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Future Perspective of *Hyssopus officinalis*

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Abstract

Hyssopus officinalis L., commonly known as hyssop, jufa, zufah-yabis, and zufah in other languages, is a member of the Lamiaceae family. It is a perennial plant that is frequently grown in temperate regions of North America, Asia, and Europe. The health benefits and therapeutic uses of *H. officinalis* are typically based on tradition rather than any scientific validation, making it an excellent candidate for compiling data on phytochemical contents, traditional uses, and biological activities available in recent scientific studies. Iso Pino Camphone (5.3%), Pino Camphone (19.6%), Pino Carvone (36.3%), -pinene (10.6%), and 1,8-cineole (7.2%) were the main components. It provides a variety of pharmaceutical benefits, including anti-oxidant, anti-fungal, anti-microbial, anti-diabetic, anti-ulcer and anti-inflammatory characteristics.

Keywords: *Pharmacological Property; Constituents; Photochemistry*

Introduction

The Lamiaceae family includes the medicinal plant *Hyssopus officinalis* L., which is also known as hyssop, jufa, zufah-yabis, and zufah in other languages. It is a perennial plant that is widely cultivated in temperate areas of Asia, Europe, and North America [1]. It is primarily found in Central Asia and the Eastern Mediterranean. *H. officinalis* is an excellent candidate to compile data, including phytochemical contents, traditional uses, and biological activities available in recent scientific studies because the health benefits and therapeutic uses of this plant are typically based on tradition rather than on any scientific validation. Industrial steam distilled essential oil from *H. officinalis* has recently demonstrated biocidal properties against *S. littoralis*, including nematicidal, ixodicidal, phytotoxic, and insecticidal actions [2]. Additionally, studies on the effectiveness and affordability of *H. officinalis* essential oil as a mosquito larvicidal agent in different environments were conducted [3]. Interleukin4 (IL-4), IL6 and IL17 as well as interferon are among the cytokines that *H. officinalis* L. influences in mice with asthma that has been generated. *H. officinalis*, a highly revered medicinal plant endemic to the Caucasus, Turkish North-eastern Black Sea region, North-western Iran, and Southern Anatolia, is an oil-rich plant [4].

Hyssopus officinalis promotes digestion and has antibacterial properties. Mid-June marked the beginning of the plant's vegetative phase; mid-July marked the beginning of flowering; mid-August marked the full bloom; and mid-September marked the end of flowering. In the years from 2006 to 2008, the impact of plant harvesting, and plant spacing (30, 40, 50 cm) on the quantity and yield of *H. officinalis* herb was assessed. Similar to the dry yield of a plant without stems, it was discovered that the plant's production increased significantly after flowering. This study also showed that the plants grown at a spacing of 40 cm produced the maximum fresh plant yield of 1.47 kg/m^2, which was comparable to the dry plant yield of the stemless plant. The amount of oil, dry matter, chlorophyll, l-ascorbic acid, flavonoids, carotenoids, and tannins was not significantly impacted by plant spacing. Nevertheless, the harvest term had a substantial impact on the amount of l-ascorbic acid, essential oil, chlorophyll, and carotenoids in *H. officinalis* herb [5].

H. officinalis was shown to require a temperature range of 20°C to 30°C for optimum germination. 30°C produced the highest germination rate. This means that the warmer weather is ideal for it. 30°C was found to be the temperature for the best seedling growth [6]. The yield and other plant characteristics of *H. officinalis* were improved through the use of biofertilizers such as *Pseudomonas fluorescens, Bacillus subtilis*, and *Azospirillum* (Super Nitro Plus), *Azotobacter/Azospirillum* (Nitroxin), *Glomus intraradices* (Mycorrhizal inoculant), and *Pseudomonas fluorescens*. With the right use of a blend of *Glomus intraradices* and *Pseudomonas fluorescens*, as well as Super Nitro Plus, *H. officinalis* had demonstrated improved plant criteria [7]. In figure 1, pictures of the plant *Hyssopus officinalis* L. and its components are displayed.

Phytochemistry and bioactive principles

The chemical makeup of Hyssop oil varies greatly between various phenotypes and geographical regions [8-11]. The origin, geography, climate, technological influence, developmental phases, components used, harvesting period, and presence of chemotypes are only a few examples of the various variables that can affect the chemical composition [12]. Gas chromatography-mass spectrometry (GC/ MS) and GC analyses were used to examine the properties of the essential oil from the genus *Hyssopus*. 21 components, or 95.6% of the oil, were found. Seven monoterpene hydrocarbons (32.3%), five oxygenated monoterpenes (60.5%), six sesquiterpenes (60.5%), one phenol (0.2%), and five other chemicals were present. The main monoterpene components were -pinene (18.4%), iso Pino camphone (9.7%), and Pino camphone (49.1%) [13]. The components of the genus *Hyssopus*, cis-pinonic, hydroxy iso Pino camphone, pinic acid, cis-pinic acid, methyl myrtenate, and myrtenol methyl ether, were first identified by Joulain [14]. Pino camphone (34 and 18.5%), camphor (0.3 and 5.3%), linalool (0.2 and 7.9%), and iso Pino camphone (3.2 and 29%) were the essential oil's main constituents.

1,8-cineole (52.89%) and -pinene (16.82%) were detected by GC and GC-MS analyses of the volatile oil from *H. officinalis* from Spain. 34 components, or 91% of the total identified components, were discovered in the GC study of the Turkish plant *H. officinalis* by Zer., *et al*. [15]. The primary ingredients were iso Pino camphone (5.3%), Pino camphone (19.6%), Pino carvone (36.3%), -pinene (10.6%), and 1,8-cineole (7.2%) [16]. When the essential oil of the *Hyssopus officinalis* plant from the French Alps' Banon region was dissected, the major constituents were -pinene (2.4%), -pinene (3.0%), limonene (5.4%), linalool (49.6%), 1,8-cineole (13.3%), and -caryophyllene (2.8%), while Pino camphone and iso Pino camphone were minor ones.

The *H. officinalis* oil from Romania is primarily composed of aliphatic fatty acids such eicosadienoic acid (0.68%), linolenic acid (63.98%), arachidic acid (2.64%), stearic acid (10.73%), and palmitic acid (15.60%) [17]. However, the plants of the genus *Hyssopus* in Iran had different constituents, and their concentrations were found to be bornyl acetate (1.42%), -caryophyllene (2.10%), -bour boneen (1.47%), camphor (6.76%), caryophyllene oxide (2.13%), spathulenol (2.14%), germacrene (3.39%), and myrtenyl acetate (74.08%). According to a chemical examination of the endemic *H. officinalis* in the former Yugoslavia, the essential oils are primarily made up of cis- and trans-pino camphone and pino carvone, with smaller levels of germacrene D, bi cyclo germacrene, elemol, and spathulenol [18].

The primary components of the essential oils isolated from hyssop plants growing in two distinct locations close to Urbino (Italy) were Pino camphone (34% and 18.5%), iso Pino camphone (3.2% and 29%), and -pinene (10.5% and 10.8%). The ratio of Pino camphone/iso Pino camphone, the percentage of linalool (0.2% and 7.9%), and the percentage of camphor (0.3% and 5.3%) were the main indicators of the compositional variations between the oils. In Poland, hyssop oil was discovered to contain 52 substances, one of which was unidentified. Iso Pino camphone (22.53 - 28.74%), Pino camphone (11.41 - 17.99%), -pinene (6.69 - 12.01%), elemol (5.02 - 7.57%), germacrene D (3.14 - 6.98%), and bi-cyclo germacrene (2.55 - 4.36%) were the major components of hyssop essential oil [19]. Garg and co. discovered that the primary volatile components of *H. officinalis* essential oil from a number of sources included -pinene, limonene, phellandrene, 1,8-cineole, Pino camphone, iso Pino camphone, Pino carvone, germacrene-D, and methyl eugenol. They discovered that the percentage composition of the main volatile ingredients varied between the oils derived from various subspecies or plant populations of various origins or morphologies.

According to Said-Al Ahl., *et al*. [20] from Egypt, the main components of *H. officinalis* oil were cis-Pino camphone (26.85%), -pinene (20.43%), trans-Pino camphone (15.97%), -elemol (7.96%), durenol (3.11%), -phellandrene (2.41%), caryophyllene (2.34%), (E)-2, After the first and second harvests, Ahmadi., *et al*. [21] studied how to increase the yield of essential oil from *H. officinalis*. It was determined that the yield after the first and second harvests improved by 15 and 30%, respectively, when citrulline was applied at a rate of 2 mm. The treatment of 2 mM of citrulline resulted in 47% iso Pino camphone as the predominant essential oil component during extreme drought, according to the scientists.

Pharmacological activities

Antioxidant activity

Two new flavonoid glycosides, quercetin-7-O-D-apiofuranosyl-1,2-D-xylopyranoside and quercetin-7-O-D-apiofuranosyl-1,2-xylopyranoside the stable 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) was effectively scavenged by -D-xylopyranoside-3'- O-D-glucopyranoside, which was isolated from *H. officinalis*. The ethanolic extracts of the stems, leaves, and flowers of *H. officinalis var. angustifolius* exhibited moderate iron (II) chelating ability, good hydrogen peroxide scavenging ability, good antioxidant activity in the haemoglobin-induced linoleic acid model, and good antioxidant activity that varied with concentration [22]. It was discovered that an *H. officinalis* extract mixed into samples of hog meat prevented lipid oxidation and the breakdown of heme pigments brought on by cooking and 8 days at 4°C storage. Additionally, it prevented metmyoglobin from forming during cooked meat storage and stabilised the colour of red meat [23] (Figure 1).

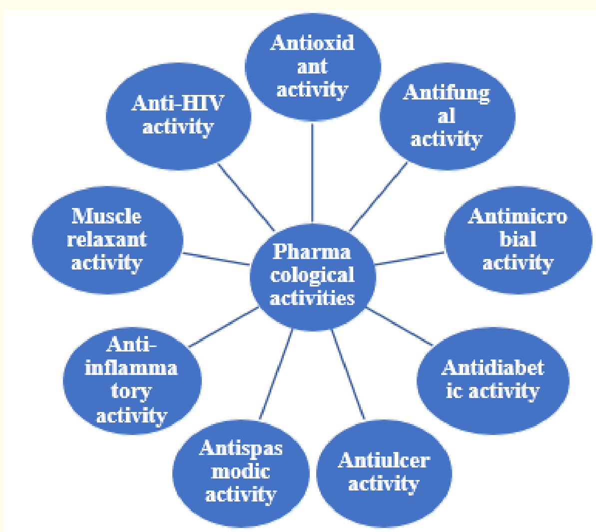

Figure 1: *Pharmacological activities.*

Antifungal activity

In vitro in agar media, *H. officinalis* oil (0.4%) completely suppressed the mycelium growth of *Pyricularia oryzae* and *Pyrenophora avenae*, the plant pathogenic fungus. The three main components of *H. officinalis* oil-Pino camphone, iso pino campheol, and l-bornyl acetate-completely inhibited fungal growth both singly and in combination when the mixture also contained iso pino campheol the mycelial growth of *P. oryzae* was less impacted by them. The uredospore's of *Uromyces viciae-fabae* and *Botrytis fabae* conidia did not germinate as much when *H. officinalis* oil was applied, although its effects on pathogen infection were less obvious. Thus, whereas 0.05% *H. officinalis* oil reduced rust infection of broad bean when administered 1, 2, or 3 days before, or 1 or 2 days after inoculation, its effects against apple powdery mildew and barley powdery mildew were varied [24]. The two essential oils from *H. officinalis* grown at 1000 metres above sea level in two distinct locations near Urbino, Italy, Marche, displayed extremely significant antifungal activity against various types of phytopathogenic fungi [25]. The fractionated and isolated growing hyphal *Aspergillus fumigatus* cell walls cultured in the presence or absence of essential oil from *H. officinalis* revealed that the essential oil caused an increase in phosphorus, lipids, and amino sugar levels while decreasing levels of uronic acid, proteins, and neutral sugars. According to HPLC analysis, the main neutral sugars were galactose, mannose, and glucose, whereas the predominant amino sugars were galactosamine and glucosamine. Galactosamine and galactose content in the culture medium underwent significant modifications as a result of the addition of *H. officinalis* oil. Similar alterations were likewise brought about in the various fractions by *H. officinalis* oil, however the principal components were more noticeably affected [26]. Industrial steam-distilled *H. officinalis* essential oil was highly effective and robustly active against *S. littoralis* in terms of its biocidal (nematicidal, ixodicidal, phytotoxic, and insecticidal) activities [27].

Antimicrobial activity

The disc diffusion tests performed on Gram +ve (*Enterococcus* spp. and *Staphylococcus aureus*) and Gram ve bacteria (*Pseudomonas* spp., *Proteus mirabilis, Escherichia coli, Klebsiella oxytoca*, and two strains of *Salmonella* spp.) bacteria revealed an antimicrobial activity insignificant for *H. officinalis* essential oil from Italy (Piedmont), but (Jordan and Fourr.). Both species significantly reduced the growth of all yeasts, including seven different strains of *Candida albicans* and *C. tropicalis* and *C. krusei*. When grown in liquid media, *H. officinalis* had a MIC of between 0.6% and 1.2% v/v for yeasts and always 41.2% v/v for bacteria, but var. decumbens had a MIC of between 0.15% and 0.3% v/v for yeasts, 0.3% and 1.2% v/v for Gram ve bacteria, and 0.15% and 0.6% v/v for Gram +ve bacteria. *H. officinalis var. decumbens* had antibacterial properties. var. decumbens had more antibacterial activity than *H. officinalis* due to the presence of 1,8-cineole and linalool, but both oils' antimycotic effects were attributed to limonene [28]. A moderately effective *in vitro* antimicrobial agent against Gram +ve and Gram-ve bacteria, *H. officinalis* also exhibits antioxidant, antifungal, antiviral, and insecticidal properties. It has been demonstrated to have *in vivo* -glucosidase inhibitory, antiplatelet, and myorelaxant properties. In a disc diffusion test, the essential oils of *H. officinalis* from Southeast Anatolia, Turkey, produced antibacterial effects against *Staphylococcus pyogenes, Staphylococcus aureus, Escherichia coli*, and *Candida albicans* but not against *Pseudomonas aeruginosa*. In vacuum-packed beef meat kept at 6 1°C and 0.5 0.5°C for 15 days, the essential oils of coriander and *H. officinalis* (0.02% v/w) prevented the growth of *Enterobacteriaceae* and the emergence of unfavourable sensory changes. Lactic acid bacteria and other groups of microorganisms had a small but comparable impact on the total viable bacterial count in both oils. These additives had a minimal impact on the ability of the oils to preserve vacuum-packed minced beef based on the results of tests on protein electropherograms, meat pigments, protease activity, pH levels, and amino nitrogen levels. With a minimum inhibitory concentration (MIC) of 15.62 l/ml to 250 l/ml against the yeast *C. albicans*, fungi, and bacteria *in vitro*, the essential oil from *H. officinalis* L. ssp. *angustifolius* shown antibacterial action. In a linoleic acid system where essential oil was inert, the methanolic extract exhibited 40% inhibition at a dose of 2 g/L while exhibiting an IC50 of 117.0 g/ml in the DPPH assay [29].

Antidiabetic activity

a-glucosidase inhibitory activity was detected in an aqueous methanolic extract of dried *H. officinalis* leaves (300 mg/kg and 100 mg/kg body weight, b.wt). It contains antidiabetic properties, but it should not be used by those who have liver conditions.

Antiulcer activity

To support its long-standing use in folk medicine, albino rats pre-treated with 100 mg/kg and 125 mg/kg body weight of *H. officinalis* ethanolic extract 1 hour before the administration of ethanol demonstrated a great antioxidant and antiulcer potential as evidenced by decreased nitric oxide level, decreased reactive oxygen species (ROS) generation, improved integrity of the stomach, and improved mucus secretion. The H. officinalis extract enriched in polyphenolic components (phenolic acids, tannins, and flavonoids) demonstrated a considerable inhibition (92.67%) against urease derived from jack bean and a mild inhibition (19.6%) against -chymotrypsin, suggesting that it may be used as a treatment for ulcers.

Antispasmodic activity

In a concentration-dependent manner, linalool and the essential oil from the *H. officinalis var. decumbens* plant prevented contractions of the isolated guinea pig ileum brought on by acetylcholine and barium chloride (IC_{50} values: linalool 51 mg/ml and 10 mg/ml; *H. officinalis var. decumbens* 60 mg/ml and 37 mg/ml). The spasmogenic effects of 1,8-cineole and limonene were also minimal.

Anti-inflammatory activity

Enzyme-linked immunosorbent assay results showed that the eosinophils ratio in bronchoalveolar lavage fluid and the levels of serum IgG and IgE immunoglobulins in the *H. officinalis* treatment group were lower than those in the ovalbumin and dexamethasone-treated group (chronic asthmatic) (ELISA). *H. officinalis* impacted immune control as well.

Muscle relaxant activity

The acetyl choline (ACh) and barium chloride ($BaCl_2$)- and acetyl chloride ($BaCl_2$)-induced muscular contractions in the isolated guinea-pig ileum were both suppressed by the essential oil of *H. officinalis*. In isolated rabbit jejunum, essential oil also decreased baseline tone and decreased the amplitude of spontaneous movements.

Anti-HIV activity

After extracting the dried leaves of *Hyssopus officinalis* with ether, chloroform, and chloroform-ethanol, methanolic extracts demonstrated very potent anti-HIV (Human Immunodeficiency Virus) activity as measured by inhibition of HIV reverse transcriptase, p17 and p24 antigen expression, and syncytia formation likely caused by caffeic acid, and they may be helpful in the treatment of AIDS patients. Inhibition of the development of syncytia and HIV-1 p24 antigen were two signs that a polysaccharide from an aqueous extract of H. officinalis had anti-HIV action against HIV-1 in HUT78 T cell line [30].

Conclusion

It concludes that *Hyssopus officinalis* have some good constituents that can be future treatment of variety of disorders. Recently one study has done on same plant, it given good result and antihyperlipidemia effect of high fat diet induced hyperlipidemia.

Author's Contribution

Arifa Hassan contributed full manuscript's literature and design. The final check and text design are all created by Mohd Rafi Reshi. The final review article was approved both authors.

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