

Review

Medicinal importance of genus *Origanum*: A review

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Genus *Origanum* is important medicinally as it has antimicrobial, antifungal, antioxidant, antibacterial, antithrombin, antimutagenic, angiogenic, antiparasitic and antihyperglycaemic activities. Phytochemical investigations of the species of this genus have resulted in the extraction of a number of important bioactive compounds. This emphasizes on the need of extensive study for reporting the additional information on the medicinal importance of other unattended species of genus *Origanum*.

Key words: Lamiaceae, secondary metabolites, *Origanum*, carvacrol.

INTRODUCTION

Primary and secondary metabolites produced by plants, encompass a wide array of functions. Secondary metabolites have been subsequently exploited by humans for their beneficial role. At the same time, essential oils and their components are also being exploited for potential multipurpose functional use (Sawamura, 2000; Ormancy et al., 2001; Gianni et al., 2005). Thus, medicinal and aromatic plants are valued for their biological activities which can be justified from the fact that about 80% of the local population still depend on these plants for primary health care. The formation and accumulation of essential oil in plants has been reviewed by many workers (Guenther, 1972; Corteau, 1986; Fischer, 1991). The compounds from the plant based essential oil are useful as an alternative therapy, either directly or as models for new synthetic products (Houghton, 2000).

Origanum is an important multipurpose medicinal plant which belongs to the family Lamiaceae, tribe Mentheae and comprises of 42 species and 18 hybrids widely distributed in Eurasia and North Africa (letsvaart, 1980; Duman et al., 1988). It is native to the mountainous parts of Mediterranean region of Europe and Asia. Following letsvaart (1980) classification, the genus *Origanum* has been divided into 10 sections. These include the following.

***Amaracus* (Gleditsch) Benth**

Amaracus (Gleditsch) Benth consists of seven species, all restricted in the east Mediterranean region. The species are mainly characterized by their usually purple bracts, 1 or 2-lipped sepals without teeth, and saccate corollas: *Origanum boissieri* letsvaart, *Origanum calcaratum* Jussieu, *Origanum cordifolium* (Montbret et Aucher ex Benth) Vogel, *Origanum dictamnus* L., *Origanum saccatum* Davis, *Origanum solymicum* Davis and *Origanum symes* Carlstrom.

***Anatolicon* Benth**

Anatolicon Benth comprises of eight species, presenting a very restricted distribution in Greece, Asia Minor, Lebanon and Libya. The plants have strongly bilabiate 5-toothed sepals: *Origanum akhdarensis* letsvaart et Boulos, *Origanum cyrenaicum* Beguinot et Vaccari, *Origanum hypericifolium* Schwarz et Davis, *Origanum libanoticum* Boissier, *Origanum scabrum* Boissier et Heldreich, *Origanum sipyleum* L., *Origanum vetteri* Briquet et Barbey and *Origanum pampaninii* (Brullo et Furnari) letsvaart.

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Brevifilamentum letswaart

Brevifilamentum letswaart comprises of six species which are steno-endemics mainly in the eastern part of Turkey. These species are characterized by bilabiate sepals and strongly unequal length of stamens; upper two stamens are very short and enclosed in the corolla: *Origanum acutidens* (Handel-Mazzetti) letswaart, *Origanum bargyli* Mouterde, *Origanum brevidens* (Bornmuller) Dinsmore, *Origanum haussknechtii* Boissier, *Origanum leptocladum* Boissier and *Origanum rotundifolium* Boissier.

Longitubus letswaart

Longitubus letswaart consists of a single species found in a few places in the Amanus Mountains. It is mainly characterized by the slightly bilabiate calyx, the lips of the corolla are nearly at right angles to the tube and has the presence of very short staminal filaments: *Origanum amanum* Post.

Chilocalyx (Briquet) letswaart

Chilocalyx (Briquet) letswaart includes four species which are steno-endemics of South Anatolia or of the island of Crete. The plants are slightly bilabiate, conspicuously pilose in throat sepals: *Origanum bigleri* Davis, *Origanum micranthum* Vogel, *Origanum microphyllum* (Bentham) Vogel and *Origanum minutiflorum* Schwarz et Davis.

Majorana (Miller) Bentham

Majorana (Miller) Bentham consists of three species. The species are characterized by 1-lipped sepals and green bracts. Out of these *Origanum syriacum* is further subdivided into three geographically distinct varieties; these are recognised mainly from differences in their indumentum and leaf shape: *Origanum majorana* L., *Origanum onites* L., *O. syriacum* L. Var. *syriacum*, Var. *bevanii* (Holmes) letswaart and Var. *sinaicum* (Boissier) letswaart.

Campanulaticalyx letswaart

Campanulaticalyx letswaart consists of six local endemic species. The sepals of the plants have 5 sub equal teeth and are campanulate even when bearing fruits: *Origanum dayi* Post, *Origanum isthmicum* Danin, *Origanum ramonense* Danin, *Origanum petraeum* Danin, *Origanum punonense* Danin and *Origanum jordanicum* Danin and Kunne.

Elongatispica letswaart

Elongatispica letswaart comprises of three steno-

endemic species of North Africa, which are characterized by loose and tenuous spikes and tubular calyces with 5 equal teeth: *Origanum elongatum* (Bunnet) Emberger et Maire, *Origanum floribundum* L. Munby and *Origanum grosii* Pau et Font Quer ex letswaart.

Origanum

Origanum is a monospecific section consisting of the species *O. vulgare*, widely distributed in North Africa and in temperate and arid zones of Eurasia (Baser et al., 2010). Introduced by humans, this species has also been encountered in North America (letswaart, 1980). The plants of *O. vulgare* have dense spikes, and tubular 5-toothed calyces, never becoming turbinate in fruit: *O. vulgare* L.

Six subspecies have been recognised within *O. vulgare* L. based on differences in indumentum, number of sessile glands on leaves, bracts and calyces, and in size and colour of bracts and flowers: subsp. *vulgare*, subsp. *glandulosum* (Desfontaines) letswaart, subsp. *gracile* (Koch) letswaart, subsp. *hirtum* (Link) letswaart, subsp. *viridulum* (Martrin-Donos) Nyman and subsp. *virens* (Hoffmannsegg and Link) letswaart.

Prolaticorolla letswaart

Prolaticorolla letswaart comprises of three species endemic to eastern or western parts of the Mediterranean. These species are characterized by dense spikes and tubular calyces becoming turbinate in fruiting: *Origanum compactum* Bentham, *Origanum ehrenbergii* Boissier and *Origanum laevigatum* Boissier.

ORIGANUM SPECIES

Origanum spp. have been used for thousands of years as spice and in ethnomedicine (Fleisher and Fleisher, 1988). It has antifungal, antimicrobial, insecticidal and anti-oxidant activities (Kokkini, 1997; Baydar et al., 2004; Kulisic et al., 2004; Bakkali et al., 2008). Antispasmodic, antitumoral, antifungal and analgesic activities of *Origanum* spp. have been reported (Elgayar et al., 2001; Puertas et al., 2002; Sokovic et al., 2002; Sari et al., 2006). Baser (2002) and Dundar et al. (2008) reported that *Origanum* has been used as expectorant, antiparasitic, antihelminthic and for gastrointestinal complaints in Turkish folk medicine. *Origanum* spp. are also used as a carminative, diaphoretic, stimulant and tonic (Hummer et al., 1999). Silva et al. (2012) have suggested that carvacrol present in the essential oil of *Origanum* probably interferes in the release and/or synthesis of inflammatory mediators, such as the prostanooids and thus favour the healing process for gastric ulcers. Further as a

folk remedy, it is used against colic, cough, toothaches and irregular menstrual cycles (Force et al., 2000; Kintzios, 2002a). *Origanum* spp. are also used as powerful disinfectant, flavouring agent in perfumes and in scenting soaps (Guenther, 1949; Chiez, 1984; Kotb, 1985). As a culinary herb, it is used in flavouring food products and alcoholic beverages (Aligiannis et al., 2001; Bendahou et al., 2008; Sivropoulou et al., 1996). Oregano has a promising potential for preventing diabetes complications in the long term treatments and has an anti-inflammatory efficacy as depicted by inhibiting soybean lipoxygenase (Koukoulitsa et al., 2006). The secondary metabolites of this plant have been well studied in terms of polyphenolic compounds and essential oils. Consequently, more than one hundred nonvolatile compounds have already been identified in this plant which includes flavonoids, depsides and organosides (Nakatani et al., 1987; Lin et al., 2003; Koukoulitsa et al., 2006; Liang et al., 2010; Skaltsa et al., 2010). The species of this plant which have been subjected to chemical profiling as discussed subsequently.

***Origanum vulgare* (L.)**

O. vulgare (L.) is a medicinal and perennial plant, locally known as Jungali Tulsi or Oregano or Himalayan marjoram. It is widely distributed in Mediterranean areas and Northern Africa (Ietswaaart, 1980; Kokkini, 1997). This is the only species of genus *Origanum* which is found in India. It is found in temperate Himalayas from Kashmir to Sikkim at an altitude of 1500 to 3600 m. It is particularly grown in Simla Hills, Gilgit, Nilgris and in the Kashmir valley.

Vokou et al. (1993), Kokkini et al. (1997), D'antuonu et al. (2000) and Skoula (2002) reported carvacrol and thymol as dominant components of its essential oil. Andreas et al. (2013) found carvacrol as dominant component in the essential oil of *O. vulgare* ssp. *hirtum*. Lagouri et al. (1993), Aeschbach et al. (1994), and Yanishlieva et al. (1999) revealed that antioxidant effect of this plant is as a result of carvacrol and thymol. Mastelic et al. (2008) reported its antimicrobial and antioxidant properties and in addition revealed carvacrol's antiproliferative activity on tumor cells of HeLa. Essential oil of this plant possesses a variety of biological activities, namely, antiradical (Cervato et al., 2000; Ahmad et al., 2010a, b; 2011a, b), antifungal (Cleff et al., 2010; Farag et al., 1989; Curtis et al., 1996; Sahin et al., 2004), antihyperglycaemic (Lemhadri et al., 2004), antibacterial (Dorman and Deans, 2000; Govaris et al., 2001; Harpaz et al., 2003; Burt and Reinders, 2003; Burt, 2004), and antithrombin (Goun et al., 2002). Antioxidant (Lamaison et al., 1991; Lagoun and Boskou, 1996; Nakatani, 2000; Vichi et al., 2001; Stashenko et al., 2002) function of this species could become helpful agent in treatment of cancer, heart disease and high blood pressure. Cervato

et al. (2000) reported that antioxidant activities of *O. vulgare* leaves can inhibit all places of lipid peroxidative processes.

O. onites

O. onites (L.) is distributed in Western and Southern Turkey. Baser et al. (2010) have reported that it grows naturally in Aegean and Mediterranean regions of Turkey. It is a perennial species with woody stem and is commonly known as 'Turkish oregano'. An essential oil reported from this plant contains carvacrol as a major component and has the potential to be utilized at reasonable concentrations to control tick infestations (Sevki et al., 2008). Diversified effects such as anti-spasmodic (Daferera et al., 2000, 2003), antibacterial (Burt, 2004), and antifungal (Ultee et al., 1997) have been attributed to this plant by modern pharmacological study. It is also used in flavouring Turkish delight candy (Facciola et al., 1998) and is also used in tea, salads and meat dishes (Small et al., 1997). Consumption of *O. onites* distillate has beneficial effects on lipid profiles, antioxidant status and endothelial functions in patients with mild hyperlipidaemia (Ozdemir et al., 2008).

O. syriacum

O. syriacum commonly known as 'Syrian marjoram' is an aromatic, herbaceous and perennial plant growing wild in the Sinai desert of Egypt (Tackholm, 1974). Biblical authorities consider this plant to be referred in the Bible as hyssop, particularly in the old Testament pages (Moldenke et al., 1952). It is a very popular culinary herb that has been used through ages in traditional medicine mainly in Lebanon and Arab world. It has antiseptic properties and has the ability to relieve stomach and intestinal pain. It is also used to treat heart problems, cough, toothaches (Gardner et al., 1989), cold, anxiety and wounds (Chandler et al., 2004). Kamela et al. (2001) and Baser et al. (2003) isolated thymol and carvacrol as a major constituent of its essential oil. Carvacrol is the signature chemical largely responsible for its sharp, pungent oregano flavor (Tucker et al., 1992). The volatile phenolic oil has been reported to be among the top 10 essential oils (Letchamo et al., 1995), showing antibacterial, antimycotic, antioxidative, natural food preservative and mammalian age delaying properties (Jackson and Hay, 1994; Letchamo et al., 1995).

***O. majorana* (L.)**

O. majorana (L.) is an endemic medicinal plant of Cyprus and is commonly known as 'Sampsishia'. Johannes et al. (2002) reported sabinene linalyl acetate and Cis-sabinene

hydrate from the essential oil of this plant species. It is used against common cold, as spasmolytic and as an antirheumatic. Dried leaves and flowering tips of this species are used in formulation of vermouths and bitters. The essential oil is used for flavouring sauces, condiments and other products (de Vincenzi et al., 1997). In India, it is used as diuretic, antiasthmatic and an antiparalytic drug (Yadava and Khare, 1995). This was a common salad herb in the 16th century (Picton et al., 2000). It is also used in herbal vinegars and tea can be made from its leaves (Facciola et al., 1998). Furthermore, it has been used to treat cancer as well (Johnson et al., 2002; Leung et al., 2003). Stefanakis et al. (2013) have assayed the essential oil extracted from *O. majorana* L., *O. onites* L. and *O. vulgare* L. ssp. *hirtum* as potential antibacterial agents for disinfection of rotifers (*Brachionus plicatilis*). Abdel Massih et al. (2010) suggested that Marjoram extracts exhibit antiproliferative effect and have high antioxidant activity as well.

O. microphyllum

O. microphyllum is a medicinal plant species of genus *Origanum*, endemic to Cretan and commonly known as 'Cretan marjoram' (Karousou, 1995). Aligannis et al. (2001) and Gotsiou et al. (2002) isolated carvacrol, terpineol-4, linalool, sabinene, α -terpinene, γ -terpinene, cis-sabinene hydrate and trans-sabinene hydrate from the essential oil of this species. This small leaved oregano has a strong spicy flavor (Small et al., 1997).

O. hypericifolium

O. hypericifolium is an endemic species of Turkey. It is used as a condiment, for flavouring meat and as herbal tea for treatment of common cold and stomach complaints (Baser et al., 1994). The essential oil of pre flowering stage extracted from this plant species is carvacrol rich.

O. dictamnus

O. dictamnus commonly known as 'Dittany of Crete' is native to the Island of Crete, Greece. It is used in traditional medicine in Greece and all over Europe (Christos et al., 2010). It possesses numerous medicinal uses like antibacterial (Aureli et al., 1992; Biondi et al., 1993; Vokou et al., 1993) and antifungal (Arras and Picci, 1984; Collin et al., 1989; Paster et al., 1993). It is also used in cooking as well. As a culinary and medicinal herb, it is used as a tonic and digestive aid (Simon et al., 1984; Bown et al., 2001) for treating kidney and liver problems, obesity and headaches (Skoula et al., 1997). Its flowers and bracts are used to make tea and the plant when combined with garlic, thyme, salt and pepper is used in a Saxon fish sauce (Jones et al., 1973). Harvala

and Skaltsa (1986) and Harvala et al. (1987) reported that the leaves of this plant contain flavonoids and flavonoid glycosides some of which have spasmolytic activity. The essential oil has carvacrol, α -terpinene, p-cymene, caryophyllene, borneol, terpin-1-en-4-ol and carvacrol methyl ether as predominant compounds. Various studies, concerning *O. dictamnus*, have shown that their oils possess strong antimicrobial activity; this activity could be attributed to their high percentage of phenolic compounds and specifically, carvacrol, thymol, p-cymene and their precursor c-terpinene (Sivropoulou et al., 1996). The variety of non-polar components such as fatty acids, lipids, sterols and essential oil has been identified from *O. dictamnus* (Revinthi-Moraiti et al., 1985; Komaitis et al., 1988).

Origanum dubium

O. dubium an endemic Mediterranean shrub is widely spread in Cyprus, Greece and in Southern Turkey. It is commonly called 'Rigani'. An infusion of its leaves, flowering stems and flowers is used as a digestive aid while its essential oil when applied externally acts as an antirheumatic (Arnold et al., 1993). Carvacrol is the major component of its essential oil. The essential oil shows antimicrobial activity and their potential antioxidant activity was investigated and found to be significant in scavenging O_2 (Karioti et al., 2006). Further, *O. dubium* shows inhibition of soybean lipoxygenase LOX and has high inhibitory activity (Karioti et al., 2006).

***O. sipyleum* (L.)**

O. sipyleum (L.) commonly called 'Showy Pink Oregano' is a polymorphic species of eastern Mediterranean area and is native to Western Anatolia, Turkey. It is used as a spice and against cough. It is also beneficial for the treatment of various respiratory and gastrointestinal disorders. The essential oil of this species is rich in α -terpinene and monoterpenes (Baser et al., 1992).

O. compactum

O. compactum is found in Morocco, South-West Spain and North Africa (Tutin et al., 1972). It is commonly called 'Compact Oregano'. It produces one of the most powerful antimicrobial essential oil. It has antibacterial (Bouhdid, 2009), antioxidant (Bouhdid, 2008) and antifungal (Bouchra, 2003) properties. It demonstrates cytotoxic activity by oxidative stress as seen by mitochondrial damage (Bakkali, 2005). It has carvacrol, p-cymene and γ -terpinene as major components of its essential oil.

O. floribundum

O. floribundum is recorded in Algerian site. It is used to

stimulate the appetite of cattle, sheep and horses. Furthermore, it is also used against diarrhoea and other digestive disorders (Houmani et al., 2002). Carvacrol, linalool, p-cymene and γ -terpinene were isolated by Baser et al. (2000) from the essential oil of this species.

O. acutidens

O. acutidens is an endemic, herbaceous, and perennial plant growing mainly in calcareous and non calcareous rocks, slopes, and screes in the Central Anatolia region of Turkey (Davis, 1982). The major components of *O. acutidens* oil are carvacrol, p-cymene, borneol, γ -terpinene, β -caryophyllene and linalool. Sokmen et al. (2004) has suggested that its essential oil has antagonistic activity against food-borne pathogenic bacteria and hence could be used in the food and pharmaceutical industries, and as an alternative to common synthetic antimicrobial products.

DISCUSSION

The aim of the present review is to present comprehensive information about the medicinal importance of genus *Origanum*. Although, there are 42 species of genus *Origanum*, only about less than 50% species have been subjected to chemical profiling. Other species have not been broadly subjected to chemical characterization and biological studies as evident from perusal of the literature. Current studies have shown that the essential oil, as well as their active principles possess several pharmacological properties like antimutagenic, angiogenic, antiparasitic, antiplatelet, antielastase, antihepatotoxic ones (Baser, 2008). The species studied by various workers indicate that the genus *Origanum* is a potent source for isolation of a variety of bioactive molecules like terpenes, phenols, flavonoids, etc. Thereby, this genus has important biological activities and acts against different types of diseases and is being used for culinary and economic uses. Furthermore it is also used as a feed additive, in honeybee breeding and in treatment of gastrointestinal ailments (Baser, 2008).

The recent scientific data and the rich historical evidence of its medicinal uses could support further research as well as its use as a safe herbal medicinal product. The antimicrobial activity can promote the use of the aforementioned natural products as potent preservative and conservation agents, not only in the food industry after testing the toxic and irritating effects on humans, but also in cosmetics and medical preparations. The present literature study further reveals that the biological properties of the investigated genus are not due only to their essential oils and their main compounds such as carvacrol and thymol, but also to the other polar constituents acting synergistically or possessing different biological activities.

Conclusion

The synthesis of medicinally important phytochemicals by the species of genus *Origanum* has been established beyond doubt. The plant species are being used both in allopathic and traditional system of medicine as a remedial measure for number of ailments. Since, only limited species are being subjected to phytochemical investigation, there is a need to broaden this study for further phytochemical and pharmacological studies for the rest of the species as well, which may prove of vital importance and could lead to new therapeutic products. Furthermore, since the plant extracts of the genus *Origanum* and its essential oils are used as dietary supplements or for medicinal purposes, it has become crucial to screen them for ensuring authenticity and product quality as toxic adulterants may prove to be life threatening.

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