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Essential oil : economic and herbal importance in Aromatherapy

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SUMMARY

Aromatherapy is a truly holistic therapy taking account of the mind and body. Spirit of the aromatherapy in practice is only essential oils, no other form of aroma. Essential oils which are complex mixtures of numerous components, extracted from different parts of plants like seeds, bark, leaves, stems, roots, flowers and fruits. Their use in aroma therapy is due to the physiological effect of a single component of the essential oil, or more often of a group of components. Essential oil is widely used in high grade perfumery and cosmetic industries. It is also worked as a flavoring agent in major food categories, alcoholic and soft drinks. The economics of essential oil production depend on both the cultivation of the herbs and extraction of oils from the herbs. Developed countries have vast potential in cultivating the herbs due to their favorable climate, rainfall and geographical conditions. The rich biodiversity of the country is yielding plants sources of various therapeutically valuable chemical compounds or their precursors which are in great demand in national as well as international drug and pharmaceutical industries. Natural plant extracts are of interest as a source of safer or more effective substitutes for synthetically produced antimicrobial agents and may provide an alternative way to prevent food or feed from fungal contamination. Cultivation of medicinal and aromatic plants, especially those having high commercial value, is opening new vistas for making agriculture profitable. Large scale cultivation of medicinal plants is inversely linked to popularity of easy and cheap collection of medicinal raw materials from their natural habitat.

Key words : Essential oils, Herbs, Aromatherapy, Medicinal plants

Since ancient times, the traditional system of medicine has become aroused the scientific curiosity of the common people, giving birth to an indian medical system called Ayurveda. Compilations of culinary herbs, Charaka and Susruta gave a detailed description of the plants, their properties, extraction techniques to get the active compound and procedures for ingestion of the medicine for effective treatment of various illness or disorder. The Indian knowledge of medicinal properties of herbs is reported in the *charak sanhita,* believed to be written 3000 years ago. The medicinal plants could grow in plenty across the country in every where.

India has been considered as treasure house of valuable medicinal and aromatic plant species. These plants have been used over the thousands year for human welfare in the promotion of health as drugs and fragrance materials. They play an important role in the health care of about 80% of world population. The rest 20% also dependent substantially on plant based medicines. It is estimated that more than half of the drugs under clinical use are derived from plants. There has been an upsurge in the production of plant based medicines, tonics and body care products in recent years. Large proportion of people in developing countries still lives in rural areas. Medicinal and aromatic plants form an integral part of Indian rural and urban lifestyle. This sector is almost totally dependent on the traditional healthcare system based on herbals. Aromatics herbs like patchouli, citronella, geranium, vanilla, jasmine, lemon grass, khus, rose oil etc., are being used since long back. The uses are being reinvented by the modern science in the areas of aromatherapy, skin cares, cure of ailments, speedier recuperation and pest repellents. Healing potential of aroma therapy has been proven convincingly across the globe. China still remains the leading practitioner in this line. A tremendous increase in the production of herbal medicines and other products based on ayurveda, unani, naturopathy and homeopathy systems of medicines is observed directly or indirectly.

The source of raw material is mostly the natural vegetation. The rich biodiversity of the country is yielding plant sources of various therapeutically valuable chemical compounds or their precursors which are in great demand in national as well as international drug and pharmaceutical industry. This has put a great pressure on the raw materials, majority of which are obtained from plants growing either in the forests or other associated natural vegetation. Natural population of a number of medicinal plants is decreasing day by day due to man made activities. Fatty or volatile oil having specific therapeutic properties

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or yielding a physiologically active chemical compound. These may be used directly or in powder form or burnt under special process (Bhasma) or extracted with oil, animal fat, water or even animal urine. Powders and extracts of various herbs, spices and essential oils have been reported to have antimicrobial activity and some of them inhibit aflatoxin formation (Thanaboripat *et al*., 2000; Bankole and Joda, 2004).

Essential oil:

Essential oils are complex mixtures of naturally occurring compounds, carotenoids, mostly monoterpenes and sesquiterpenes, different chemical groups of terpenes, aromatics hydrocarbons and their oxidized derivatives such as aldehydes, ketones, alcohols and esters. The aromatic plants are a valuable source of a huge array of chemical compounds. Many species of plants synthesize and accumulate extractable organic substances in sufficient quantities which are economically useful raw materials for various commercial applications. Economically important plants serve as an irreplaceable source of flavor and fragrances, pharmaceuticals, etc. The aromatic plants possess odoriferous and volatile substances which occur as essential oils, gum exudates, balsam and oleo-resin in one or more parts, *viz*., root, wood, bark, foliage, flower, and fruit. In some plant species one main constituent of the oil may predominate in many plant species no single compound predominates and rather there is a balance of various components (Table 1).

Table 1 : Main components of few essential oils

Sr. No.	Name of oil	Main component
1.	Geranium oil	Geraniol, Citronellol, Geranyl Acetate, Citronellyl Formate
2.	Citronella oil	Citronellal, Citronellol, Geraniol, Limonene
3.	Palmrosa oil	Geraniol, Citronellal, Farnesol
4.	Spearmint oil	Carvone, Phyllandrene, l-Limonene
5.	Peppermint oil	Pinene, Camphene, Cadinene
6.	Lemongrass oil	Citral, Geraniol, Linalol
7.	Eucalyptus oil	Eucalyptol, Phellandrene, Piperitone, Sesquiterpene
8.	Patchouli oil	β-patchoulene, Eugenol, Cinnamic Aldehyde
9.	Basil oil	Methyl- Chavicol, limnonene, Citral, citronellal
10.	Cardamom oil	Cineol, α-Terpinyl Acetate, Nerol, α-Pinene

Extraction of essential oil or aroma from plants has been economically good for the industry like pharmaceutical, perfume, cosmetics, toiletries, tooth paste, food products like confectionery, chocolate, ice cream and beverage, food preservatives and flavor enhancers. Essential oils contain highly volatile substances that are isolated by physical and chemical methods from different part of the plants of a particular single species. Natural plant extracts are of interest as a source of safer or more effective substitutes for synthetically produced antimicrobial agents and may provide an alternative way to prevent food or feed from fungal contamination (Thanaboripat, 2003).

Most components of essential oils are terpenes that contain multiples of a five carbon structural isoprene unit. Monoterpenes derived from two isoprene units, essential oils contain less volatile compounds derived from three to four isoprene units. These higher boiling point components may be extracted by vacuum distillation of the provided sample to permit facile gas chromatographic separation. Essential oils possess a variety of biological properties including antimicrobial activity. Essential oils have been shown to possess in vitro activity against plant-pathogenic bacteria and fungi. *In vivo* essential oils have been shown to reduce fungal infections on various plants (Letessier *et al*., 2001).

MATERIALS AND METHODS

Isolation techniques of essential oil:

Traditionally the extraction of bioactive compounds from herbs has been performed by steam distillation and organic solvent extraction using percolation, maceration, aqueous infusion and supercritical fluid extraction (SFE) with carbon dioxide and soxhlet techniques. Quantities and qualities of oil composition of plants may vary by using different techniques. Except in case of flowers crops such as Jasmine and Kewara, in which the fragrant constituents are likely to be decomposed or destroyed.

Water cum steam distillation:

To get rid of the above drawbacks of water distillation, the design has been improved where a perforated grid is introduced into the still just above the bottom. The main components of this process are (i) Distillation still (ii) Condenser (iii) Oil separator / receiver (iv) Brick furnace. The plant material is kept on the grid and water is filled below it. The tank is connected to the condenser through a vapor line. The condensate oil /vapor mixture is separated in the oil separator. Due to their very simple construction, low cost and easy operation the field distillation units are extremely popular. The furnace is

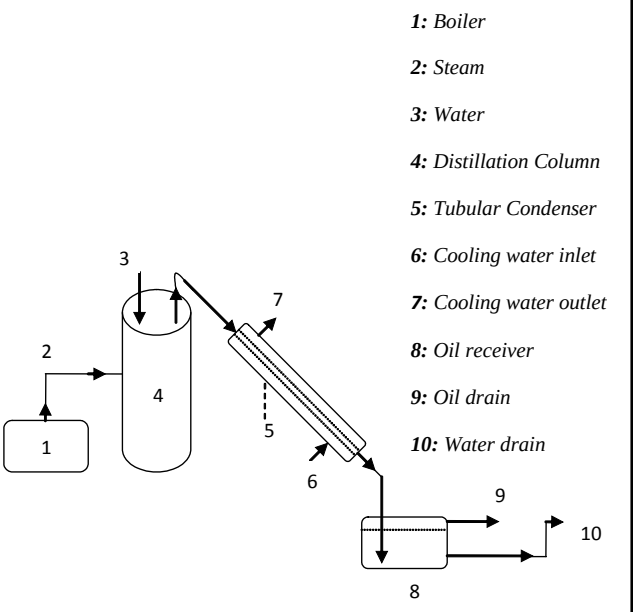

Fig. 1 : Diagram of distillation unit for essential oil

fuelled by spent agro-waste and firewood. These types of units are currently being used for the distillation of citronella, lemongrass and agar wood. Steam distillation exploits the twin action of heat and moisture from steam to breakdown the cell walls of the plant tissues to liberate the essential oil. Steam distillation is preferred where a lot of area is under cultivation and more than one unit is installed like agar wood chips, patchouli etc. Each oil has a distinct and characteristic odor, yet carvone is the major component in oils. The difference in odor is attributable solely to a difference in chirality of the carvone in the two oils. All the physical properties should be identical except for the optical rotations of the two isomers (enantiomers) which are of opposite sign. Thus for both carvones, the infrared, NMR spectra, the gas chromatographic retention times, the refractive indexes and the boiling points should be identical. Hence, the only difference in properties one should observe for the two carvones are the odors and the signs of rotation in a polarimeter. However, some of the physical properties presented above are not identical because of trace impurities.

However, long extraction time, low yield, toxic solvent residue, labour-intensive operation and degradation of thermo-sensitive compounds are involved in using such techniques. These disadvantages can be avoided by using the supercritical fluid extraction (SFE) process. SFE is a rapidly developing method to produce bioactive compounds by pure technology, under mild conditions (Simandi *et al*., 2002). The unique characteristic of this system is usage of gases above their critical point to extract selective soluble components from a raw material (Cavero *et al*., 2006). Carbon dioxide (CO_2) is the most widely used solvent in SFE, since it is physiologically harmless, environmentally safe, non-explosive, chemically inert, low toxicity and readily available and it can be easily removed from products (Simandi *et al*., 2002). Extraction and fractionation with supercritical fluids can be done in two ways: selective extraction and/or selective separation. The first involves the solvation capacity of the solvent by control of the extraction temperature and pressure and/or the addition of a co-solvent. In the second method, selective separation is achieved through gradual depressurization or gradual heating or cooling of the extract, which allows a controlled fractionation of the extract. Supercritical fluid extraction (SFE) applied to solid environmental matrices containing traces of pollutants and it has become a widespread analytical technique in both systematic applications and the development of new processes like food, biotech, pharmacy and environmental engineering (Lage *et al*., 2009; Mei-Chih *et al*.,1999).

Quality assessment:

Every essential oil is basically a mixture of different compounds. The percentage of these constituents in the oil plays an important part in determining its quality. The apparatus by which the fractions and their percentage are determined is Gas Liquid Chromatographic unit (GLC). Most of the oils being sold in the market today are on the basis of GLC report. For medicinal extracts, TLC (Thin Layer Chromatography) and HPLC (High Performance Liquid Chromatography) techniques are being used (Huafu *et al*., 2004).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been presented under following heads :

Aromatherapy:

Essential oil has a well-deserved reputation in aromatherapy with its deep, musky and sweet odor. It is an exotic aroma that can forever leave an impression on the olfactory memory. Geranium oil is used to staunch bleeding, healing of wounds, ulcers and skin disorders and also in treatment of diarrhea, dysentery and colic. It has antibacterial and insecticidal properties and is used in aromatherapy. Essential oil of geranium contains mainly monoterpenol, geraniol, citronellol, linalol and their esters and aldehydes. Geraniol, found in the essential oil of various plants, was shown to inhibit proliferation of human

colon cancer cells. Spearmint (*Mentha spicata* L.) has been used in folk remedies for exhaustion, weakness, depression, memory enhancement, circulation improvement and strengthening fragile blood vessels. Researchers have found that labiate's family plants are a source of compounds possessing high antioxidant, anti-inflammatory, anti-allergy, anti-depression activity. Many of these aromatics are powerful germicides and have anti-bacterial properties but it used as in perfumery and allied industries. Patchouli may be of benefit in cases of dermatitis, eczema, spots, dry chapped skin and other irritating conditions along with dandruff and oily scalp conditions. It slows the evaporation of other more volatile oils so that their aroma may be released over a longer period of time. It has anti-inflammatory and calming properties (Zheng and Wang, 2001). Aloe Vera oil is historically known to moisturize and soothe irritated skin. Tea tree oil has antiseptic/ antibacterial/ antifungal properties as well as being an anti-inflammatory. Ylang Ylang oil is used in aromatherapy to provide a sense of calmness and serenity. Also has a balancing effect on the skin.

Various synthetic antioxidants have been used to prevent oxidation of lipids during processing and storage of foods. By considering to possible adverse effects of some synthetic food additives on human health there is a great interest on natural antioxidants (Grigonis *et al*., 2005). Alpha- tocopherol (vitamin E) is low molecular weight lipophilic antioxidant which mainly protect membrane from oxidative damage. Flavonoid compounds, abundant in fruits, vegetables, teas, medicinal plants are a kind of highly effective natural antioxidants and less toxic than synthetic antioxidants (Benguo and Yonggi, 2007). These highly reactive molecules are present in biological systems and can reduce the risk of degenerative diseases such as cancer, heart disease, dermal disorders and aging. Carotenoids also play an important role as anti-oxidant by scavenging free radicals and as singlet oxygen quencher. Carotenoids are also found to be capable of inhibiting growth of certain cancer cells such as the colon cancer. (Heim *et al*., 2002, Wei *et al*., 2005)

Natural antioxidants from plant sources can effectively inhibit oxidation in food products (Burda and Oleszek, 2001). Designing a rose for *pan masala* and for a soft drink would be entirely different from each other and one has to be aware about the stability of ingredients used in final product. We try to reproduce what is present in nature *i.e*. rose, strawberry, pineapple, peach, vanilla, orange, etc. Fragrance is a harmonious combination comprising natural and/or synthetic ingredients with durability, diffusiveness and ability to get fixed in required cosmetics and other products. In most cases it is insoluble in water (Thanaboripat *et al*., 2004).

Flavour is combination of natural and/or synthetic ingredients with capability to get fixed in required product to give mingled but unitary experience, which includes taste, smell and sensory perception, particularly mouth feel. In most cases, it is soluble in water. When one is dealing with hundreds and now-a-days thousands of raw materials of widely different characterizing odours, intensities, chemical and physical properties, it is essential to have some means of classifying to facilitate selection, comparison, arrangement and finally the blending. The classification can be according to its volatility or to the similarity of odour group. It is the relative vapour pressure at ordinary temperature. These aromatic compounds have been illustrated to be relatively inexpensive and abundant raw materials with applications in the food and flavor industries. They can also serve as an excellent starting material in the synthesis of fine chemicals and of new fragrances for the cosmetics industries.

Conclusions:

Aromatrapy is an important gift from nature to cure diseases for human welfare and it has no side effect like chemical drugs. It depends on the concentration of essential oil or composition of the Bhasma. For the production of essential oil we use waste land which is not use for agriculture because some grasses grown in desert and they produce essential oil. India has a vast growing drug and pharmaceutical industry producing plant based medicines, phyto-pharmaceuticals and over the counter products. USA, Germany, Switzerland, UK and Japan share 75 to 80 % of total export of crude drugs from India (Prasad *et al*., 1994). The principal herbal drugs that have been finding a good market in foreign countries are aconite, aloe, belladona, acorus, cinchona, cassia tora, dioscorea, digitalis, epherdra, plantago etc. Approximately 350 plant species yield raw material which is used by the industry on a regular basis or in sufficiently large quantities. According to one of the reports of the World Health Organization (WHO), about 80% of the total population of developing countries depends on plant based medicines. It is increasingly getting popular in the developed countries. There is need for strict regulation for collection of plant material from forests. Efforts need to be made to source most of the requirements through scientific commercial cultivation that will yield superior quality produce resulting in increased medicinal efficacy and greater shelf life of the medicines produced.

REFERENCES

Bankole, S.A. and Joda, A.O. (2004). Effect of lemon grass (*Cymbopogon citrates* Stapf) powder and essential oil on mould deterioration and aflatoxin contamination of melon seeds (*Colocynthis citrullus* L.). *African J. Biotechnol.*, **3**(1): 52-59.

Benguo, L. and Yongyi Z. (2007). Extraction of flavonoids from flavonoid-rich parts in tartary buckwheat and identification of the main flavonoids. *J. Food Engg.*, **78**: 587-596.

Burda, S. and Oleszek W. (2001). Antioxidant and Antiradical activities of Flavonoids. *J. agric. & Food Chem.*, **49**(6): 2774-2779.

Cavero, S., Garcýa, W., Marin, F.R., Jaime, L., Santoyo, S., Senorans, F.J., Reglero, G. and Ibanez, E. (2006). Supercritical fluid extraction of antioxidant compounds from oregano, chemical and functional characterization via LC–MS and *in vitro* assays. *J. Supercritical Fluids*, **38**:62-69.

Grigonis, D., Venskutonis, P.R., Sivik, B., Sandahl, M. and Eskilsson, C.S. (2005). Comparison of different extraction techniques for isolation of antioxidants from sweet grass (*Hierochloe odorata*). *J. Supercritical Fluids*, **33**: 223-233.

Heim, K.E., Tagliaferro, A.R. and Bobilya, D.J.(2002). Flavonoid antioxidants: chemistry, metabolism and structure-activity relationship. *J. Nutritional Biochem.*,**13**: 572-584.

Huafu, W., Gordon, J.P. and Keith, H.(2004). Determination of rosmarinic acid and caffeic acid in aromatic herbs by HPLC. *Food Chem.*, **87**: 307-315.

Lage, M.A., Alvarez, S. and Crespo, M.O.(2009). Supercritical fluid extraction of polycyclic aromatic hydrocarbons from seaweed samples before and after the prestige oil spill. *Bull Environ Contam Toxicol.*, **82**:158–161.

Letessier, M.P., Svoboda, K.P. and Walters, D.R. (2001). Antifungal activity of the essential oil of hyssop (*Hyssopus officinalis*). *J.Phytopathology*, **149**:673–678.

Mei-Chih, L., Tsai, M.J. and Wen, K.C.(1999). Supercritical fluid extraction of flavonoids from *Scutellariae radix*. *J. Chromatography A*, **830**:387-395.

Prasad, G., Sahay, S.S. and Masood, A.(1994). Inhibition in aflatoxin biosynthesis by the extract of *Amorphophallus campanulatus* (OL) and calcium oxalate. *Letters App. Microbiol.*, **18**:203-205.

Simandi, B., Kristo, S.T., Kery, A., Selmeczi, L.K., Kmecz, I. and Kemeny, S. (2002). Supercritical fluid extraction of dandelion leaves, *J. Supercritical Fluids*, **23**:135-142.

Thanaboripat, D.(2003). Mycotoxins: Occurrence and control in foods, *The Internat. Review Food Sci. & Technol*. November:131-133.

Thanaboripat, D., Cheunoy, W., Petcharat, U., Ruangrattanametee, V. and Krisisntu, K. (2000). Control of aflatoxigenic fungi by Thai neem, *Govt. Pharmaceutical Organization J.*, **21**:41-49.

Thanaboripat, D., Monkontanawut, N., Suvathi, Y. and Ruangrattanametee, V.(2004). Inhibition of aflatoxin production and growth of *Aspergillus flavus* by citronella oil, *KMITL Sci. J.*, **49**(1):1-8.

Wei, P.C., May, C.Y., Ngan, M.A. and Hock, C.C.(2005). Supercritical fluid extraction of palm Carotenoids. *American J. Environ. Sci.*, **1** (4): 264-269

Zheng, W. and Wang, S.Y. (2001). Antioxidant activity and phenolic compounds in selected herbs. *J. agric. Food Chem.*, **49**(1): 5165-5170.

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