International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-10, Issue-7, July 2024
ISSN: 2395-3470
www.ijseas.com

The Role of Essential Oils which was extracted from Medicinal Plants and Their Applications.

Ashish Srivastava[1], Mamta Rathore[2] and H.G.Prakash[3],

Department of Agronomy[1],Department of Agriculture Biochemistry[2,3], C.S.Azad University of Agriculture and Technology, Kanpur,U.P.

Introduction

Essential oils (EOs) are obtained from aromatic and medicinal plants as a volatile mixture of chemical compounds with strong odor. EOs are extracted from thearomatic and medicinal plants using steam or hydro distillation or Soxhlet extraction(solvent extraction or continuous extraction) methods developed in the middle agesby Arabs (Bakkali et al. 2008; Raut and Karuppayil 2014). EOs are considered as one of the most predominant plant products in agriculture, as they exhibit antifungal, antibacterial, antioxidant, anticancer, anti-diabetic, antiviral, insect repellent, andanti-inflammatory properties (Buchbauer 2010; Teixeira et al. 2013; Raut and Karuppayil 2014; Said et al. 2016; Swamy et al. 2016).Research on artificial pharmaceutical substances reveals the significance of EOsextracted from medicinal and aromatic plants, as their therapeutic properties have numerous applications. Consequently, researchers and farmers have been motivated to expand the cultivation and market these substances (Swamy and Sinniah 2015,2016). Presently, about 100 herbs are known for their EOs, while more than 2000herbs scattered across 60 families, such as Umbelliferae, Lamiaceae, Lauraceae,Myrtaceae, etc., could produce medicinally valued EOs. In global markets, only 300among 3000 known types of EOs are deemed to be of commercial importance. EOshave found application in agricultural sectors and can be potentially used in other industries, such as pharmaceuticals, drugs, food, perfumes, makeup products, sanitary products, dentistry, food preservatives, additives, cosmetics, and natural remedies (Swamy et al. 2016; Mahmoudi 2017). EOs, in perfumes, creams, soaps, in flavor and fragrance for foods, sanitary products and industrial solvents D. N. Reddy. Phyto compounds, such as limonene, patchoulol, geranyl acetate, etc., derived from have been widely used. Moreover, essential oil blends are used in bath products and in aromatherapy. Further, many EOs are particularly valued for their medicin alproperties (Swamy and Sinniah 2015, 2016; Arumugam et al. 2016). For example, menthol EOs are used as natural bug repellent, as well as for treating joint pain, respiratory allergies, muscle pain, headache, hair growth, and fever relief, as well as in cancer treatment (menthol protects against cell death and DNA damage).EOs or natural products are widely used as fragrances. However, their application in human health, agricultural industry, and environmental protection requires better understanding of their biological properties. Some of the EOs and their chemical constituents are viable as alternatives to the synthetic compounds, presently widelyused in the chemical industry. This is because EOs are not associated with harmful side effects (Carson and Riley 2003). In nature, EOs play an important role in providing plant protection against pathogenic bacteria, viruses, and fungi and preventing the attack by insect pests. In addition, EOs can attract or repel insects when present in pollen and seeds. To protect chemical compounds' ecological equilibrium, the use of EOs in pharmaceutical, food, bactericidal, and fungicidal is becoming more preva-lent in recent times. EOs yielding medicinal and aromatic plants are normally nativeto warm countries, where they represent an important traditional pharmacopeia (Arumugam et al. 2016). EOs are less dense than water. They are volatile and mostly colorless, as well as soluble in organic solvents. All plant parts, such as buds, leaves, fruits, bark, root, stems, twigs, and flowers, can contain EOs. Different methods can be applied for essential oil extraction, such as hydrodistil-lation, steam distillation, and solvent extraction (including liquid carbon dioxide or microwave extraction). For example, hydro distillation or steam distillation is typically used for Citrus and Lamiaceae family members. Various factors, such as the extraction method, geographical conditions, type of soil, plant material, and har -vesting stage, are being reported to influence on the occurrence of number of chemical constituents in EOs and variations in EO quality and yield (Masotti et al. 2003;Angioni et al. 2006; Swamy and Sinniah 2015; Swamy et al. 2016). In order to ensure a constant chemical composition, quality, and quantity, EOs should be extracted under the same conditions, such as using same plant organs, extractionmethod, harvesting period or season, and growing plants in the same soil types. Many of the EOs are commercialized and chemotyped by gas chromatography mass spectrometry (GC-MS), and the results have been published in international organizations like the ISO, WHO, EP (European pharmacopoeia), and Council of Europe (Smith et al. 2005) to protect good grade and amount of EOs.Apiaceae, Lamiaceae, Myrtaceae, Poaceae, and Rutaceae families are of particular importance for medicinal applications. For example, some of the EOs, like anise, caraway, black caraway, clove, oregano, cumin, coriander, sage, basil, dill, lemonbalm, peppermint, thyme, and tea oils, already have widespread medicinal applications. Some of the essential oil containing plant families, like Liliaceae, Fabaceae, Pinaceae, Piperaceae, Cupressaceae, and Hypericaceae, also exhibit a considerable medicinal potential (Hammer and Carson 2011). The aim of the present chapter is to discuss the specific chemical compounds occurring in EOs, their medical applications, and economic importance.

.

EOs are volatile liquids that are rarely colored. They are complex mixtures comprising of different concentrations, quantities, and compositions of 20–60 chemical components (Bakkali et al. 2008). Among these, two to three major chemical com-pounds are known to occur in prominent concentrations (20–70%), while othercomponents are present in less concentration. For example, menthone (39.55%) andisopulegone (30.49%) are the major components of Mentha longifolia essential oil (Nagarjuna et al. 2017), while cinnamyl acetate (41.98%) is extracted from Cinnamomum zeylanicum Blume (Jayaprakash et al. 2000). Similarly, eugenol(86.02%) is obtained from Cinnamomum verum (Patel et al. 2013), whereas linalool(46.97%) and 1,8-cineole (14.97%) are the major components of Ocimum basilicum(Santoro et al. 2007a, b). Likewise, Pogostemon cablin essential oil possessesmainly the patchouli alcohol, also called as patchoulol (32–37%), a tricyclicsesquiterpene (Swamy and Sinniah 2015). While, the leaf essential oil of Plectranthus amboinicus is rich in carvacrol (43%), thymol (7%) (a phenolicmonoterpenes) (Arumugam et al. 2016). Mainly, higher concentrations of chemical constituents govern the biological properties of the EOs. Most of the EOs also constitute low molecular weight chemical components, such as terpenes and terpenoids (Croteau et al. 2000; Betts 2001; Bowels 2003; Pichersky et al. 2006;Swamy and Sinniah 2015; Arumugam et al. 2016). Terpenes and terpenoids, along with other of aliphatic and aromatic chemical constituents, are shown in Fig. 9.1.Terpenes are biosynthetically derived isoprene (2-methyl 1,3-butadiene) units. The molecular formula of isoprene unit is C_5H_8. Thus, the basic molecular formula of terpenes comprises of multiples of isoprene units, such as $(C_5H_8)_n$, where ndenotes the number of isoprene units. This is known as biogenetic rule or C 5 rule. The is opentenyl diphosphate (IPP) molecule has a major role in the terpenes biosynthesis. As chains of IPP units accumulate (acyclic or cyclic), the resulting terpenes are classified based on the size into hemiterpenes (C5), monoterpenes (C10), sesquiterpenes (C 15), diterpenes (C 20), triterpenes (C 30), and tetraterpenes (C 40). Terpene that is having oxygen is called oxygenated terpenoid. EOs consist of 90%monoterpene (a combination of two isoprene units) molecules, thus allowing for avariety of structures and functions. Sesquiterpenes are also present in EOs, but theyare not like monoterpenes as main. Sesquiterpenes can also assume a variety ofstructures and functions, as shown in Table 9.1. When a chemical constituent isoptically active, the two optical isomers are frequently obtained in various plants.For example, optical isomers of (+)-α-pinene and (−)-β-pinene can be obtainedfrom P. palustris and P. caribaea, respectively, while optical isomers of linaloolobtained (−)linalol is sourced from C. sativum and (+)linalool from a few C.camphora plants. Sometimes, a racemic mixture is also encountered, whereby(±)-citronellol is very common. In particular, (+) citronellol from Eucalyptus citrio-dora and the rose and geranium EOs (−) citronellol form is common .

The EOs terpenes are major chemical constituents than aromatic hydrocarbons.In plants, the biosynthetic pathways of aromatic hydrocarbons (phenyl propane) andterpene derivatives are completely different. For example, cinnamaldehyde is amajor compound in cinnamon and clove oil, while eugenol is a minor constituent.Aromatic hydrocarbons generally occur in plants, namely, C. sativum, S. aromaticum,P. anisum, F. vulgare, M. fragrans, P. crispum, S. albidum, and L. verum, and someplant families, such as Myrtaceae, Rutaceae, and Lamiaceae. In addition, EOsconstitute aldehydes (cinnamaldehyde, cuminic aldehyde, perillaldehyde, etc.),alcohols (cinnamic alcohol, terpinenol, menthol, etc.), phenols (eugenol, carvacrol,etc.), and methoxy derivatives (anethole, estragole, etc.); compounds occur on aromatic hydrocarbons

Biological Effects of Essential Oils

At present, around 60 plant families are known to produce EOs, which are valued in medicinal, pharmaceutical, flavor and fragrance, and agricultural industries. Several plant species belonging to the Apiaceae, Alliaceae, Asteraceae, Lamiaceae, Myrtaceae, Poaceae, and Rutaceae family produce EOs with medicinal and industrial values (Vigan 2010; Hammer and Carson 2011). while phenyl propanoids more frequently occurin Apiaceae, Alliaceae, Lamiaceae, Myrtaceae, and Rutaceae plant families (Chamiet al. 2004). These family plants are used for the commercial level manufacture of EOs. For example, patchoulol, coriander, anise, dill, and fennel EOs are extracted from P. cablin, C. sativum, P. anisum, A. graveolens and F. vulgare, respectively. These EOs are well known for their antimicrobial and anticancer activities. Theplants belonging to the Lamiaceae and Apiaceae family are popular for antimicro-bial, anticancer, antibacterial, antimutagenic, anti-inflammatory, and antioxidant activities (Swamy and Sinniah 2015; Swamy et al. 2016). Some of the plants from Lamiaceae family produce EOs (Burt 2004; Hammer et al. 2006; Hussain et al.2008), such as M. piperita, R. officinalis, O. basilicum, S. officinalis, M. officinal is, S. hortensis, T. vulgaris, L. angustifolia, and O. vulgore (Swamy and Sinniah 2015;Swamy et al. 2016). Likewise, EOs from Lauraceae and Myrtaceae families alsoexhibit antimicrobial, antitumor, anticancer, antibacterial, and antiviral activities.

Reference:

1.Aqil F, Gupta A, Munagala R, Jeyabalan J, Kausar H, Sharma RJ, Singh IP, Gupta RC (2012)Antioxidant and antiproliferative activities of anthocyanin/ellagitannin-enriched extracts fromSyzygium cumini L. (Jamun, the Indian Blackberry). Nutr Cancer 64:428–438.

2.Arabbi PR, Genoves MI, Lajolo FM (2004) Flavonoids in vegetable foods commonly consumed inBrazil and estimated ingestion by the Brazilian population. J Agric Food Chem 52:1124–1131

3.Armaka M, Papanikolaou E, Sivropoulou A, Arsenakis M (1999) Antiviral properties of isobor -neol, a potent inhibitor of herpes simplex virus type 1. Antivir Res 43:79–92

4.Arumugam G, Swamy MK, Sinniah UR (2016) Plectranthus amboinicus (Lour.) Spreng:Botanical, phytochemical, pharmacological and nutritional significance. Molecules 21:369.

5.Y, Karimi M, Parsaei P, Ezzati S, Khadivi R, Zamiri A, Rafieian-Kopaei M (2013) Effectsof Camellia sinensis ethanolic extract on histometric and histopathological healing process ofburn wound in rat. Middle-East J Sci Res 13:14–19

6.Astani A, Reichling J, Schnitzler P (2011) Screening for antiviral activities of isolated compoundsfrom essential oils. Evidence-Based Compl Altern Med 2011:253643.

7.A, Markosian A, Petrosyan M, Sahakyan N, Babayan A, Aloyan S, Trchounian A (2017)Chemical composition and some biological activities of the essential oils from basil Ocimumdifferent cultivars. BMC Compl Altern Med 17:60.

8.Azmi AS, Bhat SH, Hanif S, Hadi SM (2006) Plant polyphenols mobilize endogenous copper inhuman peripheral lymphocytes leading to oxidative DNA breakage: A putative mechanism foranticancer Properties. FEBS Lett 580:533–538

9.Baananou S, Bouftira I, Mahmoud A, Boukef K, Marongiu B, Boughattas NA (2013)Antiulcerogenic and antibacterial activities of Apium graveolens essential oil and extract. NatProd Res 27:1075–1083

10.Bahmani M, Golshahi H, Saki K, Rafieian-Kopaei M, Delfan B, Mohammadi T (2014) Medicinalplants and secondary metabolites for diabetes mellitus control. Asian Pac J Trop Dis4:S687–S692

11.Bajpai VK, Yoon JI, Kang SC (2009) Antifungal potential of essential oil and various organicextracts of Nandina domestica Thunb., against skin infectious fungal pathogens. ApplMicrobiol Biotechnol 83:1127–1133

12.Bakkali F, Averbeck S, Averbeck D, Idaomar M (2008) Biological effects of essential oils-a review.Food Chem Toxicol 46:446–475

13.Bansod S, Rai M (2008) Antifungal activity of essential oils from Indian medicinal plants againsthuman pathogenic Aspergillus fumigatus and A. niger. World J Med Sci 3:81–88

14.Baradaran A, Madihi Y, Merrikhi A, Rafieian-Kopaei M, Nasri H (2013) Serum lipoprotein (a) indiabetic patients with various renal function not yet on dialysis. Pak J Med Sci 29:354–357

15.Bayala B, Bassole IHN, Scifo R, Gnoula C, Morel L, Lobaccaro JMA, Simpore J (2014) Anticanceractivity of essential oils and their chemical components-a review. Am J Cancer Res 4:591–607

16.Beatovic D, Krstic-Milosevic D, Trifunovic S, Šiljegovic J, Glamoclija J, Ristic M, Jelacic S(2015) Chemical composition, antioxidant and antimicrobial activities of the essential oils oftwelve Ocimum basilicum L. cultivars grown in Serbia. Rec Nat Prod 9:62–75

17.Bedi S, Tanuja VSP (2010) A handbook of aromatic and essential oil plants: Cultivation, chemis-try, processing and uses. Agrobios, JodhpurBegnami AF, Duarte MCT, Furletti V, Rehder VLG (2010) Antimicrobial potential of Coriandrumsativum L. against different Candida species in vitro. Food Chem 118:74–77

18.Behradmanesh S, Horestani MK, Baradaran A, Nasri H (2013) Association of serum uric acid withproteinuria in type 2 diabetic patients. J Res Med Sci 18:44–46

19.Bejaoui A, Chaabane H, Jemli M, Boulila A, Boussaid M (2013) Essential oil composition andantibacterial activity of Origanum vulgare subsp. glandulosum Desf. at different phonologicalstages. J Med Food 16:1115–1120

20.Benencia F, Courreges MC (2000) In vitro and in vivo activity of eugenol on human herpes virus.Phytother Res 14:495–500D.