 1: *Plectranthus tenuiflorus* leaves

The 6 species of *Plectranthus* are:

P. tenuiflorus,

P. barbatus,

P. arabicus,

P. cylindraceys,

P. lanuginosus and

P. asirensis

The shape of seeds varies from ovoid to sub-spherical. *P. tenuiflorus* seeds are slightly larger, measure about 0.8 - 1 × 0.7 - 0.9 mm. Seeds colour vary from reddish to brown with the biggest pollen grains. The polar axis constitutes about 41 micrometre and with 29 micrometre central diameter. The glandular trichomes of *P. tenuiflorus* are

made of one basal cell, 1 or 2 stalk cells and one head-like (apical secretory) cell. Flowers of *P. tenuiflorus* are with long pedicels up to 11 mm (**Figure 1**).

Phytochemical Investigation

The literature review shows that essential oil was acquired from the *Plectranthus tenuiflorus* by hydro-distillation. Investigated by GC-MS representing a total of 31 components concerning oil (92.79%), Thymol (62.53%), found to be as the chief active component. The essential oil additionally contains 1- 10% of m-cymene, 1-octen-3-ol, Farnesol, γ -terpinene, 1-terpinen-4-ol, α -bergamotene, hexahydro 6h benzo[c]quinolizine and Selinane.⁹ (**Figure 2**).

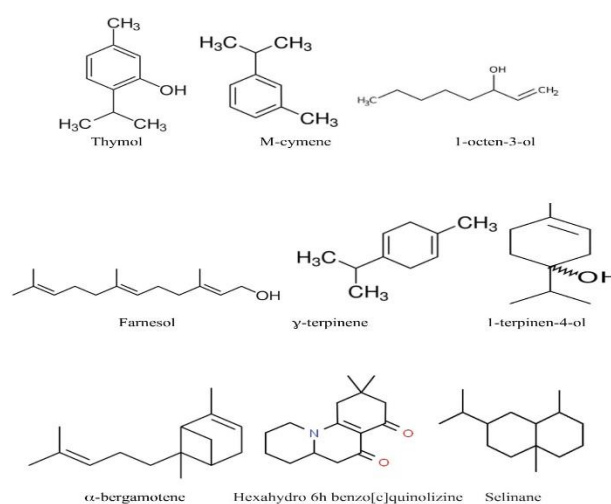


Figure 2: Chief active component *Plectranthus tenuiflorus*

Botanical description and medicinal uses

Plectranthus tenuiflorus naturally grows in high-altitude mountains in the Taif province of Southwest of Saudi Arabia. In Tiaf region of Saudi Arabia, *Plectranthus tenuiflorus* is also known by 'Shara'. It raises up to 50 cm height in crisp areas with succulent perennial leaves are inverse and inflorescence comprising of round and hollow spikes of flowers. It has a pleasant odor comparative to that of commercial preparation 'Vicks.' In Taif region *Plectranthus tenuiflorus* is utilized as an eardrop for irritation and ear throb. The flora of Saudi Arabia represented by 7 species, but only 6 species are accepted: *P. tenuiflorus*, *P. arabicus*, *P. barbatus*, *P. cylindraceys*, *P. lanuginosus*, and *P. asirensis*.¹⁰⁻¹²

P. tenuiflorus considered as a well-known species in Saudi Arabia, the herb used as folk medicine for the treatment of sore throat,¹³ respiratory system infections, and abdominal disorders.¹⁴ The species of this genus are used extensively for the treatment of different illnesses. The plant species are widely using for liver stress and intestinal disorders, malaria, heart diseases, respiratory disturbances, and CNS disorders.¹⁵⁻¹⁹ This species is rich in essential oils and diterpenoids, which are reported to play an important role for numerous pharmacological activities, such as anti-plasmodial, antibacterial, antifungal, cytotoxic

activities.²⁰⁻²⁵ Paper chromatography separation proved that leaf contain 7 protein amino acids represented by Ala; His; Phe; Asn; Asp; Glu and Leu. The descriptive tests showed the presence of hydrolysable tannins, coumarins, triterpenoids and essential oils (mostly thymol 62.53%). While anthraquinones, flavonoids, condensed tannins alkaloids, steroids, cardiac- and anthraquinone glycosides are said to be absent.²⁶

Methodology

The synonyms of *Plectranthus tenuiflorus* were affirmed from plants data accessible on website "www.theplantlist.org". The review data on *Plectranthus tenuiflorus* were gathered using some prevalent searching sites such as Publons (web of science), PubMed, Google Scholar, and ScienceDirect. Other review literature source, includes are books and journals. About 75 literature research and review articles were considered, and only 44 reference literature were added in this review paper.

PHARMACOLOGICAL PROPERTIES

Various pharmacological activities of *Plectranthus tenuiflorus* are attributed to the presence various phytochemical constituents (Figure 3).

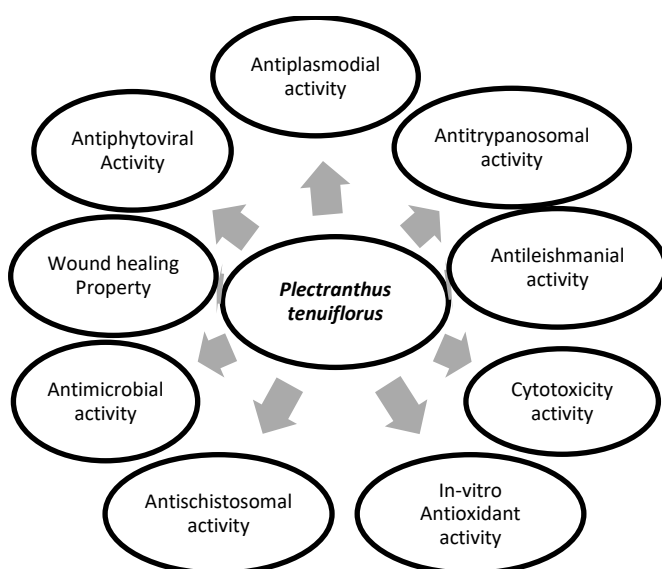


Figure 3: Pharmacological activities of *Plectranthus tenuiflorus*

Antiplasmodial activity

Literature shows that *Plectranthus tenuiflorus* had reported with antiplasmodial activity. The plant extracts were tested for chloroquine sensitive *P. falciparum* K1-strain according to procedures reported.²⁷ Percentage of growth inhibition were calculated compared to the negative blanks. The results revealed that plant extracts of *Plectranthus tenuiflorus* exhibited a noticeable action against *Plasmodium falciparum* (K1-strain) with IC₅₀ value of 10.08 micro/ml. According to the principles of WHO and existing data²⁸ the antiplasmodial effect was categorized as follows: moderate (15 < IC₅₀, <50grams/ml), promising (5 < IC₅₀, <15grams/ml), and high (IC₅₀ <5grams/ml).

Antitrypanosomal activity

The plant extracts of *Plectranthus tenuiflorus* found be effective against plasmodium. Trypomastigotes of *Trypanosoma brucei* (Squib- 427) strain, which are sensitive to suramin were cultivated at normal temperature(37°C) and 5% CO₂ in Hirumi-9 medium,²⁹ with 10% fetal calf serum (FCS) supplemented. According to procedures reported assay was performed.³⁰ *Trypanosoma cruzi* strains, Tulahuen strain (CL2) (nifurtimox-sensitive) was kept in minimal essential medium (MEM) on MRC-5 cells. Invitro inhibitory trypanosomal effect were determined according to procedures prescribed. The colour reaction was measured at 540nm and absorbance values were shows as blank controls percentage. The results of *Plectranthus tenuiflorus* extract showed moderate action against *Trypanosoma cruzi* (IC₅₀, 25µg /ml) and also against *Trypanosoma brucei* (IC₅₀, 47µg / ml).

Antileishmanial activity

The plant extracts of *Plectranthus tenuiflorus* also found to be effective against Leishmanial infantum. *Leishmania infantum* amastigotes was gathered from a contaminated hamster donor and which is utilized to infect essential peritoneal macrophages of mouse. The in-vitro antileishmanial effect was determined according to reported procedures.²⁷ Microscopically evaluated parasite inhibition after the Giemsa staining and specified in % of blank controls without the sample. The result of *Plectranthus tenuiflorus* plant extract reported moderate effect against *Leishmania infantum* (IC₅₀, 27µg/ml). The outcome was expressed as the mean LD₅₀(lethal dose). (LD₅₀ = concentration of the drug that diminished the quantity by 50% of viable cells).

Cytotoxicity activity

The extracts concentration of *Plectranthus tenuiflorus* were tried in-vitro for their possible antiprotozoal effect against *Trypanosoma cruzi*, *Trypanosoma brucei*, *Leishmania infantum* and *Plasmodium falciparum*, also for cytotoxicity, against MRC-5 cell lines & estimation of selectivity. In MEM (minimal essential medium), MRC-5 cells were cultured complement through L-glutamine (20 mM), 5% FCS and 16.5 mM NaHCO₃, 5% CO₂ at 37°C temperature. For this assay, 104 MRC-5 wells or cells were implanted on test plate comprising the previously dilute samples and breaded at CO₂(5%) and temperature(37°C) for a period of 72 hours.³¹ Fluorometrically reasonability of cells were decided after the expansion of resazurin (phenoxazine dye), IC₅₀ were additionally decided using a dose response curve and the outcome were expressed. The methanol extract *Plectranthus tenuiflorus* indicated intense cytotoxicity, and emphatically recommending that the observed effect against tested protozoa is due to nonspecific reactions.

In-vitro Antioxidant activity

DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) in-vitro free radical scavenging assay of methanol extract of *Plectranthus tenuiflorus* were determined. Which depends on the scavenging activity of the stable DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) free radical.³² An aliquot of about (0.1 ml) of test sample solution (50, 100 or 200 µg/ml) were mixed to 3 ml of 0.004% methanol DPPH solution and reserved in darkness. After 30min absorbance were estimated at 517nm wavelength, the % inhibitory property was determined from $[(A_0 - A_1)/A_0] \times 100$, A_0 represent "control absorbance" and A_1 represent "extract or standard absorbance". The DPPH solution without the sample solution were used as control. All the above tests were run thrice. Substance quercetin were used as the positive control. The concentration of extracts provided IC₅₀(inhibition 50%), which were evaluated from the plot of % inhibition against the concentration of extract. The MeOH(methanol) extracts of *Plectranthus tenuiflorus* had displayed a notable dose dependant restraint of DPPH action. The IC₅₀ value reported as quercetin/mg extract (38.31g/ml).

Antischistosomal activity

The recent study showed that ethanol extract of *Plectranthus tenuiflorus* showed that significant antischistosomal activity against Schistosoma. *Plectranthus tenuiflorus* exhibited the potent antischistosomal activity against cercariae and Schistosoma mansoni schistosomula and were moderately effect against Schistosoma mansoni miracidia.³³ In-Vitro antischistosomal activity of ethanolic extracts were also tested for their potential antiprotozoal activity. Extracts of *Plectranthus tenuiflorus* showing scoring three in contrast to any one of the protozoa with lower cytotoxicity got subjected for further fractionations and these fractions were re-examined in the model, were the leading activity was found.

Antimicrobial activity

The literature showed the antimicrobial activity of *Plectranthus tenuiflorus*.³⁴ The beneficial and variety feature of endophytic microorganisms are studied in *P. tenuiflorus* medicinal plant. From the root, leaves and stem of *Plectranthus tenuiflorus* endophytic bacteria were isolated. Amongst the 28 isolated endophytic bacterial from distinct parts of *Plectranthus tenuiflorus*, 8 isolates have been distinguished by 16S rRNA gene sequencing, they are *Acinetobacter calcoaceticus*, *Micrococcus luteus*, *Pseudomonas* species, *Paenibacillus* species, *Bacillus* species, *Bacillus megaterium*, *Bacillus licheniformis* and *Bacillus pumilus*. The isolates that had displayed extracellular enzymatic effect were belonged to *Bacillus* genus. Besides, HE613660 (*Bacillus* sp.) had displayed the stronger affect in extracellular enzymes like proteolytic enzyme, xylanase, cellulase, pectinase, amylase, esterase, lipase, and additional strains. Essentially, antimicrobial activity in contrast to the human

infectious microbes (*Staphylococcus*, *Escherichia coli* *Klebsiella* and *Proteus*, *Candida*) were recorded utilizing the crude plant extracts of the collected endophytic microbial strains. This examination proves that the extract of *P. tenuiflorus* is potent. This investigation indicated promising enzymatic and antimicrobial activity. Elaborated investigations on *Plectranthus tenuiflorus* plants endophytic microorganisms were essential to demonstrate its possible further and which can cause the invention of diverse valuable metabolites.

Wound healing Property

In recent study proved that both essential oils and juice exerted from *Plectranthus tenuiflorus* has a wound healing property, promoting impact in wound induced rat method.³⁵ The reported effect was principally due to the ability of extract in stimulating proliferation of fibroblasts, in additional to antibacterial effect of its thymol component. The essential amino acids isolated are (Asp, Asn, His Phe, Ala, Leu and Glu) appears to have an important role and thymol was well known to own an antimicrobial property. Thymol isolated in this investigation found as the principle compound, which constitute about 82.16% from *Plectranthus tenuiflorus* extract.

Antiphytoviral Activity

The crude extract obtained from *Plectranthus tenuiflorus* were confirmed as an antiphytoviral agent in contrast to various kinds of plant viruses, such as; Tomato Spotted Wilt Virus (TSWV), Tobacco Necrosis Virus (TNV) and Tobacco Mosaic Virus (TMV).³⁶ Once the extract was applied(In-vitro) as pre-inoculation spray on plant virus (*Chenopodium amaranticolor* *Phaseolus vulgaris* and *Datura stramonium*), diminished the contamination of the above described viruses by 90.6%, 85.8% and 77.7%, significantly. Nonetheless, when the extract of *Plectranthus tenuiflorus* was blended with the virus in vitro as inoculum, showed 100% local lesions inhibited after 1hr of mixing for TNV, and 3hrs for both TSWV and TMV. *Plectranthus tenuiflorus* effect on the systemic viral infection (TMV) were additionally studied. Extract concentration had delayed the development of the disease for 4 to 5 days, though it had lower impact on the virus growth. Observing the effect of rate of dilution and temperature on the antiphytoviral effect exposed that the thermostable effect of the cure extract and its antiphytoviral activity was up to 10-2 dilution rate.

CONCLUSION AND FUTURE PERSPECTIVES

Plectranthus species also reported with cytotoxic, antimicrobial and antioxidant activities.³⁷

Some *Plectranthus* species extract is found to inhibit Dental Bacteria, *Streptococcus sobrinus* and *Streptococcus mutans*.³⁸ The essential oil obtain from *Plectranthus incanus* extract is found to be active against Gram +ve bacteria (*Staphylococcus aureus*) and *Plectranthus glandulosus* hook reported to be effective against *Staphylococcus aureus* and *Escherichia coli* respectively.³⁹



⁴³ In the recent study shows that some *Plectranthus* species gathered near Al-baha area (Saudi Arabia) possess antimicrobial activities, which are used traditionally in the treatment of many microbial diseases. It is also reported that the essential oil extracted from French lavender and *P. tenuiflorus*, showed effective against both gram-ve bacteria; *Pseudomonas aeruginosa* and *Acinetobacter* species (MIC 50 to 150µl/ml).⁴⁴

The present review article on *Plectranthus tenuiflorus* reviewed about phytochemical, medical uses, and a brief pharmacological finding of this significant species. The existing literature on *Plectranthus tenuiflorus* shows that aerial parts of this plant extensively studied and shows high important by tradition. The Lamiaceae family species have been demonstrated with excellent pharmacological activities with safely and highly benefits. From essential oils of *Plectranthus tenuiflorus*, the thymol (62.53%) is the major component. The reported Pharmacological work includes, Antiplasmodial, Antitrypanosomal, Antileishmanial, Cytotoxicity, Antioxidant, Antischistosomal, Antimicrobial, Antiphytoviral and Wound healing activity have been reported. The major ambition of this current review is to promote forthcoming logical investigators, directing mainly on phytochemical, pharmacological and traditionally important of natural products and study for further biochemical change. Nevertheless, further improvements are needed due to increasing research interest on *Plectranthus tenuiflorus*: (i) moderate pharmacological research need to be done on the aerial parts and leaves of *Plectranthus tenuiflorus* but still, a comprehensive research on other parts of plant such as stem, endophytes, roots, flowers, and essential oils to detailed chemistry and medical aspects (ii) There is need for pharmacokinetic research on ADME (absorption, distribution, metabolism, and elimination) process in *Plectranthus tenuiflorus*. (iii) Preclinical evaluation of *Plectranthus tenuiflorus* plant should be carried in several features for claiming scientifically and clinically applications. In addition, there is a need of mechanism-based research studies on phytochemical constituent (especially coumarins, tannins, essential oil 'thymol' and triterpenoids). Traditionally valued plants as the natural resources been main aspect for drug discoveries and development. The summarized information from the current review may be useful tool for researchers to carry out further study and explore other scientific aspects of the herbs.

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