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A Short Review on the Study of Essential Oils

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Abstract

A concise investigation was carried out on the research papers published in different scientific journal and a short review was prepared based on the facts provided in those papers about various studies conducted in the field of essential oils. It was found that essential oils were first extracted from different parts of aromatic plants mostly using a common method called hydrodistillation. The extracted oils were then subjected to several studies such as chemical constituents, antimicrobial study, antioxidant activity, etc. It was found that essentials oils not only have use in perfume and cosmetics for its ecstatic aroma and fragrance but also have several medicinal values. The GCMS analysis revealed the chemical constituents present in the oil, the strong antimicrobial and antioxidant activity showed its potential in development of antibacterial and antifungal medicines and it can be natural additive ingredient for preservation of food and pharmaceutical industries.

Keywords: *Antimicrobial activity, Antioxidant acitivity. Chemical constituents, Essential oils, GCMS analysis*

Introduction

Essential oils are complex volatile mixtures, constituted by terpenoid hydrocarbons, oxygenated terpenes and sesquiterpenes which originated from the plant secondary metabolism and are responsible for characteristic aroma of plant (Chamorro et al., 2012). Essential oils are obtained from leaf, twig, and wood pulp or bark tissue of higher plants and are valuable natural products used as raw materials in many fields such as perfumes, cosmetics, aromatherapy, spices and nutrition (Innocenti et al., 2010). Some of the common aromatic plants from which the essential oils are mostly extracted are Anthopogon, Chamomile, Citronella, Lemmon grass, Mentha, Wintergreen, Jatamansi, Valerian, Sugandhakokila, Tejpat, Timur, Calamus, Eucalyptus, etc. Trades of these oils have flourished between countries and throughout the world.

Individual components of the whole essential oil are present within the source tissue (leaves, stem or bark), either in the same molecular form or as a heat labile precursor. Essential oils are most commonly extracted using hydrodistillation which involves heating source tissue in presence of water to temperatures higher than boiling point as a result of which volatile chemicals (essential oil) convert to mixed gases that expand and travel into a condenser where they are cooled to below 30 °C and condensed into two separated (non-mixing) liquid phases; one phase being a hydrosol and the other an essential oil. A variation of this is steam distillation, which places the source tissue in the path of steam and not in the boiling water. The two condensed liquids are fed into a separation funnel, where they are separated under gravity. It is generally a priority to regulate the boiling temperature in order to optimize the process to maximize essential oil yield (Sadgrove & Jones, 2015). The development of gas chromatographic technique has facilitated the separation of volatile components in essential oil and the mass spectrometer has provided a means to identify these chemical constituents. Thus, in recent years a hyphenated system such as GCMS, in which gas chromatograph is coupled with mass spectrometer, would initially separates a volatile organic mixture into its components which are then further identified by mass spectrometer using a MS library.

Some common constituents present in these essential oils and their properties are; (Higley & Higley, 2016)

Terpenes - inhibit the accumulation of toxins and help discharge existing toxins from the liver and kidneys. e.g. farnesene, limonene, pinene.

Esters- are anti-fungal, calming and relaxing. e.g. linalyl acetate, geraniol acetate.

Aldehydes- are anti-infectious with a sedative effect on the central nervous system. They can be quite irritating when applied topically, but may have a profound calming effect when inhaled. e.g. citral, citronellol.

Ketones- stimulate cell regeneration, promote the formation of tissue, and liquefy mucous. They are helpful with such conditions as dry asthma, colds, flu and dry cough stimulate cell regeneration, promote the formation of tissue, and liquefy mucous. They are helpful with such conditions as dry asthma, colds, flu and dry cough. e.g. thujone, fenchone.

Alcohols - are commonly recognized for their antiseptic and anti-viral activities. They create an uplifting quality and are regarded as non-toxic. e.g. linalol, citronellol, geraniol, farnesol, bisabolol.

Phenols - are responsible for the fragrance of the oil. They are antiseptic, anti-bacterial, and strongly stimulating but can also be quite caustic to the skin. They contain high levels of oxygenating molecules and have antioxidant properties. e.g. eugenol, thymol, carvacrol.

Oxides- e.g. eucalyptol is anesthetic, antiseptic, and works as an expectorant and is well known as the principal constituent of eucalyptus oil. Other oxides include linalol oxide, ascaridol, bisabolol oxide and bisabolone oxide.

All pure essential oils have some anti-microbial properties. Essential oil benefits come from their antioxidant, antimicrobial and anti-inflammatory properties. These healing oils are rapidly growing in popularity because they act as natural medicine without any side effects. Some of the uses of essential oils in home and cleaning purpose;

- All-purpose cleaner
- Natural mosquito repellent
- Kill pests
- Improve depression
- Sauna therapy
- Body butter lotion
- Bathroom freshener
- Detoxify the air

The antimicrobial activity is studied for the activity showed by the oils against the microorganism such as bacteria and fungi which is commonly accomplished by Agar Well Diffusion Assay and Disc Assay and the antioxidant activity is commonly tested by Free Radical Scavenging Assay (Can Baser & Buchbauer, 2010).

Literature Review

The first systematic investigations of constituents from essential oils may be attributed to the French chemist M. J. Dumas (1800–1884) who analyzed some hydrocarbons and oxygen as well as sulfur- and nitrogen-containing constituents. He published his results in 1833 (Can Baser & Buchbauer, 2010). The structure of the frequently occurring bicyclic sesquiterpene â-caryophyllene was for many years a matter of doubt. After numerous investigations W. Treibs (1952) has been able to isolate the crystalline caryophyllene epoxide from the auto-oxidation products of clove oil and F. Šorm et al. (1950) suggested caryophyllene to have a 4- and 9-membered ring on bases of infrared (IR) investigations. This suggestion was later confirmed by the English chemist D. H. R. Barton (Barton and Lindsay, 1951), who was awarded the Nobel Prize in Chemistry in 1969 (Can Baser & Buchbauer, 2010).

In the course of the last half century, a great number of techniques have been developed and applied to the analysis of essential oils. The methods available for the analysis of essential oils have been at that time thin-layer chromatography (TLC), various types of liquid column chromatography (LC), and gas liquid chromatography (GC). In addition, several spectroscopic techniques such as UV and IR spectroscopy, MS, and 1H-NMR spectroscopy have been available. The most common technique employed in the chemical characterization of essential oils is gas chromatography coupled with mass spectrometry (GC-MS) (Sadgrove & Jones, 2015). One of the study on the GCMS analysis showed that the major components of lemon verbena are geranial (26.9%) and neral (23.1%); those of sweet marjoram are ã-terpinene (18.5%), thymol methyl ether (15.5%), and terpinen-4-ol (12.0%); those of clove basil are eugenol (73.6%), and â-(Z)-ocimene (15.4%); those of patchouli are carvacrol (47.5%) and p-cymene (15.2%); those of rosemary are á-pinene (54.8%) and 1,8-cineole (22.2%); those of tea tree are terpinen-4-ol (33.0%) and 1,8-cineole (27.7%); and those of rose geranium are citronellol (28.9%) and 6,9-guaiadiene (20.1%) (Lin et al., 2016).

Some of the studies in chemical composition of essential oils revealed that the major components of *Acorus calamus* oil were â-asarone, á-asarone, acorenone, shyobunone, preisocalamendiol, isoacorone, (E)-methylisoeugenol and ã-cadinene (Raal et al., 2016; Chandra et al., 2015); *Artemisia vulgaris* oil were á-pinene, menthol, â-eudesmol, spathulenol, 1,8-cineole, cis-thujone, trans-thujone, chrysanthenyl acetate, germacrene D, caryophyllene (Saadatian et al., 2012; Judþentienë et al., 2006); *Zanthoxylum armatum* oil were limonene, 2-undecanone, 2-tridecanone, sabinene, terpinolene, 3-borneol, dihydro carveol, isobornyl acetate and â-elemene (Singh et al., 2013; Waheed et al., 2011). Many research conducted on major chemical constituents of an essential oil have shown that the several factors such as nutrients, environmental conditions, extraction processes, drying methods, soil conditions, climatic conditions, etc. affects the components in essential oils (Yamaura et al., 1989; Rajeswara et al., 1990; Mejdoub et al., 1998; Aminzadeh et al., 2010; Pradhan & Paudel, 2015) thus variation are observed among the oil of even same species. Further, it was found that some of the chemical constituents were characteristics of the oil: Chamazulene, á-bisabolol and its oxides in *Chamomile* oil (Amir & Sharafzadeh, 2014; Sharafzadeh & Alizadeh, 2011; Pirzad et al., 2006); Eucalyptol, á-pinene and p-cymene in *Eucaluptus sps.* Oil (Song et al., 2009; Elaissi et al., 2012; Husain & Ali, 2013); Citral, geraniol, citronellol and citronellal in *Cymbopogon sps.* oil (Ganjewala 2009; Heiba & Rizk 1986; Matasyoh et al., 2011; Tajidin et al., 2012); Valeranone in *Nardostachys sps*. oil (Ghassemi-Dehkordi et al., 2014; Sugumarpandian & Nagarajan, 2015; Purohit et al., 2015); á-pinene in *Juniperus sps.* (Stewart et al., 2014; Höferl et al., 2014; Dahmane et al., 2015) and so on. Based on these chemical constituents and their bioactivity, essential oils are priced internationally, e.g. Chamomile oil would have high price when chamazulene content is high since it will enhance its anti-inflammatory and antipyretic quality (Singh et al., 2011).

Plant products were the principal sources of pharmaceutical agents used in traditional medicine. Studies also revealed that presence of these bioactive components in essential oils is in fact responsible for various activities such as antioxidant, antimicrobial, anti-inflammatory, analgesic and other pharmacological properties (Alexander 2001; Baylac & Racine, 2003; Bhusita et al., 2005; Kamdem et al., 2015). Some medicinal plants are rich in antimicrobial reagents (Mahesh & Satish, 2008). Similarly, several essential oils derived from varieties of medicinal plants are known to possess insecticidal, antifungal, anti-inflammatory, and antioxidant activities (Lin et al., 2016). It was found that the essential oils of *Apium graveolens* and *Thymus vulgaris* constitute a source of natural antioxidants, anti-infammatory and antifungal materials (Kamdem et al., 2015). The study of antioxidant activity of essential oil from *Blumea eriantha* provides a bridge for further application of this plant in cosmetics as well as traditional medicines (Pednekar et al., 2013). Similar study of antibacterial and antioxidant properties of essential oils of *Jatropha gossypifolia* would suggests that apart from the traditional uses of the plant extracts, the essential oils may be good candidates in the search for lead compounds for the synthesis of novel potent antibiotics (Okoh et al., 2016). The significant antimicrobial and antioxidant activities of cinnamon and ginger essential oils suggest that it could serve as a source of compounds with preservative phenomenon (El-Baroty et al., 2010). Oil from *Zanthoxylum alatum* could be used as a resource of antioxidant and antimicrobial compounds which may find applications in food and pesticide industries (Guleria et al., 2014). It was demonstrated that oils dominated by the sesquiterpene alcohols provided the greatest antimicrobial activity against a range of organisms, most pronounced against some Gram-positive species. Individual components found in significant amounts in the essential oils were related to this enhanced antimicrobial activity, particularly prostantherol. In a separate study of *Prostanthera centralis* a prostantherol-rich essential oil demonstrated significantly low antimicrobial activity against Gram-positive bacteria and the yeast *Candida albicans* (Collins et al., 2014). Similarly, essential oils of medicinal plants (*Citrus aurantium*, *C. limon*, *Lavandula angustifolia*, *Matricaria chamomilla*, *Mentha piperita*, *M. spicata*, *Ocimum basilicum*, *Origanum vulgare*, *Thymus vulgaris* and *Salvia officinalis*) were investigated for their potentiality against pathogenic bacteria and highest and broadest activity was shown by *Origanum vulgare* oil (Sokoviæ et al., 2010). In one study the essential oil of *Thymus vulgaris* and its major compound thymol both showed potent bacteriostatic and bactericidal activities against *Escherichia coli* strains *in vitro*. However the activity of the essential oil was superior to the compound alone which provides evidence that the high antimicrobial activity showed by some essential oils results from the synergism of the major components (Santurio et al., 2014). Another study compares the inhibitive property of *Artemisia* oils on the growth of bacteria, yeasts, dermatophytes, *Fonsecaea pedrosoi* and *Aspergillus niger*. It was found that *Artemisia biennis* oil was the most active against dermatophytes, *Cryptococcus neoformans*, *Fonsecaea pedrosoi* and *Aspergillus niger* and *Artemisia absinthium* oil was most active against Staphylococcus strains (Lopes-Lutz et al., 2004). Similarly the findings of fungicidal properties of *Eucalyptus camaldulensis* essential oils confirm their potential use in the management of economically important *Fusarium* spp. and as possible alternatives to synthetic fungicides (Gakuubi et al., 2017).

Conclusion and Suggestions

Based on brief investigation on some of the works published in the study of essential oils a concise review was reported. Going through some research that were carried out in field of the essential oils from different aromatic plants we now ascertain that essentials oils not only have use in perfume and cosmetics for its ecstatic aroma and fragrance but also have wide use in therapeutic purpose because of its several medicinal values. The GCMS analysis revealed the chemical constituents present in the oil, the strong antimicrobial and antioxidant activity indicate its potential in development of antibacterial and antifungal medicines and usefulness to be natural additive ingredient for preservation of food and pharmaceutical industries. Hence, we would like to suggest that many more research are needed to be conducted to explore either new plants or new use and further investigation should be exercised to make the application of essential oils wider than its being currently used for. This is because more the uses of essential oils of aromatic plants are discovered and identified in our laboratory and elsewhere, more commercially valuable industries are established that will lead to new product development flourishing the trade of medicinal and aromatic plants globally.

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