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CHEMICAL CONSTITUENTS AND BIOLOGICAL ACTIVITIES OF SEVEN IRANIAN *SATUREJA* SPECIES- A REVIEW

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ABSTRACT

Plants Play a vital role in maintaining human health and contribute toward important of human life. They are important components of medicines, cosmetics, dyes, beverages etc. Plants have been one of the important sources of Medicines, even since the down of human civilization. The present review describes the chemical and biological activities of seven Iranian *Satureja* species namely *Satureja atropatana* Bunge., *S. bachtiarica* Bunge., *S. Boissieri* Hausskn. ex Boiss., *S. edmondi* Briquet., *S. hortensis* L., *S. intermedia* C. A. Mey. And *S. isophylla* Rech. f.

KEYWORD: Seven Iranian *Satureja* species, Chemical Components, Biological Activities Labiatae.

INTRODUCTION

Satureja is a genus of aromatic plants of the family Lamiaceae, related to rosemary and thyme. It is native to North Africa, Souther + Southern Europe, The Middle East and Central Asia. A few new world species were formerly included in *Satureja*, but they have all been moved to other genera. Several species are cultivated as culinary herbs and they have become established in the wild in a few places.[1,2]

Since antiquity, these plants have been used in treatment of medicine as antimicrobial, spasmolytic, cicatrizing and diuretic agents, however, the essential oil has only been scientifically evaluated as a spasmolytic agent.[3]

Satureja atropatana Bunge

The oil obtained by hydrodistillation of the aerial parts of *Satureja atropatana* Bunge., endemic in Iran, was analyzed by GC/MS. Thirty-seven compounds representing 99.3% of the oil of *S. atropatana* were identified, among them carvone (21.5%), menthol (18.1%), 1,8-cineol (13.1%), methyl chavicol (11.1%) and menthone (10.5%) being the major ones. The oil was richer in oxygenated monoterpenes than sesquiterpenes. *S. atropatana* Bunge. growing wild in the 10-35 km from Tabriz to Ahar, Province of Azarbaijan, Iran, in June 1999.[4]

In another study, the essential oil of the aerial parts of *S. atropatana* Bunge was analyzed by GC/MS. The main components were thymol (62.1%), p-cymene (6.1%) and spathulenol (5.2%). In the oil of *S. atropatana*, 32 different compounds 85.6% of the oil were identified. The main components were rich in oxygenated compounds.[5]

Satureja bachtiarica Bunge

Satureja bachtiarica Bunge. is a perennial plant belonging to the Lamiaceae family that is widely distributed in the southern and southwest parts of Iran. The Mediterranean region can be mentioned as the origin of the genus *Satureja*.[6]

It is famous for its therapeutic value as an analgesic and antiseptic in folk medicine. The leaves species *Satureja*, flowers and stems are used for herbal tea and, in traditional medicine, to treat various ailments, such as cramps, muscle pains, nausea, indigestion, diarrhea and infectious diseases.[7] The main component of essential oil of *S. bachtiarica* is carvacrol and thymol.[8]

In another study, the essential oil of the aerial parts of *Saturja bachtiarica* Bunge. collected from Sepidan near Shiraz, Province Fars (Iran) in May 2008, were identified. The percentage of monoterpene hydrocarbons and phenolic compounds were 93.8%. The main constituents of the oil were thymol (65.5%), γ-terpinene (15.0%), β-caryophyllene (4.8%), p-cymene (4.4%), linalool (3.5%) and borneol (3.5%).[9]

The essential oil isolated by steam distillation from the aerial parts of *S. bachtiarica*, collected from Chahar Mahal-e-Bachtiari Province Southwest of Iran at the flowering stage, and the major components were thymol (44.5%), γ-terpinene (23.9%), p-cymene (7.3%), β-caryophyllene (5.3%) and borneol (4.2%).[10]

The gas chromatography-mass spectrometry and ultrasonic assist with headspace solid phase microextraction (US-MS-SPME) were developed for the analysis of essential oil compounds in dry *Satureja bachtiarica* Bunge. aerial parts. Which has been collected around Iylam, West of Iran. The essential oil extracted from the aerial parts of the plant was analyzed by nano scale injection to a GC/MS system. As a result, 21 constituents representing 99.6% of the oil, were identified. The highest extraction efficiency was achieved with a 100 µm polydimethylsiloxane (PDMS) fiber. Different experimental parameters such as the type of coating used for the fibers, sonication time, extraction time, temperature and desorption time were optimized. The major components by this method are as carvacrol (64.3%), cis-jasmone (15.2%), p- cymene (3.2%), β-bisabolene (5.3%) and geranyl acetone (5.0%).[11]

Essential oils composition, antioxidant activities and phenolic content of wild and cultivated *S. bachtiarica* of Yazd origin were determined. Hydrodistilled essential oil were analyzed by GC-FID and GC/MS. Folin- Ciocalteu and $AlCl_3$ methods were served to determine total phenolics and flavonoids of methanol extracts, respectively. Antioxidant activities of the extracts were examined by DPPH and FRAP methods and their rosmarinic acid content was measured by using HPLC. The oil content of cultivated and wild plants was 1.8% and 0.9% v/w, respectively.[12]

Oxygenated monoterpenes (78.6%) constituted the major fraction of essential oils with carvactol (71.4% and 57.4%) in cultivated and wild plants, respectively. p-cymene (8.6-12.5%) was another major components of essential oils. Methanol extract from wild growing plants exhibited the higher levels antioxidants in both DPPH and FRAP methods (29.0 and 58.2 mg Trolox/g, respectively). This extract also contained the higher amounts of total phenolics (24.5 mg caffeic acid/g sample and 1.73 mg dry weight, respectively).[12]

Satureja boissieri

The plant material was collected (August 2000) from Adiyaman Celikhan-Kocali village. The voucher specimen is kept at the Herbarium of the Faculty of Pharmacy, Anadolu University, Eskisehir, Turkey (ESSE: 13394).

The air dried aerial parts of the plants were subjected to hydrodistillation for 3 h using a Clevenger-type apparatus. The oil yield was 2.1%.

The oil was analyzed by GC/MS using a Shimadzu GC/MS QP5050A system. CPSil5CB column (25m × 0.25mm i.d., 0.4 µm film thickness) was used with helium as the carrier gas. GC oven temperature was kept at 60ºC and programmed to 260ºC for at a rate of 5ºC/min, and then kept constant at 260ºC for 40 min. The split flow was adjusted at 50 mL/min. The injector temperature was at 250ºC. MS were taken at 70 eV. Mass range was between m/z 30 to 425. A library search was carried out using the Wiley GC/MS Library and in-house TBAM Library of Essential Oil Constituents. The MSs were also compared with those of reference compounds and confirmed with the aid of retention indices from published as well as our own sources. Relative percentage amounts of the separated compounds were calculated from total ion chromatograms by a computerized integrator.

Water-distilled essential oil from the aerial parts of *S. boissieri* was analyzed by GC/MS. Forty- five components were characterized representing 97% of the oil. The main components were identified as carvacrol (40.8%), γ-terpinene (26.4%) and p-cymene (14.5%).[13]

Satureja hortensis

The aerial parts of flowering *S. hortensis* grown in the open air were collected from sites in Tehran Province. The collected plant materials were dried in the shade; the leaves of the plants were separated from the stem and ground in a grinder with a 2 mm in diameter mesh.[14]

In order to obtain *S. hortensis* essential oil 40 g the plant material was hydro distilled for 4 hours (yield 1.32% v/w).[15] The essential oils obtained were dried over anhydrous sodium sulphate and after filtration, stored at 4ºC until tested and analyzed.

The antibacterial activities of essential oils in vitro tested against *S. hortensis* showed inhibit growth of this bacterium. GC/MS was employed to identify the essential oils compounds.

Plant essential oils are a potentially useful source of antimicrobial compounds. Essential oils are natural products extracted from vegetal materials which, because of their antibacterial, antifungal, antioxidant and anti-carcinogenic properties, can be used as natural additives in many foods.[16] Results reported from different studies are difficult to compare, presumably because of the different test methods, bacterial strains and sources of antimicrobial samples used. The composition of the essential oil of herbs and spices can vary greatly depending upon the geographical region, the variety, the age of the plant, the method of drying and the method of the extraction of the oil.[17]

***Satureja intermedia* C. A. Mey**

The essential oil constituents from the aerial parts of *Satureja intermedia* C. A. Mey were detected by GC/MS.

The antimicrobial activity of essential oil on oral pathogens and its cytotoxicity to human cancer cells were determined by the microbroth dilution method and crystal violet staining method, respectively. Thirty-nine compounds were identical and the main essential oil constituents were γ-terpinene (26.4%), thymol (30.2%), p-cymene (16.2%), limonene (3.9%), α-terpinene (3.3%),

myrcene (2.5%), germacrene B (1.4%), elemicine (1.1%) and carvacrol (0.5%).[18]

The *satureja intermedia* essential oil showed a concentration-dependent decrease in viability of Hep-G2 (hepatocellular carcinoma) and MCF-7 (breast adenocarcinoma) human cancer lines ($p<0.05$). Antimicrobial screening of *S. intermedia* essential oil demonstrate slight antibacterial and antifungal activities against *streptococcus mutants*, *S. salivarius*, *Entercoccus faecalis*, *Staphylococcus aureus*, *Candida albicans* and *Candida glabrata*. Surely further preclinical studies are needed to assess the efficacy and safety of *Satureja intermedia* essential oil as a new promising anticancer agent.[18]

The toxicological study on 5637 and KYSE cell lines showed IC_{50} values OF 156 µg/ml. The essential oil exhibited considerable antimicrobial activity on tested bacteria and fungi.

***Satureja kermanshahensis* Jamzad**

Satureja kermanshahensis is described as a new species from Iran. It is characterized by a dense columnar spicate in florescence, 3-10 cm long, verticillasters 2-flowered and densely glandular pubescent leaves. It grows in crevices of rocks in Kermanshah province in western Iran. It is compared with *S.coerulea* from Bulgaria, Romania and NW Turkey, *S. bachtiarica* and *S. edmondi* growing in western Iran.[19]

Satureja kermanshahensis seems to be most closely related to *S. coerulea* Janka described from Bulgaria and with its closest locality to Iran so far reported being N.W Turkey. It is recorded as a rare in Turkey (Davis, 1982) and differs from it in longer leaf and calyx and leaves glabrous except in the margin with scattered glands and calyx teeth glabrous in *S. coerulea*. The new species differs from *S. edmondi* Briq. Which is an Iranian endemic growing in Kermanshah Province, in leaf shape and size, the lower ones with flat surface; verticillastrs 4-6 flowered, lowers distant and calyx glabrous in *S. edmondi*. The new species differs from *S. bachtiarica* Bunge. which is also distributed in Kermanshah Province in habit which is erect subshrub, inflorescence many flowered verticillasters, lowers distant and smaller calyx in *S. bachtiarica*.[19]

***Satureja mutica* Fisch. et C.A. Mey.**

Satureja mutica grows in Iran, Turcomania and Talish.[20] This species have been used in treatment medicine as antimicrobial, spasmolytic, cicatrizing and diuretic agents.[5] The oil obtained by hydrodistillation of the aerial parts of *S. mutica* Fisch. et C.A. Mey. Was analyzed by GC/MS. The oil of *S. mutica* was characterized by higher amount of menthol (37.4%), menthone (17.2%) and 1,8-cineol (9.3%) among the 39 components comprising 95.1% of the total oil detected. The oil was richer in oxygenated monoterpenes than sesquiterpenes. *S. mutica* Fisch. et C.A. Mey. Was collected from Mandjil, around Rasht, Province of Guilan, Iran, in June 1999.[4]

In other study, *Satureja mutica* Fish. et C.A. Mey which grow in northern Iran was also analyzed by GC/MS. The main components of the oil were thymol (62.6%), p-cymene (9.4%), carvacrol (6.6%) and methyl thymol (5.4%). In the oil of *S. mutica*, 32 different compounds (98.5% of the oil) were identified.[5]

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