AROMATHERAPY
AND ITS BENEFITS

Edited by

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Contents

Aromatherapy A Mythological Approach for Medicine. *In:* Aromatherapy and its Benefits edited by Preetha Bhadra and Sagarika Parida © Renu Publishers, New Delhi: 2021, (pp. 01-14). **ISBN:** 978-81-940943-7-1, **DOI:** 10.30954/NDP-AMTHY.2021.1

Chapter

1

Aromatherapy A Mythological Approach for Medicine

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ABSTRACT

Aromatherapy, a part of herbology, is one of the quickest developing treatments on the planet today. Generally, fundamental oils are best utilized as back rub or shower oils or inward breaths. Much of the time, it is accounted for that fragrance based treatment leaves one inclination elevated, animated, empowered, or restored, contingent upon the oil utilized. At the point when breathed in, the different smells infiltrate the circulatory system through the lungs causing physiologic changes. Thus, the limbic framework, which controls our feelings and recollections, is influenced. Some think about fragrant healing as mysterious or supernatural; others, in any case, are endeavouring to approve observationally this old treatment as therapeutic.

Keywords: Aromatherapy, Types of aromatherapy, Pharmacological application, Anti- bacterial, Anti-Fungal

INTRODUCTION

Aromatherapy based treatment is the utilization of concentrated fundamental oils extricated from spices, blossoms, and other plant parts to treat different diseases. The defenders of fragrant healing make a case for an antiquated convention of natural medication rehearsed in nations for example, Egypt and India a huge number of years back. Be that as it may, the term was at first utilized by the French scientific expert Gattefossé in a book previously distributed in 1936. It is currently regularly directed by kneading into the skin, and the term fragrance based treatment generally infers knead with a scope of fragrant plant extricates known as fundamental oils. It is polished in the United Kingdom by specialists with an assortment of capabilities

(Banerjee and Bhadra, 2020). The Aromatherapy Associations Council (AOC) goes about as an umbrella association for expert fragrance based treatment associations; there is no single perceived capability.

Each antiquated culture utilized fragrances either for sterile or therapeutic purposes. For instance, Hippocrates (460–370 BC) acquainted aromas with treat mania, which he viewed as indications brought about by developments of the belly. Records show that the restorative utilization of refined oils was at that point applied in the tenth Century AD. As per assessments, there are around 350,000 plant species, among which roughly 17,500 are fragrant plants. Of these, exactly 400 are monetarily prepared for their fragrant crude materials. Nonetheless, after the presentation of clinical viability testing during the 1950s and the ascent of pharmacotherapy overwhelming Western medication, aromatherapeutic approaches were only limited to elective clinical methodologies. Up to this point, ordinary medication viewed fragrance based treatment as pseudoscientific because of an absence of convincing experimental proof supporting its adequacy. In the most recent decade or somewhere in the vicinity, this circumstance has changed, and there is developing clinical interest in fragrance based treatment. Clinical investigations just as meta-analyses show that a portion of the previous reservations against the clinical utilization of basic oils cannot, at this point be maintained. There is no uncertainty that basic oils have quite certain pharmacologic properties, which might be effectively used to inspire explicit physiological reactions.

For instance, certain scents (e.g., peppermint oil) may adjust the endogenous narcotic pathways of the mind and in this way diminish agony or uneasiness. Different smells (e.g., eucalyptus or thyme) have surprising antibacterial, antifungal, anti-inflammatory, immunomodulatory, or cell reinforcement impacts. Late meta-analyses and efficient surveys uphold the idea that fragrant healing may apply clinical indication alleviation when contrasted and fake treatment or standard treatment. For instance, in a meta-analysis analyzing various sorts of agony the board, fragrant healing was better than fake treatment in treating postoperative, obstetrical, and gynecological torment. A precise survey examining the impacts of fragrance based treatment on dysmenorrhea demonstrated that the lightening impact on feminine agony was bigger with aromatherapeutic intercessions than with fake treatment mediations. In a meta-analysis of randomized controlled preliminaries on pressure decrease, fragrance inward breath yielded ideal impacts contrasted and no treatment, yet this impact primarily appeared in emotional self-reports. An assessment of fragrance based treatment on rest quality including randomized controlled preliminaries and quasi-experimental preliminaries uncovered that it was compelling in both sound

and unfortunate people, particularly when utilized as inward breath instead of back rub treatment. Paradoxically, an efficient audit exploring fragrant healing for treating burdensome manifestations discovered more grounded mitigating impacts for rub fragrance based treatment than for inward breath fragrance based treatment. Together, these discoveries exhibit that remedial utilization of basic oils may apply clinical impacts. All in all, fragrance based treatment might be applied for an assortment of ailments, however it gives off an impression of being best for ailments whose fundamental instruments include enthusiastic and attentional data handling, just as the movement of the independent sensory system. Shockingly, huge numbers of the clinical investigations are of rather low methodological quality.

For instance, a deliberate survey of malignant growth patients discovered a few impacts of fragrance based treatment rub for long-term torment, nervousness, and personal satisfaction yet presumed that these didn't convert into clinical advantage because of the inferior quality of the investigations. In the above referred to investigations, up to half of the screened contemplates were accounted for to be of lacking quality with respect to the key results, the method of organization, or the appraisal conventions. There are extra reasons that may either profit or mischief the assessment of aroma therapeutic mediations. One basic factor relates to the absence of exactness of what fragrance based treatment establishes.

In particular, there is a lot of disarray with respect to the meaning of fragrant healing. Working with fundamental oils essentially isn't adequate to make a clinical case. In the clinical setting, applying them topically or even inside is really phytotherapy. Conversely, working with unstable mixes of basic oils by inward breath is fragrant healing. This mix-up and theoretical equivocalness even in high-ranked research papers fuels any target evaluation of the clinical utilization of fundamental oils. Numerous analysts appear to be at a misfortune or halfway oblivious when testing the particular components comprising a supposed fragrance based treatment. Shockingly, this issue additionally relates to contemplates exploring cell instruments of fundamental oils. For instance, in an investigation surveying the proof from the logical writing with respect to the basic systems of limonene for treating various infections, the writers mixed up utilization with inward breath and reach inferences which, best case scenario, should be viewed as equivocal as to the useful pathways included. In like manner, in an investigation talking about the phytochemical instruments of aroma therapeutic oils for the treatment of conduct and mental manifestations in patients experiencing dementia, the creators call for more thorough examination. Be that as it may, this end is made without giving a sound meaning of what establishes fragrance based treatment. At long last, in an ongoing efficient audit and meta-analysis investigating the impacts of

fragrant healing on the treatment of mental indications in postmenopausal ladies, the creators are trapped in the reasonable snare that has made fragrant healing a to some degree questionable mediation by befuddling the extremely useful instruments they wish to examine. While reasoning that fragrance based treatment knead improves mental side effects, no separation is made whether the causative system is the exercise based recuperation (likely) or the fragrance based treatment (far-fetched), subsequently adding to the disarray whether fragrant healing has clinical advantages. From this, it turns out to be evident that the current information on the viability of basic oils in the clinical setting is lacking. Besides, quite a bit of what passes today for fragrant healing is nothing else except for setting and climate, which, best case scenario, might be viewed as a vague factor. Before we expand on this, we will quickly plot the olfactory framework to exhibit how, why, and when fragrant healing is gainful.

HISTORY

Aromatherapy based treatment goes back more than 6,000 years to antiquated Egypt, the Far East, China, and Renaissance Europe. Ayurveda is India's customary, common arrangement of medication that has been drilled for over 5,000 years. Ayurveda is a Sanskrit word that, in a real sense interpreted, signifies "study of life;" it remembers the utilization of sweet-smelling oils for restoring and recuperating plans. The middle age doctor Avicenna is credited with deciding the techniques for extricating fundamental oils from plants. The antiquated Egyptians utilized fragrance based treatment for strict and restorative purposes and in incense, preserving, scents, and beauty care products. Hairpieces frequently were scented with oils to cover the smell of unsanitary roads and bodies. Hippocrates, the dad of current medication, utilized fragrance based treatment showers and scented back rub. He additionally utilized sweet-smelling fumigations to free Athens of the plague. In France, clinics regularly consumed rosemary and lavender for fumigation. During the 1930s the term fragrance based treatment was instituted when French physicist Ren'e Maurice Gattefosse found the advantages of lavender oil when it mended his consumed hand without leaving scars. He at that point began exploring the impacts of other basic oils for mending. During World War I, French armed force specialist Dr Jean Valnet probed injured troopers and found that fundamental oils were astounding germicides that detoxified. Afterward, Madame Marguerite Maury raised fragrance based treatment as an all-encompassing treatment. She began endorsing basic oils as solutions for her patients' diseases. She additionally is credited with the cutting edge utilization of fundamental oils in back rub. Today, fundamental oils are extremely strong, complex, exceptionally fragrant, and unstable substances. Basic oils comprise of synthetic mixes that contain hydrogen,

carbon, and oxygen. The essential practical gatherings of the fundamental oils utilized in fragrant healing are monoterpenes, esters, aldehydes, ketones, alcohols, phenols, and oxides. Current fragrant healing items are accessible as treatments, salves, creams, cleansers, shampoos, shower salts, knead oils, packs, vaporizers, individual fogs, room diffusers, room fogs, incense, and candles. Most fragrant healing items are "conveyed" to the body through back rub or inward breath. Verifiably, fragrant healing must be recognized as an immortal mediation, developing and advancing as experts utilize logical thoroughness to investigate its belongings.

AROMATHERAPY: COMMON MISCONCEPTIONS AND IMPORTANT REQUIREMENTS

The term 'Aromatherapy' is overflowing with misguided judgments, even inside the domain of natural chemistry. It is usually utilized as a conventional term to portray the utilization of fundamental oils on the skin, for knead, or in the encompassing air. A considerably more dubious definition incorporates the utilization of fundamental oils added to corrective consideration items. In certain nations (e.g., France), fragrant healing even incorporates the admission of fundamentals oils, making the entire idea more uncertain. It is essential to note, in any case, that neither the contribution of a scent nor a treatment is adequate for the case that an application is aromatherapeutic. An exact and restricted meaning of the term characterizes fragrance based treatment as the utilization of aromas to incite mental or physiological reactions. The pivotal component of fragrance based treatment, accordingly, is the practical part of the pre-owned aromas. Besides, any impact inspired by an aroma must be simply the after effect of the fragrance itself as well as of the technique for application, which critically addresses the idea of atom fixation arriving at the objective framework. On account of breathed in aromas, air immersion is a significant factor for evoking the reaction. Nonetheless, this relationship isn't direct with the end goal that delayed most extreme air immersion guarantees greatest impacts. Because of the laws of adjustment the body's view of tangible boosts is managed in a manner as to guarantee negative input between improvement power and the reaction force. Supported presentation to a particular scent improvement definitely brings about the force of the boost being seen as diminished. This physiological wonder has a significant natural capacity, as it permits one to stay responsive to new boosts. Then again, the force of the reaction is needy upon the level of neurological handling, with direct tactile preparing connected to a more grounded reaction. Our capacity to identify moderately low degrees of fragrance doesn't negate the way that expected unpredictability of an aroma is insignificant. In actuality, to guarantee a full impact, fragrances must be conveyed straightforwardly and

at greatest fixations to the nose. This is one reason why the exact proof testing aromatherapeutic mediations is discernibly differed and heterogeneous. Aside from test research testing explicit properties of the olfactory framework even beneath the limit of detectable quality by exceptionally normalized attire, for example, face veils, the impacts of smells are typically tried in a climate that permits generalizability of the outcomes to common and clinically sensible conditions (e.g., the restorative setting). Contingent upon the method of use, there might be significant helpful contrasts regardless of whether viable fragrances are directed. Notwithstanding the specialized part of smell organization, there are various biochemical angles that represent the adequacy of fragrance based treatment.

One significant factor is immaculateness of the substance. Numerous basic oils are weakened with modest engineered and semisynthetic monoterpenes.

- Another factor is the utilization of single note or complex mixes. Albeit most smells tried for aromatherapeutic intentions are single note, the helpful advantage might be upgraded by utilizing complex fragrance arrangements. This is on the grounds that unpredictable fragrance mixes act synergistically, and a significant number of the afflictions treated are related with various side effects, which are bound to be all the more enough treated with complex aroma mixes. This is likewise underscored by the standards of phytotherapy that misuse the joined activity of a combination of constituents to augment the quantity of synergistic or adversarial collaborations that may exist between various phytochemicals.
- Albeit numerous aromatherapeutic specialists are incorporated, there is experimental proof demonstrating that the cerebrum separates between them. For instance, an examination estimating the mind movement of ladies found that genuine stench tests acquired from companions and outsiders were handled by various pieces of the cerebrum than their manufactured scent blend partners. All the more critically, regular fragrances might be more viable because of their chirality. Manufactured (racemic) substances consistently contain reflect particles that may have significant pharmacokinetic contrasts.
- Moreover, most of engineered aromas comprise of a couple of particles. Regular aromas, then again, are intricate combinations of up to a few hundred individual substances—which clarifies why the general impact of such complex fragrances is simply infrequently restricted to the activities of only one or a portion of their parts. Common aromas are desirable over manufactured ones for one more explanation. Because of assembling measures, numerous manufactured aromas contain hints of impurities or added substances that might be possibly destructive.

- In contrast to pharmacologic specialists, normal plant-derived crude materials are hard to normalize in view of elements that are hard to control (e.g., population-specific taxons, atmosphere, and chemotype varieties). Organically, characteristic plants will create fluctuating degrees of various basic oils to shield themselves from possible microbes and consequently wellsprings of crude material will consistently differ. It might in this manner not be precluded totally that relying upon the wellspring of the aromas somewhat unique helpful results may follow.

We may consequently detail the fundamental preconditions for a viable fragrance based treatment as follows: It should

(a) include unstable mixes of basic oils by inward breath,

(b) straightforwardly and explicitly focus on the button,

(c) in sufficiently high atom fixations that can trigger physiological changes. From a more extensive perspective, compelling fragrant healing must

(d) include normal basic oil mixes of high phytochemical quality, and

(e) be intense enough to emphatically invigorate the olfactory framework without causing adjustment.

CLASSIFICATION OF AROMATHERAPY

Cosmetic aromatherapy

This treatment uses certain basic oils for skin, body, face and hair corrective items. These items are utilized for their different impacts as purging, saturating, drying and conditioning. A sound skin can be gotten by utilization of basic oils in facial items. On an individual level, corrective fragrance based treatment of fullbody or foot shower will be a basic and a successful method to have an encounter. Also, hardly any drops of fitting oil give a reviving and rejuvenating experience.

Massage aromatherapy

The utilization of grape seed, almond, or jojoba oil in unadulterated vegetable oil during rub has been appeared to have great impacts. This is otherwise called mending hint of back rub treatment.

Medical aromatherapy

The organizer of present day fragrant healing Rene-Maurice Gattefosse has utilized basic oils to knead patients during medical procedure, in this way using the clinical fragrance based treatment information on the impact

of fundamental oils on advancing and treating clinically analyzed clinical afflictions.

Olfactory aromatherapy

Inward breath of basic oils has offered ascend to olfactory fragrance based treatment, where basic inward breath has brought about improved passionate well-being, smoothness, unwinding or restoration of the human body. The arrival of stress is welded with pleasurable aromas which open scent recollections. Basic oils are supplemented to clinical treatment and can never be taken as a swap for it.

Psycho-aromatherapy

In psycho-fragrant healing, certain conditions of temperaments and feelings can be gotten by these oils giving the joy of unwinding, fortification or a lovely memory. The inward breath of the oils in this treatment is immediate however the implantation in the room of a patient. Psycho-fragrant healing and aromacology, both arrangement with the investigation and impacts of smell be it characteristic or manufactured. Psycho-fragrance based treatment has restricted itself with investigation of characteristic basic oils.

ESSENTIAL OIL SAFETY ISSUE

The fundamental oils are regularly ensured with least opposing effects. A couple of these have been supported as food added substances and fall in the class of ordinarily saw as ensured by the U.S. Food and Drug Administration. The most broadly perceived hostile events are eye, mucous layer and skin exacerbation and refinement particularly to oils containing aldehydes and phenols. Photo harmfulness of fundamental oil that contains furocoumarins, for example Citrus bergamia, is also declared. Contact honing will undoubtedly happen due to oxidation of monoterpenes, consistently on account of uncalled-for amassing conditions. Cross-honing to other fundamental oils and sustenances is moreover possible. Excessive touchiness from took in essential oils can occur; nevertheless, data about introduction levels are confined and colossal quantities of the reports concern smells instead of fragrant recuperating fundamental oils. An extraordinary example of airborne contact dermatitis was represented only a solitary time in setting to scent based treatment without rub. The aroma based treatment utilizes non described mixes of these fundamental oils without uncovering their plant sources. Touchy reactions have been represented in couple of cases, especially with viable association. These oils are not freed from oxidization reaction with age and are represented the change in their substance sythesis on limit with respect to long time. Reversible prepubertal gynecomastia was represented in one examination on repeated prologue to lavender and tea tree

oils by compelling association. There is reliably a significant conflict which arises when the security of these essential is analyzed. No overall portrayed thinks about have shown that these fundamental oils are damaging. On the off chance that there should be an event of some withdrew assessments, we have seen that these are unreliable, yet the vast majority of studies have not exhibited these oils at whatever point used in scent based treatment are risky.

PHARMACOLOGICAL ACTIONS OF ESSENTIAL OILS

Numerous basic oils were screened for assortment of pharmacological possibilities. Significant pharmacological activities of fundamental oils are summed up as underneath. A portion of the pharmacological activities of fundamental oils are examined beneath.

Antibacterial

Numerous basic oils were screened for their antibacterial movement against Gram-positive and Gram-negative microorganisms alongside antifungal properties. These fundamental oils are all around read for their antibacterial properties and certain they have indicated some extremely encouraging outcomes on salmonella, staphylococci and other oral microorganisms. They can be excellent options for anti-toxins assuming appropriately and completely read for these impacts of there (Behera and Bhadra, 2020). One such oil is Basil fundamental oil; this oil demonstrated a decent antimicrobial potential. It has bactericidal properties against Aeromonas, Hydrophila and *Pseudomonas fluorescens*. The examination of antibacterial impacts was positive to demonstrate its potential for oral microbes like *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Streptococcus mutans*, *Actinobacillus actinomycetemcomitans*, and *Streptococcus sobrinus*. Manuka oil was generally intense among the eucalyptus oil, rosmarinus oil, lavandula oil and tea tree oil for antibacterial potential. From 15 genera of oral microbes, 161 detaches were delicate to *Melaleuca alternifolia* (tea tree) oil, demonstrating its medical services properties for oral cleanliness. *Staphylococcus epidermis, Hedychium gardnerianum* and *Pittosporum undulatum* (*P. undulatum*) were vulnerable to basic oils from the leaves of *P. undulatum* and *Hedychium gardnerianum* with the most elevated exercises against *Staphylococcus aureus* and *Staphylococcus epidermis*. *P. undulatum* furthermore, have great antithrombin action moreover.

Antifungal

Melaleuca alternifolia (tea tree) oil tried positive for its all constituents for in vitro antifungal movement aside from beta-myrcene. Mallet *et al.* distinguished that the vast majority of the parts of tea tree oil had wide scope of fungicidal potential, particularly against dermatophytes and filamentous parasites. In one of the reports, the sprouted *Aspergillus niger conidia* was more helpless

to non-developed one (Banerjee and Bhadra, 2020). The fundamental oils got from the new leaves of *Melaleuca ericifolia* (*M. ericifolia*), *Melaleuca armillaris* (*M. armillaris*), *Melaleuca leucadendron* (*M. leucadendron*) and *Melaleuca styphelioides* showed great movement against *Aspergillus niger*. Numerous plants like *M. piperita*, dark mustard (*Brassica nigra*), *Angelica archangelica*, *Cymbopogon nardus*, *Skimmia laureola*, *Artemisia sieberi* and *Cuminum cyminum* have been tried positive for their antifungal action. They are in the underlying period of clinical preliminaries and if the outcomes are according to the desire, they will be a generally excellent option for existing antifungal medications which are not much of the time utilized for their poisonous fundamental impacts.

Antiviral

The antiviral movement assessed by Deans and Ritchie for the fundamental oils of *M. ericifolia, M. leucadendron, M. armillaris* and *Melaleuca styphelioides* on kidney cells of African green monkey through plaque decrease measure on herpes simplex infection type 1, gave the amazing outcomes for *M. armillaris* (up to 99%) trailed by *M. leucadendron* (92%) and *M. ericifolia* (91.5%).

Anti-inflammatory

Histamine response of weal and flare were diminished by tea tree oil in human. The effective utilizations of 100% tea tree oil can lessen the aggravation prompted by histamine diphosphate after a time of 10 min. Existing information on different fundamental oils shows that noncytotoxic fixations apply a mitigating activity by expanding interleukin-10 creation.

Anti-lice

Most of the preparation for head lice infestations contains the tea tree oil. The insecticidal activity of tea tree oil is due to its anticholinesterase potential.

Anti-dandruff

In a solitary visually impaired and equal gathering study, it was seen that shampoos which contain five percent tea tree oil were viable and very much endured by patients having gentle to direct dandruff and in any event 41% improvement was noticed. Very little have been investigated on the anti+dandruff capability of plant items, and particularly on unstable items, a few endeavors have been made by Anjum *et al.* however the outcomes are not promising.

Anti-tumor

Tea tree oil and terpinen-4-ol both had the option to hinder the development of human melanoma M14 WT cells and M14 adriamicinresistant cells. This activity was connected to apoptosis through caspasedependent instrument

in melanoma cells. 5-Fluorouracil therapy is improved in human colon malignancy cells whenever sharpened by geraniol, a part of plant fundamental oils. Endeavors are being made to set up the connection between basic oils and their enemy of tumor action. Polypharmacological hostile to tumor method of-activity of basic oils in cardamom makes them guarantee results to prove the cases.

Anti-oxidant

The basic oil from seeds of *Nigella sativa* L. is a powerful cell reinforcement *in vitro*, with compelling hydroxyl extremist rummaging movement. Kanuka (*Kunzea ericoides*), Manuka (*Leptospermum scoparium*) and *Leptospermum petersonii* have great antibacterial movement and cancer prevention agent properties. The basic oil from the *M. armillaris* has stamped cancer prevention agent potential; it changes the boundaries of superoxide dismutase, improves nutrient E and nutrient C focuses. The free extremists delivered during irritation, can actuate quality changes and post-translational adjustments of different proteins. If not, eliminate may turn damaging revolutionaries to the entire framework. This system is commonly countered by cancer prevention agent properties of mixes. Different plants like *Thymus vulgaris*, *C. limon*, *E. globulus* and *Cupressus sempervirens* have indicated their mitigating consequences for creature study.

Insect/mosquito repellant action

Insect repellency/toxicity results were promising from the essential oils of *Nepeta parnassica*, on the *Culexpipiens molestus*.

Spasmodic action

Solid spasmogenic and spasmolytic action was appeared by Kunzeaericoides and *Leptospermum scoparium* basic oils, individually and their different concentrates when tried on detached rodent ileum. *Ferula gummosa* is greatly improved in loosening up the contractile over-action of the ileum which shapes the fundamental of gastrointestinal issues.

Hormonal action

Geranial, neral, geraniol, nerol and trans-anethole are entrenched for their incitement of estrogenic reaction, when contrasted with eugenol which has against estrogenic action. Citra i.e., the blend of geraniol, nerol and eugenol were viable in supplanting [3H] 17b-estradiol from the estrogen receptors in recombinant yeast cells.

DISCUSSION

The discoveries of this methodical audit must be seen with alert on the grounds

that the first investigations were all little and experienced methodological defects. Obviously, preliminaries of fragrance based treatment meet impressive methodological issues. For example, the smell of the oils is hard to veil and patient blinding can consequently be troublesome. However none of these investigations offers a plainly expressed speculation at the start, and the overall tone of the reports is one of archiving, surveying or assessing (as opposed to testing) the 'set up' impacts of fragrant healing by utilizing polls controlled when an intercession. A few scientists are done talk about theory testing yet just inferred that her speculation was that her two medicines were the equivalent, and improvement rules were not characterized. The decision of oil was commonly expressed with no referred to defense. There was an earlier presumption that the patients in these investigations experienced a level of uneasiness or pain that justified intercession. A portion of these patients were calmed, yet there is no proposal that they were contender for ordinary anxiolytic treatment, (for example, benzodiazepines). The patients were not looking for alleviation from an indication and afterward being offered section into a randomized controlled helpful preliminary of a set up treatment for that side effect. They were not selected into the examinations since they were whining of uneasiness, but since the agents accepted that they were possible subjects with a degree of nervousness or different indications that would react agreeably to fragrance based treatment knead. This may obviously be valid, however the logical thoroughness of this methodology in viability research is flawed. By and by, the outcomes appear to help a conviction that fragrant healing back rub can be useful for tension decrease for brief periods. The information don't subvert a speculation that fragrance based treatment rub is wonderful, marginally anxiolytic, and regularly pleasant for patients in unpleasant circumstances.

In any case, the information don't uphold a theory that there might be authentic clinical signs for the remedy of fragrance based treatment rub in a medical services setting; it appears to have no enduring impacts, fortunate or unfortunate. Five of these examinations contrasted knead and without the expansion of fundamental oils. They all revealed an inclination for fragrance based treatment back rub to be marginally more powerful than 'fake treatment'. Nonetheless, the distinctions were unobtrusive and could all have been owing to defects in the examination plan. A twofold visually impaired plan to contrast fragrant healing medicines is most likely inconceivable with accomplish. In this manner whether or not we are managing explicit or vague impacts may never be settled totally agreeably.

Furthermore, as there was no endeavor to separate between the impacts of any transdermal assimilation of the oils and the impacts of smell, it isn't clear what the systems of activity may be. It is additionally hazy how much mental

elements might be significant — lovely recollections set off by specific scents might sufficiently be to represent any distinctions noticed. Fragrant healing is lovely and generally safe contrasted and numerous different methods of going through 60 minutes. The undoubted prominence of fragrance based treatment and the excitement of some medical services experts has prompted its presentation in a few medical services settings, eminently disease care and birthing assistance. Until now, the proof that this methodology might be financially savvy is deficient to advocate the utilization of fragrance based treatment on a more extensive premise.

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Chapter

2

Medicinal and Aroma-therapeutic Use of Plants

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ABSTRACT

Different civilizations witnessed use of various plants for medicinal and therapeutic uses, food additives and preservatives; and these are commonly known as medicinal and aromatic plants. These are also commonly known as herbs and spices and in use since ancient time as folk medicine and food preservatives. They contain many biologically active compounds and essential oils (EOs) which have medicinal and therapeutic values. During recent time, there is the rising attention of consumers in materials of natural origin by replacing unsafe synthetic additives has caused enhanced use of aromatic plants and their derivatives. As ingredients of aromatherapy, EOs extracted from medicinal and aromatic plants are fetching high demand because of gradual increase of market size. The present chapter enumerates the various health benefits of some important plants highlighting their medicinal and aroma-therapeutic importance.

Keywords: Aromatherapy, demand, essential oils, importance, medicinal and aromatic plants

INTRODUCTION

During recent time, there is the rising attention of consumers in materials of natural origin by replacing unsafe synthetic additives has caused enhanced use of aromatic plants and their derivatives (Christaki *et al.* 2012). These bio-origin materials are basically extracts of different medicinal and aromatic plants and used as functional ingredients in the pharmaceutical, food and feed trades (Sacchetti *et al.* 2005). These firms are presently in search of effective and safe materials of plant origin. Plant based material are full of different essential compounds to meet such needs. Many human civilizations have their heritage of using materials from plant origin for well-being. But,

still there is a lack of information; especially on mode of action of different ingredients available (Giannenas 2008) and interestingly they could be useful as new generation materials for health and nutrition of human and livestock. The livestock health is also a prime concern because of change in food habit of humans in the current context and upgraded animal health is synonymous to food safety and quality of the consumer. The *Ayurveda* (a Sanskrit word, meaning 'the science of life') is an ancient alternative medical system developed in Indian subcontinent that originated during prehistoric time (Hansch *et al.* 1990) and later appeared as texts (Gupta *et al.* 2014). In addition to spice and aroma, medicinal and aromatic plants were in use since 5000 BC in the Middle East (Chang 2000; Li 2006). Use of traditional medicines is still continuing in the developing countries taking care of nearly 80% of global population (Collin 2006; Gurib-Fakim 2006). Moreover, feed supplements derived from plant extracts are used animal diet (Windisch *et al.* 2009).

Basically, the plant derivatives are chemically substances like polyphenols, quinines, flavonols/flavonoids, alkaloids, polypeptides or their oxygen-substituted derivatives (Perumalla and Hettiarachchy 2011; Negi 2012). In today's society, there is a flourish in using complementary and alternative medicine (CAM) and in this way aromatherapy is becoming popular among health-conscious people aware of side effects of synthetic medicines (Gaware *et al.* 2013). Aromatherapy uses plant derivatives as essential oils for massage, compresses and inhalation (Rho *et al.* 2006; Kim 2007; Dwivedi *et al.* 2010). A general belief is that the essential oils are absorbed by the skin through the blood stream and thus cure illness. Inhaling of essential oils also stimulates activities of brain and diseases are cured. As ingredients of aromatherapy, essential oils extracted from medicinal and aromatic plants are fetching high demand. The worldwide market size of aromatherapy was USD 1.37 billion in 2019 with expected annual growth rate of 11.8% from 2020 to 2029 (Grandview Research, 2020).

In the present chapter, aroma therapeutic uses of some important medicinal plants have been discussed.

MEDICINAL VALUE OF ESSENTIAL OILS AND USE IN AROMATHERAPY

Essential oils (EOs) are extracted from different plants as a volatile mixture of chemical compounds. EOs are considered as one of the most predominant plant products in agriculture, as they exhibit antifungal, antibacterial, antioxidant, anticancer, antidiabetic, antiviral, insect repellent, and anti-inflammatory properties (Teixeira *et al.* 2013; Said *et al.* 2016). Presently, about 100 herbs are known for their EOs, while more than 2000 herbs scattered across 60 families, such as Umbelliferae, Lamiaceae, Lauraceae, Myrtaceae, etc., could produce medicinally valued EOs. In global markets,

only 300 among 3000 known types of EOs are deemed to be of commercial importance. EOs have found application in industries like pharmaceuticals, drugs, food, perfumes, makeup products, sanitary products, dentistry, food preservatives, additives, cosmetics, and natural remedies (Swamy *et al.* 2016; Mahmoudi 2017). Detailed compositional analysis of EOs can be obtained by gas chromatography and mass spectrometry (Brenes and Roura, 2010). It was found that there are valuable mixtures of mainly terpenoids like linalool, geraniol, borneol, menthol, thujanol, citronnillol, α-terpineol and a variety of low molecular weight aliphatic hydrocarbons like phenols (thymol, carvacrol, eugenol, gaiacol) and aromatic aldehydes (cinnamaldehyde, cuminal and phellandral) (Bakkali *et al.* 2008).

Being less dense than water EOs are volatile and mostly colorless, as well as soluble in organic solvents. The occurrence of essential oils is very widespread in the plant kingdom. According to market data, there are about 400 species, from 67 plant families, from which essential oils are produced on a large commercial scale. All plant parts, such as buds, leaves, fruits, bark, root, stems, twigs, and flowers, can contain Eos. Further, many EOs are particularly valued for their medicinal properties (Swamy and Sinniah 2015, 2016; Arumugam *et al.* 2016) and some important medicinal plants are listed below (Table 1).

Table 1: Medicinally important plants from some specific families and their medicinal value

Family	**Medicinally important Plants**	**Medicinal value**	**References**
Apiaceae	Fennel, black caraway, dill, cumin, anise, celery, coriander	Antidiabetic; anticancer; antibacterial; antifungal; antiviral	Raut and Karuppayil (2014) and Swamy *et al.* (2016)
Asteraceae	Wormwood, tarragon	Antifungal; anticancer; antiviral	Bakkali *et al.* (2008), and Swamy *et al.* (2016)
Geraniaceae	Rose geranium	Antibacterial	Swamy *et al.* (2016)
Lamiaceae/ Labiatae	Oregano, lemon balm, mint, peppermint, spearmint, sweet basil, rosemary, lavender	Antibacterial; antifungal; anticancer; antidiabetic; antioxidant; antiprotozoal; antiviral; antimutagenic; anti-inflammatory;	Bakkali *et al.* (2008), Raut and Karuppayil (2014), and Nagarjuna Reddy (2019)
Lauraceae	Cinnamon	Antimicrobial; anti-inflammatory; antimutagenic	Toscano-Garibay *et al.* (2017)
Liliaceae	Garlic, onion	Antifungal; antiviral; antiprotozoal	Lodha and Telang (2016); Swamy *et al.* (2016)
Myrtaceae	Clove, thyme, tea, blue gum, nutmeg	Antibacterial; antifungal; anticancer; antiviral; antimutagenic; anti-inflammatory; antiprotozoal	Raut and Karuppayil (2014) and Swamy *et al.* (2016)

Oleaceae	Jasmine, olive	Antibacterial, anticancer	Raut and Karuppayil (2014)
Poaceae	Palmarosa, lemongrass, citronella	Antifungal; anticancer	Bakkali *et al.* (2008), Raut and Karuppayil (2014)
Pinaceae	*Cedrus libani* (cedarwood oil)	Antifungal	Swamy *et al.* (2016)
Piperaceae	Black pepper	Antibacterial; antifungal; anticancer; antiprotozoal	Bakkali *et al.* (2008)
Rosaceae	Rose	Antifungal	Bakkali *et al.* (2008),
Rutaceae	Lemon, grape fruit	Antibacterial; antifungal; anticancer	Bakkali *et al.* (2008) and Swamy *et al.* (2016)
Santalaceae	Sandalwood	Antiviral	Raut and Karuppayil (2014)
Zingiberaceae	Ginger, turmeric, cardamom	Antifungal; anticancer; antioxidant; antimutagenic	Raut and Karuppayil (2014); Swamy *et al.* 2016

Moreover, essential oil blends are used in aromatherapy. Aromatherapy is a different kind of therapy in which a person's body and mind are tranquilized with oil massages and fragrance and the process is delicate. In this therapy oil which should be less sticky is poured over a person's body and is applied all over with soft hands. The soft massage loosens the muscles and soothes the flow of blood. This automatically results in a cool and calm mind and relaxed body. The latest innovations of aromatherapy products have made aromatherapy quite significant in vast range of appliances. Perfumes, creams, chemical, soaps, bath solutions and many more products are there in which aromatherapy is available. Some of the most popular products of aromatherapy are aromatherapy oil, aromatherapy diffuser, aromatherapy cream, aromatherapy perfume, aromatherapy soap, aromatic oil and so on. These products offer curing of diseases.

IMPORTANT PLANTS USED IN AROMATHERAPY

Table 2: Medicinal and aroma-therapeutic importance of plants

Name of the aromatic plant	**Medicinal and aroma-therapeutic importance**
Mint (Pudina) *Mentha arvensis* L.	Mint has high percentage of menthol (40-90%), which is widely used in preparation of ointments, pain balms, cough syrup, cough lozenges and tablets (Fischer-Rissi 1992; Sellar 1992; Lodha and Telang 2016). Menthol is used in aromatherapy also. A belief was there that ancient Greeks used to rub it on their arms for strength (Sanderson and Renfrew 2005). It has importance in relieving chest pain and stomach ache, even to cure post-surgery nausea (Hunt *et al.* 2013; Jamila and Mostafa 2014).

Rose *Rosa damascene* Mill. L.	Rose oil is prepared from petals by steam distillation. Rose essence is rich in flavanoids, tannins, antioxidants, and vitamins A, B_3, C, D and E (used in skin care). Rose oil is composed of ethylalcohol (78.38%), citrenellol (9.91%), nonadecane (4.35%) and geraniol (3.71%) ethanol (0.00-13.43%), and heneicosane (Ulusoy *et al.* 2009). Rosewater is an excellent relaxing agent and soothes the nerves (Fischer-Rissi 1992). The medicinal functions of rose are partly attributed to their abundance of phenolics compounds that possess a wide range of pharmacological activities, such as antioxidants, free-radical scavengers, anticancer, anti-inflammatory, antimutagenic, and antidepressant (Ng *et al.* 2000; Najem *et al.* 2011). The respiratory, cardiovascular, laxative, antidiabetic, antimicrobial, anti-HIV, anti-inflammatory, and antioxidant are other effects of this plant (Mahboubi, 2016). It is suggested that lipid soluble (non-polar) constituents of this plant are mainly responsible for most of the above-mentioned effects (Boskabady *et al.* 2011).
Tuberose *Polianthus tuberosa* L.	The fresh flowers yield about 0.08 to 0.11 percent essential oil. The health benefits of Tuberose Essential Oil can be attributed to its properties as an aphrodisiac, deodorant, relaxing, sedative, and warming substance.it is very popular & priced among perfume manufacturers (Seller 1992). This oil has pleasant fragrance along with chemical components that relax nerves, brain and muscles. It provides a great relief from tension, stress, depression, anxiety, anger, convulsions, cramps, convulsions, diarrhea and spasmodic coughs.
Lavender *Lavandula angustifolia* Mill.	The flowers and leaves are used as an herbal medicine as oil or as an herbal tea. Both the petals and the oil are the most popular ingredients in handmade soap. Major components of the essential oil are linalool and linayl acetate. The essential oil is antiseptic and antispasmodic. The flowers are also used as a culinary herb. Lavender essential oil is commonly used as relaxant in body massage in aromatherapy. The oil is sedative, carminative, anti-depressive and having anti-inflammatory properties and antimicrobial effects (Cavanagh and Wilkinson, 2005). Researchers suggest that the extract of lavender is anxiolytic, mood stabilizer, analgesic, and anticonvulsive and neuro-protective, having therapeutic efficacy in neurological disorders (Koulivand *et al.* 2013).
Ocimum (Tulasi) Ocimum sanctum L.	Different parts have been recommended for the treatment of bronchitis, bronchial asthma, malaria, diarrhea, dysentery, skin diseases, arthritis, painful eye diseases, chronic fever, insect bite etc. It has also been suggested to possess antifertility, anticancer, antidiabetic, antifungal, antimicrobial, hepato-protective, cardio-protective, antiemetic, antispasmodic, analgesic, adaptogenic and diaphoretic actions. Eugenol, the active constituent present , is largely responsible for the therapeutic potential (Warrier *et al.* 1993-'95). It has also anti-stress/ adatogenic, antioxidant, immune modulator and anti-radiation properties (Singh *et al.* 2012).

Rosemary *Rosmarinus officinalis* L.	Rosemary has therapeutic properties and has been used in the folk medicine, pharmaceutical, and cosmetics industries. The most important constituents of rosemary are carnosic, ursolic and caffeic acid and derivatives such as rosmarinic acid. Rosmarinic acid is anti-viral, anti-bacterial, anti-inflammatory and antioxidant. The other uses are wound healing and skin cancer and mycoses treatments. Besides it therapeutic uses, rosemary has potential applications in cosmetic formulations and in the treatment of pathological and non-pathological conditions, such as cellulite, alopecia, ultraviolet damage, and aging (de Macedo *et al.* 2020).
Celery *Apium graveolens* L.	Seeds are used for distilling oil which is useful in toning the nervous system, relieving cellulite and water retention. It cleanses and purifies the kidneys, liver and spleen and helps to reduce uric acid in the joints of arthritis, rheumatic and gout patients. In Ayurveda it is used as a nerve tonic, to relieve bronchitis and asthma. It reduces blood pressure, relieves indigestion, and stimulates the uterus, acts as anti-inflammatory, diuretic anti-microbial, anti-fungal, anti-bacterial, anti-virus, anti-cancer, anti-spasmodic, gastro-intestinal, anti-oxidant, nematocidal, anti-rheumatism, antiasthma, anti-bronchitis, hepatoprotective, appetizer, anticonvulsant, antispasmodic, breast milk inducer, anti-jaundice, anti-hypertensive, anti-dysmenorrhea, prevention of cardiovascular diseases, aphrodisiac and spermatogenesis (Hassanen *et al.* 2015; Khalil *et al.* 2015; Salehi *et al.* 2019).
Coriander *Coriandrum sativum* L.	The coriander seeds contain essential oils such as linalool (68%), a pinene (10%), geraniol, camphene, terpine and so on. These active principles have great importance in treating disorders like diabetes, increased cholesterol, arteries blockage leading to high blood pressure, ulcers, urinary tract problems, anti-anxiety, anti-bacterial and anemia prevention, skin Problems, swelling prevention, anti-osteoporosis, liver diseases etc. (Lodha and Telang, 2016). Further, it is used in the preparation of medicines to cure bed cold, seasonal fever, nausea, vomiting, stomach disorders and also used as a drug for indigestion, against worms, rheumatism and pain in the joints (Rajeshwari and Andallu, 2011; Iqbal *et al.* 2019).
Cumin *Cuminum cyminum* L.	Cumin seed is a very common spice with distinct flavour and aroma. Cuminaldehyde, pinene, cymene, terpinene, oleoresin and thymol are the major components of cumin showing medicinal properties. It is an anti-oxidant and has medicinal value as antimicrobial, antifungal, antithrombotic, anti-atherosclerotic, hypolipidemic, ntiinflammatory, anti-aggregatory and eicosanoid inhibitor (Hanif *et al.* 2012; Singh *et al.* 2017).
Fennel *Foeniculum vulgare* Mill.	The fennel is highly aromatic due to presence of anethole, an aromatic compound. Other active constituents are α-pinene, β-myrcene, β-pinene, fenchone, camphene, estragole, fenchone, limonene, p-cymen, and safrole. Sweet fennel oil is often used in aromatherapy and provides a relaxing soothing effect on the body. EO extracted from seed is used for constipation, cold, cough and nausea. Further, uses in diuretic & relaxation of muscle cramps, breath-freshener and carminative are also noted (Singh *et al.* 2012).

Cardamom *Elettaria cardamom* L.	Cardamom is known to have been anti-oxidant, disease preventing and health promoting properties. It is Used as antiseptic, anti-spasmodic, carminative, antimicrobial, antiinflammatory, hypolipidemic, anti-mutagenic and anti-carcinogenic, digestive, diuretic, expectorant, stimulant, stomachic and tonic (Abdullah *et al.* 2017; Mani *et al.* 2017). Cardamom oil is also used in aromatherapy as a digestive remedy to alleviate flatulence, heartburn, nausea, indigestion and colic (Tambe and Gotmare 2019).
Ginger *Zingiber officinale* Roscoe.	Ginger is used as analgesic, anodyne, anti-cancer, aphrodisiac, astringent, muscle relaxant, anti-flatulent and carminative. Ginger oil is further used as a safe and effective medicine for the prevention and treatment of the complications of nausea and vomiting associated with general anaesthesia (Geiger, 2005). Further ginger oil shows anti-microbial, bronchodilator, anti-oxidant, anti-inflammatory and analgesic, anti-ulcer, immuno-modulatory effects (Mahboubi M (2019).
Sandalwood *Santalum album* L.	Sandalwood oil imparts a long-lasting and woody base to perfumes. The smell of Sandalwood oil is very quiet fragrant, relaxing and helps to clear up dry cough and boosts the digestive system. Sandalwood oil has also anti-inflammatory, anti-microbial, anti-viral, anti-bacterial, anti-proliferative and anticancer effects (Santha and Dwivedi 2015). It has also shown promise in clinical trials for treatment of acne, psoriasis, eczema, common warts, and recent availability of pharmaceutical-grade sandalwood oil is useful in dermatology (Moy and Levenson, 2017).
Eucalyptus *Eucalyptus globulus* Labill	Eucalyptus leaf extract has been used to treat influenza, chest problem, skin rashes and its vapour inhaled in cases of inflammation of respiratory tract (Sonker *et al.* 2017). The EO of Eucalyptus shows anti-microbial, anti-fungal, anti-viral, anti-inflammatory, analgesic, anti-oxidant properties (Hardel and Sahoo, 2011; Hayat *et al.* 2015).
Clove *Syzygium aromaticum* (L.) Merrill & Perry	Cloves are used in Ayurvedic medicine,where the essential oil is used as an anodyne (pain-killer) for dental emergencies. The essential oil is used in aromatherapy when stimulation and warming are needed, especially for digestive problems. Moreover, clove is used as anti-microbial, cytotoxic, anti-oxidant, anti-viral, hepato-protective, analgesic and anesthetic (Cortés-Rojas *et al.* 2014; Mittal *et al.* 2014; Xu *et al.* 2016; Hussain *et al.* 2017).
Camphor *Cinnamomum camphora* (L.) J.Presl.	Camphor is used as an antimicrobial, cough suppressant, decongestant, antipyretic and antifungal. It is also used as carminative, reflex expectorant and reflex stimulant of heart, sedative and nervous depressant in convulsions, hysteria, epilepsy, and chorea. Topically used as mild analgesic. Externally used in catarrhal diseases of the respiratory tract and muscular rheumatism; internally in hypotonic circulatory regulation disorders, catarrhal diseases of the respiratory tract (Frizzo *et al.* 2000; Chelliah Abiya, 2008; Garg and Jain, 2015).

Cinnamon *Cinnanomum verum* J. Presl.	The EOs and extracts cinnamon have antibacterial and antifungal properties (Freires *et al.* 2015; Bakhtiari *et al.* 2019; Monawer, 2019). In dental medicine and oral hygiene use of cinnamon extract is well known (Quintas *et al.* 2015). Cinnamon is traditionally used in medicine applications. The effect of cinnamon has been studied during pregnancy (John and Shantakumari, 2015), for diabetes control (Wazaify *et al.* 2011), and gynecological problems (Jaafarpour *et al.* 2015). It's anti-inflammatory, antibacterial, antifungal, cardioprotective, antioxidative, and antimicrobial properties have also been researched (Kawatra and Rajagopalan, 2015; Yanakiev, 2020).
Nutmeg *Myristica fragrans* Houtt.	The essential oil obtained by steam distillation of ground nutmeg is used widely in the perfumery and pharmaceutical Industries. The health benefits of nutmeg oil can be attributed to its medicinal properties such as its role as a sedative, stimulant, relaxing, anti-inflammatory, antiseptic, antifungal, and antibacterial substance. Nutmeg oil is obtained from the seed of nutmeg fruit ability to treat stress, pain, menstrual cramps, heart disorders, indigestion, blood pressure, cough, and bad breath (Neeraja and Margaret, 2016; Staughton, 2018; Felita Dhaslin *et al.* 2019).
Black pepper *Piper nigrum* L.	Black pepper is traditionally recommended for fevers and a variety of gastrointestinal conditions, neurological and broncho-pulmonary disorders (Majeed *et al.* 2015). Traditional medicine utilizes black pepper for the treatment of pains (headaches, muscular pain), rheumatism, infections such as strep throat and influenza, as well as for enhancing the blood circulation (Gorgani *et al.* 2017). The major compounds found in this essential oil are sabinene, α-pinene and β-pinene, β-caryophyllene, phellandrene, limonene, linalool, citral and others. Antioxidants such as beta carotene, lauric, myristic and palmitic acids, as well as piperine, are found in pepper (Meghwal and Goswami, 2012). The pungent taste of pepper is due to presence of piperine (piperoylpiperidine, $C_{17}H_{19}NO_3$) that has various physiological effects, including antihypertensive, antiaggregant, antioxidant, antitumor, antispasmodic, antiasthmatic, antidepressant, anxiolytic, and many others (Damanhouri, 2014; Stojanovi´c-Radi´c *et al.* 2019).
20. Lemon *Citrus limon* (L.)	Essential oil from different lemons shows various medicinal properties. Sweet orange EO showed anti-carcinogenic potential, physiological and psychological relaxation. Inhalation of orange EO creates relaxed and natural feelings. It is also considered as anti-tumor, anti-oxidant, anti-bacterial and anti-fungal. The odor of sweet orange decreases the symptoms of anxiety and improves the mood (Hata *et al.* 2003; Chidambara Murthy *et al.* 2012; Goes *et al.* 2013; Igarashi *et al.* 2014). EO of mandarin orange has anti-proliferative, chemo-protective, anti-oxidant, anti-bacterial and anti-fungal properties. Further, sour lemon shows anti-proliferative, chemo-protective, anti-oxidant, anti-bacterial and anti-fungal, anti-spasmodic, analgesic, anti-anxiety, neuro-protective, anti-obesity, stress relief properties (Dosoky and Setzer, 2018).

CONCLUSION

India is one of the pioneers of investigations of plants as medication, for example Ayurveda. In our social and monetary life we scarcely deal with our food we are taking. One such extraordinary spice recorded which have regularly been viewed as a cerebrum promoter. The entire plant including the blossoms can be utilized for therapeutic purposes. It has a harsh and sweet taste and is known to give a cooling energy. These spices are brimming with cancer prevention agents that are fundamental for carrying on with a sound life. We have utilized these properties of these spices to get some new medications for various plant organisms. The employments of different pesticides, additives, and so forth transform the nourishments into poison. Besides the results of these pesticides and additives, and so forth are hazardous as on the grounds that it prompts commencement of various disease. In this entire world, the quantity of patients passing on from disease is expanding in an extremely compromising manner.

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Chapter

3

Essential Oils and Plant Sources Used in Aromatherapy

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ABSTRACT

Aromatherapy is one of the harmonious therapy in which essential oils are used to treat various diseases. This chapter deals with the plant oil including essential oils obtained from various parts of the plant focusing their role in aromatherapy and different traditional healing system. This explores information available in the literature on therapeutic, cosmetic, medicinal, olfactory and massage aromatherapy and about different plants and plant parts used for extraction of the essential oil to be used in aromatherapy. Data were gathered for 120 essential oils derived from different parts of the plant and also from the whole plant from 127 plant species belonging to 37 families. It was found that maximum number of plants of about 14.17% belong to Lamiaceae family produce essential oils followed by Apiaceae and Asteraceae each with 12.127% and Rutaceae with 10. 23%.

Keywords: Aromatherapy, Essential oils, Traditional healing system, Volatile oil

INTRODUCTION

Alternative and complementary medicine has gained the popularity along with other recognized common medicines. The effects of aroma have immediate reactions and have powerful action. These molecules pass to olfactory lobe via nose and reach the limbic system of the brain that helps in relieving pain, inducing calmness and reduces stress. Aromatherapy is one of the harmonious therapy in which essential oils are used to treat various diseases. "Aroma" is derived from the Late Latin word "Aromata" which means "spices". "Aroma" is also derived from the ancient Greek word ἄρωμα" (aroma). Aromatherapy is derived from the French word "Aromatherapie". In Greek, "Aroma" means "sweet smell" or "sweet herb" and "Therapeia" means "healing". It

is a holistic healing treatment which uses aromatic essential oils or scents extracted from the natural plant extracts to be used medicinally for physical well-being of body, mind and spirit (Worwood, 2000). The use of aromatic plant oils, essential oils are being used for physical and psychological well-being. It is used to alleviate the symptoms of headaches, insomnia, stress and digestive problems. The use of aromatics was first recorded more than 3,500 years before the birth of Christ. This is the time where ancient Egyptians first burned incense made from wood, herbs and spices in order to honor their God in believing that the rose up smoke would carry their prayers directly to their deities for fulfillment of their desires. Chinese may have been the first cultures to use aromatic plants for their well-being. From the literature data it is revealed that this therapy has gained attention in late 20 century and popular in 21st century and is recognized as aroma science therapy (Esposito *et al.* 2014).

Essential oils are volatile in nature and are liquid aromatic compounds sourced from natural sources, majority from plants. Essential oils are complex mixtures of many individual aroma compounds. Essential oils and aroma oils are different from each other and aroma oils are essential oil with aromatic compounds in an oily solvent. Inhalation therapy of vapors of essential oil has significant role in controlling central nervous system and had an anti-inflammatory properties. The essential oils are highly concentrated and extracted from leaves, flowers, fruits, roots, seeds and from resins by fragrance extraction techniques like distillation, solvent extraction and cold pressing (Dunning, 2013). Essential oils are saturated or unsaturated hydrocarbons, alcohol, esters, ethers, terpenes, ketones and phenols which produce pleasant odours (Schiller & Schiller, 1994; Wildwood, 1996). Essential oils are present in different specialized secretory cells and tissues, glandular hairs and also in intercellular spaces and diffused on to the plant organ surface (Iriti, 2006). Large amount of volatiles are obtained from fragrant plant materials viz. flowers like roses, jasmine, tuber rose (Rajanigandhaa), leaves like lavender, fruits like anise, roots (ginger) and from barks (cinnamon). Common way to use the essential oil is to inhale directly from the bottle or can be used using a humidifier or diffuser. The essential oil can be diluted with carrier oil for using on skin. It can be used in body wash, shampoo or in bath.

This chapter deals with the plant oil including essential oils obtained from various parts of the plant focusing their role in phytotherapeutics, different traditional healing system and as aromatherapy. This explores information available in the literature on therapeutic, cosmetic, medicinal, olfactory and massage aromatherapy and about different plants used in aromatherapy.

METHODS

Systematic search was performed using different electronic databases such as Academic Journals, Google Scholar, PubMed, Medline, Embase, Web of Science and Wikipedia. Articles published in English language were taken into consideration.

Essential Oils from Plant Sources

A number of plant species have been reported to use in aromatherapy because of the essential or volatile oils. Essential oils of about 120 types are enumerated in Table 1.

Table 1: List of essential oils Extracted from Plant Sources

Sl. No.	Essential oil
1	Agar wood oil
2	Ajwan oil
3	Angelica root oil
4	Anise oil (rich odour of licorice)
5	Asafoetida oil
6	Balsam of Peru
7	Basil oil (Leaves and flowering tops)
8	Bay laurel essential oil
9	Bay oil
10	Bergamot oil
11	Birch oil
12	Black pepper oil
13	Black seed oil
14	Calamondin oil or Calamansi oil
15	Calamus oil
16	Camphor oil
17	Cannabis flower essential oil
18	Caraway seed oil
19	Cardamum seed oil
20	Carrot seed oil
21	Cedar oil/Cedar wood oil
22	Chamomile oil
23	Cinnamon oil
24	Citronella oil
25	Clary sage oil (Leaves and flowering tops)
26	Clove oil
27	Coconut oil
28	Coffee oil
29	Coriander oil
30	Costomary essential oil/ Bible leaf oil
31	Costus root oil

32	Cranberry seed oil
33	Cubeb oil
34	Cumin seed oil
35	Curry leaf oil
36	Cypress oil (twigs, stem, leaves)
37	Cypriol oil
38	Davana oil
39	Dill oil
40	Elecampane oil
41	Elemi oil (from oleoresins)
42	Eucalyptus oil
43	Fennel seed oil
44	Fenugreek oil
45	Fir Needle oil
46	Frakincense oil (hardened gum resin)
47	Galangal oil
48	Galbanum oil
49	Garlic oil
50	Geranium oil
51	Ginger oil
52	Goldenrod oil
53	Grape fruit oil (Extracted from peel of the fruit)
54	Helichrysum oil
55	Hickory nut oil
56	Horse radish oil
57	Hyssop oil
58	Idah grown Tansy
59	Jasmine oil
60	Juniper berry oil
61	*Laurus nobilis* oil
62	Ledum oil
63	Lemon oil
64	Lemongrass
65	Lime
66	Litsea cubeba oil
67	Marjoram
68	Melissa oil (Lemon balm)
69	Mint oil
70	Moringa oil
71	Mountain Savory
72	Mustard oil
73	Myrrh oil
74	Myrtle oil
75	Neem oil
76	Neroli oil (produced from blossom of bitter orange tree)

77	Nutmeg oil
78	Orange oil
79	Oregano oil
80	Oriss oil
81	Palmarosa oil (Palmarosa grass/Geranium grass/ginger grass)
82	Palo Santo
83	Parsely oil
84	Patchouli oil
85	Pennyroyal oil (highly toxic)
86	Peppermint oil
87	Perilla essential oil
88	Petit grain
89	Pine oil
90	Pipermint
91	Ravensara essential oil
92	Red cedar (eastern red cedar)
93	Rock rose essential oil
94	Rose oil
95	Rosehip oil
96	Rosemary oil
97	Rosewood oil
98	Sage oil
99	Sandal wood oil
100	Sassafras oil
101	Savory oil
102	Schisandra oil
103	Spearmint oil
104	Spike lavender
105	Spikenard oil/Jatamansi essential oil
106	Spruce oil
107	Star anise oil
108	Sweet orange
109	Tangerine/Mandarin oil
110	Tarragon oil
111	Tea tree oil
112	Thyme oil
113	Tsuga oil
114	Turmeric oil
115	Valerian oil
116	Vetiver oil
117	Warionia
118	Wintergreen
119	Yarrow oil
120	Ylang ylang oil

Essential Oils from Plant Parts and Their Uses

It was found that these essential oils were extracted from different parts of the plant and also from the whole plants from 127 plant species belonging to 37 families (Table 2). One species each from 19 families viz. Acoraceae, Liliaceae, Thymelaeaceae, Meliaceae, Annonaceae, Ranunculaceae, Cannabaceae, Juglandaceae, Cistaceae, Cyperaceae, Rubiaceae, Caprifoliaceae, Geraniaceae, Iridaceae, Moringaceae, Myristicaceae, Oleaceae, Santalaceae and Valerianaceae family was found having essential oil, two species each from five families viz. Betulaceae, Piperaceae, Schisandraceae, Fabaceae and Rosaceae, three species from Ericaceae, four each from Brassicaceae, Burseraceae, Poaceae and Zingiberaceae; five species each from Cupressaceae, Myrtaceae, six plant species each from Pinaceae; seven plant species from Lauraceae; 12 species each from the family Apiaceae and Asteraceae, 13 from Rutaceae and 18 species from Lamiaceae were reported to contain essential oil in various parts and also from whole plants depending upon the species (Table 2).

Table 2: Essential oils produced from plant parts and their uses

Parts of the Plant	Essential Oil	Plant species	Uses
Root	Angelica root oil	*Angelica archangelica* L.	Aromatherapy in reducing anxiety, fear and depression/Boosting immune system/Strengthen the nervous system (Pasqua *et al.* 2003; Chauhan, 2016)
	Calamus oil	*Acorus calamus* L.	Perfumery
	Costus root oil	*Saussurea costus* (Falc.) Lipsch.	Perfumery/Insect repellant/making incense/in making hair oil (Bhatterjee, 2001)
	Cypriol oil	*Cyperus scariosus* R. Br.	Perfumery
	Elecampane oil	*Inula helenium* L.	No known aromatherapy used/used as fixative in cosmetics and perfumes as it extends the life of other aromas (Anonymous, a)
	Horse radish oil	*Cochlearia armoracia* L.	Used to treat Rheumatism and Swollen Joints/Cough/Brochitis/Siatic nerve pain
	Oriss oil	*Iris florentina* L.	Flavoring agent/Perfumery/ Medicinally
	Valerian oil	*Valeriana officinalis* L.	Reduces mental stress/Used in insomnia/Reducing nervousness and tension
	Vetiver oil	*Vetiveria zizanoides* (L.) Nash	Aromatherapy/ Fixative in Perfumery/ Cosmetics (Soaps, Deodorants) (Anonymous b; Chomchalow & Chapman, 2003).

Root bark	Sassafras oil	*Sassafras albidum* Nees & Eberm	Aromatherapy/Perfumery/Soap industry (Anonymous c)
Rhizome	Galangal oil	*Alpinia galanga*	Aromatherapy/Used for boosting intuition
	Ginger oil	*Zingiber officinale* L.	Aromatherapy/Effective in postoperative nausea and vomiting (Contreras-Moreno, 2017)
	Spikenard oil/Jatamansi essential oil	*Nardostachys grandiflora* DC. Syn. *N. jatamansi* DC.	Perfumery/ Calm anxiety/Deep inhalation in insomnia/Reduce tress (Anonymous,d)
	Turmeric oil	*Curcuma longa* L.	Anti-inflammatory/Anti-nociceptive/ Antiatherosclerotic/Antioxidant activity (Liju *et al.* 2011)
Tubers	Garlic oil	*Allium sativum* L.	Antioxidant activity/Used to cure skin ailments/Reduce pain and relieves degenerative afflictions/Stong anti-inflammatory (*Anonymous,e)*
Stem Bark	Cinnamon oil	*Cinnamomum zeylanicum* Blume	Aromatherapy/Stress releving/Cold and Flu relief (Lawless, 2013)Muscle aches and pain/mouthwash
	Birch (sweet) essential oil	*Betula lenta* L.	Aromatherapy/Perfumery (*Anonymous, f)*
Wood	Cedar oil/ Cedar wood oil	*Cedrus atlantica* (Endl.) G. Manetti ex Carriere (Atlas Cedar wood)	Aromatherapy/Perfumes/fragrances/ Antimicrobial/Insceticidal and used in mummifying process in Ancient Egypt/Coughs and hiccups/Regulating sebum production
		C. deodara (Roxb.) Loud (Himalayan Cedar wood)	Aromatherapy/Insect repellant/ Disinfectant/Soap (Kumar, 2019)
		Juniperus mexicana Schltdl. & Cham. (Texas Cedar wood)	Aromatherapy/Perfumery and used in making Men's cologne/Reduces anxiety and brings harmony/ Mucolytic/Expectorant/ Skin rashes
		J. virginia (Verginian Cedar wood)	Aromatherapy/Muscular aches and pain/Rheumatism/Arthritis/Fixative in perfumery (*Anonymous g*)
	Sandal wood oil	*Santalum album* L.	Perfumes/fragrances
	Rosewood oil	*Aniba rosaeaodora* Ducke	Skin care
	Agar wood oil	*Aquilaria malaccensisi* Lam.	Perfumes/fragrances
	Camphor oil	*Cinnamomum camphora* (L.) J. Presl.	Perfumes/Used to treat muscular strains, inflammation, rheumatic conditions (Babu *et al.* 2003)

Leaves	Citronella oil	*Cymbopogon nardus* (L.) Rendle.	Used as insect repellant
	Lemongrass	*C. citratus* (DC. ex Nees) Stapf	Used as insect repellant
	Petitgrain oil (Leaves and Green twigs of bitter orange)	*Citrus aurantium* L.	Perfumery/Insomnia/Reducing Stress/ Regulating Perspiration
	Palmarosa oil (Palmarosa grass/ Geranium grass/ginger grass)	*C. martini* (Roxb.) Stapf	Used as massage oil/Perfumery/ Skincare products/Enhance complexon
	Patchouli oil	*Pogostemon cablin* (Blanco) Benth.	Used in Aromatherapy to calm down depression /Prevents infection/Anti aging essential oil/Perfumery
	Pipermint	*Mentha pipertia* Linn.	
	Mint oil	*M. arvensis* Linn.	Aromatherapy/Used in flavoring Toothpastes/ Mouthwashes/Pharmaceutical
		Salvia sclarea Linn.	Aromatherapy/Perfumes/Muscatel flavouring for vermouths, wines and liqueurs (Clebsch, 2003)
		Eucalyptus globules Labill.	Aromatherapy/Helps in skin nourishment/Hair care/Two drops of essential oil in a cup of warm water strengthens gums and teeth/Promotes salivation process (*Anonymous,h)*
		Cistus ladanifer L.	Perfumery
	Costomary oil/ Bible leaf oil	*Tanacetum balsamita* L.	Medicinally used in Europe and Southwest Asia
	Wintergreen	*Gaultheria procumbens*	Aromatherapy/Reduces joint discomfort
	Curry leaf oil	*Murraya koenigii* (L.) Spreng	Used to flavor food
	Perilla essential oil	*Perilla frutescens* (L.) Britton	Cosmetics/ Perfumery/Antidepressant/ Antioxidant/Antimicrobial/ Antiallergic (*Anonymous,i)*
	Ajwan oil	*Carum copticum* L.	Used in food and flavoring industries/ Antiinflammatory/Analgesic/ Anasthetic [Braga, *et al.* 2006; Haeseler *et al.* 2002)
	Cinnamon oil	*Cinnamomum zeylanicum* Blume	Reduces depression/Faintness/ Exhaustion/Immunity booster/Calm respiratory tract/Anticandida activity (Oliveira *et al.* 2014)

	Red cedar essential oil(western red cedar)	*Thuja pilicata* Donn ex D. Don	Rheumatism/Arthritis/Calmimg and meditativeeffect/Insecticidal/ Antimicrobial property (Guleria *et al.* 2008; Tsiri *et al.* 2009; Hudson *et al.* 2011)
	Red cedar (eastern red cedar)	*Juniperus virginiana* L.	In aromatherapy the essential oil is used to treat muscular aches, pains, painful joints, rheumatism and arthritis/used as decongestant to clear blocked sinuses/insect repellant (*Anonymous,j)*
	Warionia	*Warionia saharae* Benth& Cross	Antimicrobial activity against *Staphylococcus aureus*, *Candida albicans*, *Bacillus aureus* (Sellam, *et al.* 2012)
	Tea tree oil	*Melaleuca alterifolia* (Maiden & Betche) Cheel	Antiseptic/Anti-inflammatory (Caldefie-Chezet, *et al.* 2014)
	Geranium oil	*Pelargonium graveolens* L.	Aromatherapy/Medicine/Perfumery
	Rosemary oil	*Rosemarinus officinalis* L.	Aromatherapy/Antioxidant
	Bay oil	*Pimentara cemosa* var *racemosa*	Aromatherapy/Prevent dandruff/Body relaxation when added to bath water
	Bay laurel essential oil	*Laurus nobilis* L.	Aromatherapy/ Perfumery/Aleppo soap (Encyclopedia of Herbs, 2010)
	Birch oil	*Betula pendula* Roth.	Aromatherapy
	Spearmint oil	*Mentha spicata* L.	Flavoring Mouthwash/Chewing gum/ Toothpates
	Basil oil (Leaves and flowering tops)	*Ocimum basilicum* L.	Aromatherapy/ Perfumery/relieves from headaches, migrains, depression
	Clary sage oil (Leaves and flowering tops)	*Salvia sclarea* L.	Aromatherapy/Sedative abilities/ Induce calmness/Perfumery and as an additive in flavoring some alcoholic beverages/Used for dyspeptic symptoms and excessive perspiration (Raal *et al.* 2007)
	Ravensara essential oil	*Ravensara aromatic* Sonn.	Used in Influenza/colds/Bronchitis/ Cold sores (*Anonymous,k:)*
	Pennyroyal oil (highly toxic)	*Mentha pulegium* L.	Abortifacient
	Eucalyptus oil	*Eucalyptus camadulensis* Dehneh	Germicide

	Laurus nobilis oil	*Laurus nobilis* L.	Soap and Cosmetics industries/ Perfumery/Relieves rheumatic pains (Aqili Khorasani, 1992; Zargari, 1970).
	Melissa oil (Lemon balm)	*Melissa officinalis* L.	Aromatherapy for releaving from mild depression/Mild sedative/Spasmolytic (Sheppard-Hanger *et al.* 1995; Foster, 1990)
	Peppermint oil	*Mentha pipertia* L.	For treating Neuralgia/Myalgia/ Headaches/Migraine (Cowan, 1999; Craft, & Setzer, 2017)
		M. arvensis var. *piperascens* L.	Used as Inhalent/Fragrances/ Antiseptic
Needles	Fir Needle oil	*Abies balsamea* (L.) Miller	Aromatherapy/Natural Perfumery/ Sanitize air/Relieves Asthmatic breathing problem/Chronic bronchitis/Relives mental exhaustion (*Anonymous, l)*
	Pine oil	*Pinus sylvestris* L.	Aromatherapy/Disinfectant
	Spruce oil	*Picea mariana* (Mill.) Britton	Aromatherapy/Added in bath to revive tired muscles/Lowers sadness and mental fatigue
	Tsuga oil	*Tsuga canadensis* (L.) Carr	Analgesic/Antiinflammatory/ Rheumatism (Craft, & Setzer, 2017)
Twigs / Leaves	Myrtle oil	*Myrtus communis* L.	Used in vapour therapy to reduce anger, fear/Cures lungs infection/ Used in making Cures depression, anxiety/ lotion for reducing sebum (*Anonymous, m)*
	Oregano oil	*Oreganum vulgare* L.	Used as insect repellant, to treat gum disease, muscle pain
	Palo Santo	*Bursera graveolens* (Kunth) Triana and Planch.	Used in Aromatherapy for spiritual purifying properties/increases relaxation of mind (Gibson, , 2008)
	Cypress oil (twigs, stem, leaves)	*Cupressus sempervirens* L.	Cosmetics/Boosting the respiratory system/Soothing the mind/Releasing muscle pain/Maintains oily skin troubles (*Anonymous, n)*
Flowers	Jasmine oil	*Jasminum officinale* L.	Aromatherapy/Used for its fragrance
	Rose oil	*Rosa hybrida* L.	Fragrance
	Rosemary oil	*Rosmarinus officinalis* L.	Relives from headaches/Inflammatory diseases/Treating dyspepsia/Muscular and Articular pain (EMA, 2010).
	Cannabis flower essential oil	*Cannabis sativa* L.	Analgesic and anti-inflammatory
	Rock rose essential oil	*Cistus ladanifer* L.	Perfumery

Flowering spike	Clove oil	*Syzyzium aromaticum* (L.) Merr. & L.M. Perry	Aromatherapy/Perfumery/Analgesic for reducing dental pain/Food ingredient/Used as anesthetic compound [Pereira, 2018; Phyllis, 2000)
	Neroli oil (produced from the blossom of bitter orange tree)	*Citrus aurantium* ssp. amara	Brings positive mood/Soothes joints/ helps to resist stress, insomnia and reduce muscle spasm
	Ylangylang	*Cananga odorata* (Lam.) Hook. f. & Thomson	Aromatherapy/Perfumes/Reduces anxiety, sadness, tension, blood pressure/Increase sexual desire/ Promotes hair growth (*Anonymous,o)*
	Chamomile oil (Only two species are used in aromatherapy)	*Chamaemelum nobile* (L.) All. (Roman chamomile)	Relives allergies/hay fever/Asthma/ Reduce swelling/Anti-inflammatory/ Cosmetics/Perfumery
		Matricaria recutita L. (German chamomile)	Aromatherapy/Perfumery/Inhaled for anti-inflammatory and antibacterial action
	Davana oil	*Artemisia pallens* Wall. ex DC.	Flavoring beverages/Perfumery ingredient
	Spike lavender	*Lavandula latifolia* Med./*L. angustifolia* Mill.	Aromatherapy/Fragrance/Skin ailments/Reduce Stress anxiety and depression/Promote calmness/
Flowers/ Leaves/	Helichrysum oil	*Helichrysum aungustifolium* (Roth) G. Don fil.	Muscle aches and pain/Respiratory problem/Creams and lotions for anti ageing properties
Flowering tops/ Leaves	Hyssop oil	*Hyssopus officinalis* L.	Treat head ache/Alleviate symptoms of cold/Reduce sore throat and cough/ Cosmetics industries
Flower/ Stem	Goldenrod oil	*Solidago canadensis* L.	Used in urological problems
	Petit grain	*Citrus aurantium* ssp. *amara*	Used in nervous problems/soothes aches and pains/clear and tone the skin/used in vapour therapy in depression, anxiety/Boost conscious intellectual side (Al-Aamri, 2018)
Fruits	Lemon	*Citrus limon* Linn.	Reduce anxiety and depression/ Relieve pain/Improve cold symptoms
	Bergamot oil	*Citrus bergamia* Risso et Poiteau	Aromatherapy/ Perfumery
	Lime	*C. aurantifolia* (Christm.) Swingle	Anti-inflammatory agents/Used as natural flavouring agent (Al-Aamri *et al*. 2018)

	Sweet orange	*C. sinensis* (Linn.) Osbeck	Inhalation for 90 s causes significant decrease in oxy-hemoglobin which induces psychological and physiological relaxation/reduces knee pain (Igarashi *et al.* 2014; Yip, Y.B. & Tam, 2008)
	Tangerine/ Mandarin orange	*C. reticulata* L.	Aromatherapy/Anti-inflammatory/ Antioxidant (Menichini, 2011)
	Yarrow oil	*Acilleam illefolium* L.	Reduces anxiety, irritabilty insomnia/ Arthritis/Rheumatism (Mojay, 1999; Wood, 1997)
	Star anise oil	*Illicium verum* Hook.	Perfumery/Soap/Toothpastes/ Mouthwashes/Skin creams/ Manufacturing influenza and Avian flu drug "Tamiflu'/Relives muscular aches (*Anonymous, q*)
	Schisandra oil	*Schisandra chinensis* Turcz. (Baill.)/*S. sphenanthera*	Aromatherapy to reduce stress, anxietyand weakness/revitalizes skin and induces mental clarity (*Anonymous, s)*
	Litsea Cubeba oil	*Litsea cubeba* (Lour.) Pers.	Aromatherapy/ Perfumery
Fruit Kernel	Coconut oil	*Coccus nucifera* L.	Used as food/ Nourishing Skin and hair
Fruit rind/ Fruit peel	Orange essential oil (Cold pressed)	*Citrus aurantium* ssp. *amara*	Aromatherapy/ Stimulates central nervous system, lowers blood pressure/Anti-inflammatory, analgesic/ Reduce heart rate palpitations and encourage sleep (Stohs *et al.* 2011; Kang *et al.* 2016)
	Grape fruit oil (Extracted from peel of the fruit)	*C. paradise* Macfadyen	Aromatherapy
	Calamondin oil or Calamansi oil	*Citrus microcapa* Bonge	Mosquito repellant (Soonwera, 2015)
	Lemon oil	*Citrus limonum* L.	Perfumes/Cosmetics/eaux de Cologne
	Orange oil	*Citrus sinensis* (L.) Osbeck	Used in Aromatherapy to treat anxiety, cold, flue, depression, tension, reduce stress and inflammation (*Anonymous, q)*
	Tangerine/ Mandarin oil	*Citrus reticulata* Blanco	Aromatherapy/ Insomnia/ Used to reduce anxiety and Stress (*Anonymous,t)*

Berries	Black pepper oil	*Piper nigrum* L.	Used to reduce Joint pain/Anti-inflammatory/Used in food industry (Ahmad *et al.* 2012; Islam *et al.* 2015)
	Juniper berry oil	*Juniperus communis* L.	Flavor
Seed	Caraway seed oil	*Carum carvi* L.	Mouthwash/Toothpaste
	Cranberry seed oil	*Vaccinium macrocarpum* Aiton	Used in cosmetic industries
	Cardamum seed oil	*Elettaria cardamomum* (L.) Maton	Aromatherapy/Soaps/Perfumes
	Cumin seed oil	*Cuminum cyminum* L.	Perfumes/Cosmetics/Falvoring agent *(Anonymous,u;* Bettaieb *et al.* 2011; *Anonymous,v*)
	Black seed oil	*Nigella sativa* L.	Used as flavor in meat product
	Carrot seed oil	*Daucus carotai* L.	Aromatherapy
	Fennel seed oil	*Foeniculum vulgare* Mill.	Used as flavoring agent in baked foods and beverages/fragrance component in soaps and cosmetics/prevent sun burn/ Memory enhancer and reduce stress (*Anonymous,w)*
	Rosehip oil	*Rosa rubiginosa* L./*R. canina* L.	Used in inflammatory dermatitis/ Reduce oxidative stress/Reduces skin pigmentation/natural skin vitalizer (Michalak, & Kiełtyka-Dadasiewicz, 2018)
	Cinnamon oil	*Cinnamomum zeylanicum* Blume	Used in cosmetics, Food processing/ Treat inflammatory disease (Vangalapati *et al.* 2012)
	Parsely oil	*Petroselinum crispum* Mill.	Soaps/Detergents/Colognes/ Cosmetics/perfumes specially for Men's Fragrances
	Neem oil/ Neem tree oil	*Azadiracta india* Juss.	Used as a contact insecticide/used to control agricultural pests/Used in cosmetics, face masks, sunscreens, soaps and toothpastes (Cox, 2002; Mathur, & Kachhwaha, 2015)
	Coffee oil	*Coffea arabica* L.	Flavor food/Perfumery for its fragrance/Cosmetic industry/ Antidepressant/Boost immunity (*Anonymous,z)*
	Dill oil	*Anethum graveolens* L.	Relieves intestinal spasm/Improves appetite (Duke, 2002; Fleming, (Ed.). 2000)
	Coriander oil	*Coriandrum sativum* L.	Aromatherapy/Flavor industries
	Cubeb oil	*Piper cubeba* L.	Aromatherapy/Calming effect to balance emotion (*Anonymous,1)*

	Anise oil (rich odour of licorice)	*Pimpinella anisum* L.	Used as digestive, carminative and relieve gastrointestinal spasm/used as aromatic agent in sweets and gums (Zargari, 1997; Özcan, & Chalchat, 2006).
	Moringa oil	*Moringa oleifera* L.	Used on skin and hair/Soap/Cosmetics
	Fenugreek oil	*Trigonella foenum-graceum* L.	Cosmetics/improves respiratory health/relives from stress and anxiety/ Maintain skin health in treating acne, blackheads, natural sun repellant and used for protecting from UV rays, reduces blemishes and dark circles (Sina, 1988)
	Mustard oil (Black mustard)	*Brassica nigra* (L.) Koch.	Reduces respiratory problems, inflammation and pain/Enhances skin and hair health
	Mustard oil (Brown ustard)	*B. juncea* L.	Relieves arthritis/Foot ache/ rheumatism
	Mustard oil (White mustard)	*Synapsis alba* L. Synonym: *B. alba* (L.) Rabnen.	Used in neuralgia, aches and pain in rheumatism, sciatica ad lumbago
	Nutmeg oil	*Myristica fragrans* Houtt.	Reduce muscular pain/Reduce rheumatic pain of joints/reduce swelling of joints (Neeraja, & Margaret, 2016)
Nuts	Hickory nut oil	*Carrya illinoensis* (Wangenh.) K. Koch	Aromatherapy/cosmetics/Sunless tanning products
Resins	Asafoetida oil	*Ferula asafetida* L.	Flavor food
	Balsam of Peru	*Myroxylon balsamum* (L.) Harms	Flavor food and drink/Perfumery/ Toiletries
	Elemi oil (comes from oleoresins)	*Canarium luzonicum* (Blume) A. Gray./ *C. ovatum* Engl.	Used as perfume/fragrance ingredient
	Frakincense oil (hardened gum resin)	*Boswellia sacra* Flueck.	Aromatherapy/ Perfumery/Soothes mind/helps in treatment of short breath/bronchitis, cough/High quality incense
	Galbanum oil	*Ferula gummosa* Boiss.	Aromatherapy to treat rheumatism and back ache (Mahendra, & Bisht, 2012).
	Myrrh oil	*Commiphora myrhha* (Nees) Engl.	In aromatherapy it relieves from cold, congestions, coughs, bronchitis *(Anonymous,2)*
Aerial parts	Marjoram	*Origanum majorana* L.	Used in Aromatherapy to bolster the mind/Relives the feeling of grief and loneliness (Vasudeva, 2015)

	Idah grown Tansy	*Tanacetum vulgare* L.	Reduces coughing, sneezing/ Asthma(*Anonymous,3)* Used for spiritual purposes/Relives from stress, anxiety and depression/Treats sciatica/ Insect repellant (*Anonymous,4)*
	Ledum oil	*Ledum palustre* L.	Aromatherapy/Rejuvinates mind and body Used in massage oil and inhalers/reduces Vomiting and Nausea during Chemo (Politeo, 2006)
	Sage oil	*Salvinia officinalis* L.	Used in Aromatherapy to reduce stress and calming the mind, reduce the feeling of anxiety/Natural antidepressant/Ease negative moods (*Anonymous,5)*
	Thyme oil	*Thymos vulgaris* L.	Used as fumigants/Antiseptic/ Antioxidants/Mouthwashes/Suppress coughing/ease chest congestion (Gregory, 2003; Barnes, 2003)
	Mountain Savory	*Satureja Montana* L.	Reduce arthritis joints pain (Breverton, 2011).
Whole Plant	Savory oil	*Saturejahortensis* L.	Aromatherapy/Cosmetics/Soap making
	Tarragon oil	*Artemisia dracunculus* L.	Flavoring food/Antispasmodic/Reduce muscle cramps (Kordali *et al.* 2005)

Table 3: Essential oils produced from plants species with their families

Sl. No.	Plant Species	Family
1	*Abies balsamea* (L.) Miller	Pinaceae
2	*Acilleam illefolium* L.	Asteraceae
3	*Acorus calamus* L.	Acoraceae
4	*Allium sativum* L.	Liliaceae
5	*Alpinia galanga* L.	Zingiberaceae5
6	*Anethum graveolens* L.	Apiaceae
7	*Angelica archangelica* L.	Apiaceae
8	*Aniba rosaeaodora* Ducke	Lauraceae
9	*Aquilaria malaccensisi* Lam.	Thymelaeaceae
10	*Artemisia dracunculus* L.	Asteraceae
11	*Artemisia pallens* Wall. ex DC.	Asteraceae
12	*Azadiracta india* Juss.	Meliaceae
13	*Betula lenta* L.	Betulaceae
14	*B. pendula* Roth.	Betulaceae
15	*Boswellia sacra* Flueck.	Burseraceae
16	*Brassica juncea* L.	Brassicaceae
17	*B. nigra* (L.) Koch.	Brassicaceae
18	*Bursera graveolens* (Kunth) Triana & Planch.	Burseraceae
19	*Cananga odorata* (Lam.) Hook. f. & Thomson	Annonaceae

20	*Canarium luzonicum (Blume) A. Gray. /C. ovatum Engl.*	Burseraceae
21	*Cedrus deodara* (Roxb.) Loud (Himalayan Cedar wood)	Pinaceae
22	*Cannabis sativa* L.	Cannabaceae
23	*Carrya illinoensis* (Wangenh.) K. Koch	Juglandaceae
24	*Carum carvi* L.	Apiaceae
25	*Carum copticum* L.	Apiaceae
26	*Cedrus atlantica* (Endl.) G. Manetti ex Carriere (Atlas Cedar wood)	Pinaceae
27	*Chamaemelum nobile* (L.) All. (Roman chamomile)	Asteraceae
28	*Cinnamomum camphora* (L.) J.Presl.	Lauraceae
29	*C. zeylanicum* Blume	Lauraceae
30	*Cistus ladanifer* L.	Cistaceae
31	*Citrus aurantium* ssp. *amara*	Rutaceae
32	*C. limon* Linn.	Rutaceae
33	*C. microcapa* Bonge	Rutaceae
34	*C. aurantifolia* (Christm.) Swingle	Rutaceae
35	*C. aurantium* ssp. *amara*	Rutaceae
36	*C. aurantium* L.	Rutaceae
37	*C. bergamia* Risso et Poiteau	Rutaceae
38	*C. limonum* L.	Rutaceae
39	*C. paradise* Macfadyen	Rutaceae
40	*C. reticulata* Blanco	Rutaceae
41	*C. reticulata* L.	Rutaceae
42	*C. sinensis* (L.) Osbeck	Rutaceae
43	*Coccus nucifera* L.	Arecaceae
44	*Cochlearia armoracia* L.	Brassicaceae
45	*Coffea arabica* L.	Rubiaceae
46	*Commiphora myrhha* (Nees) Engl.	Burseraceae
47	*Coriandrum sativum* L.	Apiaceae
48	*Cuminum cyminum* L.	Apiaceae
49	*Cupressus sempervirens* L.	Cupressaceae
50	*Curcuma longa* L.	Zingiberaceae
51	*Cymbopogon citratus* (DC. ex Nees) Stapf	Poaceae
52	*C. martini* Roxb.Stapf	Poaceae
53	*C. nardus* (L.) Rendle.	Poaceae
54	*Cyperus scariosus* R. Br.	Cyperaceae
55	*Daucus carotai* L.	Apiaceae
56	*Eucalyptus globules* Labill.	Myrtaceae
57	*Inula helenium* L.	Asteraceae
58	*Elettaria cardamomum* (L.) Maton	Zingiberaceae
59	*Eucalyptus camadulensis* Dehneh	Myrtaceae
60	*Ferula asafetida* L.	Apiaceae
61	*F. gummosa* Boiss.	Apiaceae
62	*Foeniculum vulgare* Mill.	Apiaceae

63	*Gaultheria procumbens* L.	Ericaceae
64	*Helichrysum aungustifolium* (Roth) G. Don fil.	Asteraceae
65	*Hyssopus officinalis* L.	Lamiaceae
66	*Illicium verum* Hook. f.	Schisandraceae
67	*Iris florentina* L.	Iridaceae
68	*Jasminum officinale* L.	Oleaceae
69	*Juniperus communis* L.	Cupressaceae
70	*J. mexicana* Schltdl. & Cham. (Texas Cedar wood)	Cupressaceae
71	*J. virginiana* L.	Cupressaceae
72	*Laurus nobilis* L.	Lauraceae
73	*Lavandula latifolia* Med./*L. angustifolia* Mill.	Lamiaceae
74	*Ledum palustre* L.	Ericaceae
75	*Litsea cubeba* (Lour.) Pers.	Lauraceae
76	*Mentha pipertia* Linn.	Lamiaceae
77	*M. arvensis* Linn.	Lamiaceae
78	*M. pulegium* L.	Lamiaceae
79	*M. spicata* L.	Lamiaceae
80	*Matricaria recutita* L.(German chamomile)	Asteraceae
81	*Melaleuca alterifolia* (Maiden & Betche) Cheel	Myrtaceae
82	*Melissa officinalis* L.	Lamiaceae
83	*Moringa oleifera* L.	Moringaceae
84	*Murraya koenigii* (L.) Spreng	Rutaceae
85	*Myristica fragrans* Houttuyn	Myristicaceae
86	*Myroxylon balsamum* (L.) Harms	Fabaceae
87	*Myrtus communis* L.	Myrtaceae
88	*Nardostachys grandiflora* DC. Syn. *N. jatamansi* DC.	Valerianaceae
89	*Nigella sativa* L.	Ranunculaceae
90	*Oreganum majorana* L.	Lamiaceae
91	*O. vulgare*	Lamiaceae
92	*Ocimum basilicum* L.	Lamiaceae
93	*Pimenta racemosa* var *racemosa*	Myrtaceae
94	*Pimpinella anisum* L.	Apiaceae
95	*Pinus sylvestris* L.	Pinaceae
96	*Piper cubeba* L.	Piperaceae
97	*P. nigrum* L.	Piperaceae
98	*Pelargonium graveolens* L.	Geraniaceae
99	*Perilla frutescens* (L.) Britton	Lamiaceae
100	*Petroselinum crispum* Mill.	Apiaceae
101	*Picea mariana* (Mill.) Britton	Pinaceae
102	*Pogostemon cablin* (Blanco) Benth.	Lamiaceae
103	*Ravensara aromatic* Sonn.	Lauraceae
104	*Rosmarinus officinalis* L.	Lamiaceae
105	*Rosa hybrida* L.	Rosaceae

106	*R. rubiginosa*L./*R. canina* L.	Rosaceae
107	*Satureja hortensis* L.	Lamiaceae
108	*S. montana* L.	Lamiaceae
109	*Salvia sclarea* L.	Lamiaceae
110	*Salvinia officinalis* L.	Lamiaceae
111	*Santalum album* L.	Santalaceae
112	*Sassafras albidum* Nees & Eberm	Lauraceae
113	*Saussurea costus* (Falc.) Lipsch.	Asteraceae
114	*Schisandra chinensis* Turcz. (Baill.)/*S. sphenanthera*	Schisandraceae
115	*Solidago canadensis* L.	Asteraceae
116	*Synapsis alba* L. Synonym: *B. alba* (L.) Rabnen.	Brassicaceae
117	*Tanacetum balsamita* L.	Asteraceae
118	*T. vulgare* L.	Asteraceae
119	*Thuja pilicata* Donn ex D. Don	Cupressaceae
120	*Thymos vulgaris* L.	Lamiaceae
121	*Trigonella foenum-graceum* L.	Fabaceae
122	*Tsuga canadensis* (L.) Carr	Pinaceae
123	*Vaccinium macrocarpum* Aiton	Ericaceae
124	*Valeriana officinalis* L.	Caprifoliaceae
125	*Vetiveria zizanoides* (L.) Nash	Poaceae
126	*Warionia saharae* Benth & Cross	Asteraceae
127	*Zingiber officinale* L.	Zingiberaceae

The essential oil is extracted from whole plant and in the Fig. 1 about 22 plant parts were shown from which the essential oil is extracted and used in aromatherapy. It was observed that leaves are mostly used to extract the essential oil followed by seeds, flowers, roots, fruits, and woods respectively (Fig. 1).

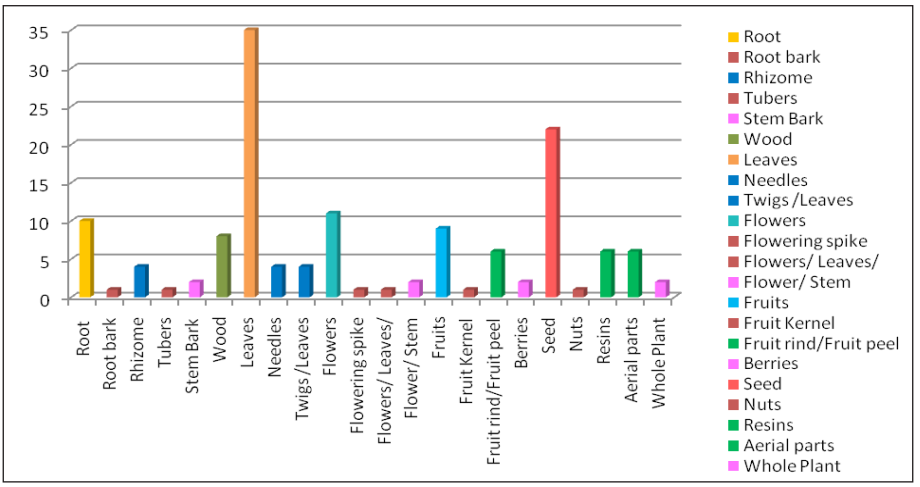

Fig. 1: Essential oil extracted from different parts of plants

These essential oils extracted from different plants are tabulated for their scientific names of the plant and the families they belong (Table 3). It was found that maximum number of plants of about 14.17% belong to Lamiaceae family produce essential oils followed by Apiaceae and Asteraceae each with 12.127% and Rutaceae with 10. 23% (Fig. 2).

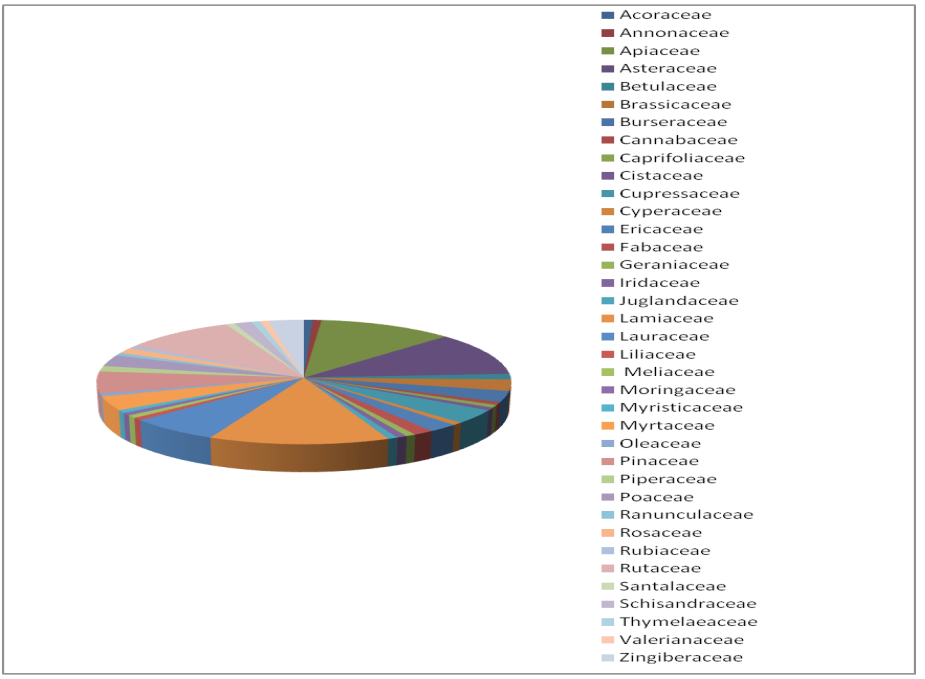

Fig. 2: Percentage of Different Families Producing Essential Oils

CONCLUSION

Volatile oils and other aromatic compounds are used in Aromatherapy to alter mental health and mood of the person. Inhalation therapy of vapors of essential oil has significant role in controlling central nervous system. In this chapter 127 plant species were reported to contain volatile oil that is essential to use in aromatherapy. This chapter revealed that the essential oil can be extracted from root, root bark, rhizome, tubers, stem, stem bark, wood, leaves, needles, twigs, flowers, flowering spikes, fruits, fruit kernel, fruit rind or fruit peel, berries, seeds, nuts, resins, aerial parts and whole plants. This chapter will definitely help the researchers and cosmetics laboratories to know about different essential oil yielding plants as well as the uses of these volatile oils for keeping the psychological and physiological well-being.

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Chapter

4

Traditional Uses of Essential Oils in Aromatherapy

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ABSTRACT

In these times and these days, people used to prefer use of CAM (Complementary and Alternative Medicines) over the standard medical care. Majority of the complementary therapies concentrate on the relaxation and relieving from stress, so in this day and age, people opt for CAM. One of the emerging complementary therapies of the recent days is ''AROMATHERAPY'' which uses the essential oils extracted from different plant pars as the major therapeutic agents. Aromatherapy is holistic alternating remedy that uses the natural plant extracts starting from flowers to fruits, barks to stems, roots to leaves, all parts of the plants contribute to the extraction of essential oils. The main motto of aromatherapy is the absorption and penetration of the essential oils to the human skin surface through inhalation and local application as the name signifies essential oils are much essential on one hand and friendlier on the other hand. Aromatherapy treatment uses different change and blends to get alleviation and unwind from different problems like cerebral pain, stomach ache, conjunctivitis, mononucleosis, indigestion, arthritis, skin allergies, respiratory problems, cardiovascular disorders, urine associated diseases, etc. This review probes the particulars present in the literature regarding the functioning of aromatherapy, its classification different plants used, pharmacological actions and safety issues.

Keywords: Aromatherapy, Complementary, Essential oils, Medicines, Inhalations, Therapeutic

INTRODUCTION

Aromatherapy which is otherwise called "essential oil treatment which has been gotten from the word aroma which implies scent and therapy which means care". This therapy is treated for various arrays of remodification and conditions. Science 6000 years it has been found that many ancient

civilisations like India, Egypt, and China are using this as an admired compatible and auxiliary therapy (Alok *et al.* 2000; Manniche, 1999). The main aim of this therapy is to improve the mood or health of a person which is the familiar method of curing a person's mind, sprit and body. According to NAHA (National Association for Holistic Aromatherapy), they defined "aromatherapy as the therapeutic application or the medical use of essential oils for healing". Aromatherapy uses essential oils from highly concentrated materials which are extracted from various parts of plants as a main therapeutic and are purified from mastrics (Dunning, 2013). From an overview, it has been disclosing that because of its significance and popularity this treatment has increased in various respects in the late twentieth century, it additionally perceived as the treatment of aroma science (Esposito *et al.* 2014). These essential oils which produces characteristic odour that are the mixture of both saturated and non-saturated hydro carbons, alcohols, ketones etc. for which these oils gained the importance in cosmetics, spiritual uses, aromatic, fragrant, and therapeutic (Evans, 1995; Svoboda and Deans, 1994; Schiller and Schiller, 1994; Wildwood, 1996). The essential oils are administrated in little quantity like inhalation, massage in different methods on the skin surface and taken at first seldom (Svoboda *et al.* 1998). For the next day work this therapy uses the essential oils for remove the stress and regenerate the individuals.

On investigating this treatment, it has been found that this treatment shows various consequences for the brain and feelings. As of late, there was a conversation among scientific researchers about its function in mind-set, sharpness, and mental stress on health subjects (Ali1Babar *et al.* 2015). According to the aromatherapist, the importance of essential oils does not match with the synthetic odour as they are insufficient in nature; by the way between the phycologists and biochemists this has been remained as the matter of debate (Dodd, 1998). As synthetic scents for the most part contain aggravations that cause a disturbance in certain individuals so this treatment was found to be better when it is compared to synthetic odour

HOW DOES AROMATHERAPHY WORKS

The aroma particles are the natural plant substances that make the encompassing liberated from illnesses, microscopic organisms (Baratta *et al.* 1998; Baratta, 1998). The essential oils have been identified as a scent with a capability of the body, psyche, and soul. Numerous researchers have archived that character of antiviral, antibacterial, mitigating naturally alongside safe promoter body with hormonal, circulatory, recollections and quieting impacts (Svoboda and Deans, 1995; Svoboda *et al.* 1998; Liu *et al.* 2013). As the potency of the oil is lost, so these oils are known for their specific energy characters.

The incitement properties of these oils lay in their structures which are likeness with genuine hormones (Colgate and Molyneux, 1933). Because of their unpredictable structure and chemical compound, their belongings are likewise complex and unobtrusive. The signals which cause the brain to deliver neuro messages like serotonin and so on communicate to the limbic and hypothalamus part of the cerebrum to connect our nervous and other body to give a sentiment of alleviation and guaranteeing an ideal change. To give anticipated impact on the body, psyche, and soul quieting oil, euphoric, stimulation oil offer delivery to serotonin, noradrenalin, and endorphin (Buchbauer and Jirovetz, 1994).

(a) Classifications of Aromatherapy

According to the study it has been found that the essential oils in aromatherapy has gained their importance in medical, massage, cosmetic, olfactory and psycho aromatherapy.

1. Medical aromatherapy

Rene-Maurice Gattefosse is the founder of modern aromatherapy. Clinically it is found that some of the essential oils are used as the knowledge of the effective essential oils to massage patients during surgery. These oils show effect on promoting and treating clinical ailment (Maeda, 2012).

2. Massage aromatherapy

This therapy is also known as healing touch of massage therapy. During the massage the use of grape seed, almond or jojoba oil in vegetable oil shows the wonderful effect (Soden *et al.* 2004; Chang, 2008).

3. Cosmetic aromatherapy

Cosmetic therapy is one of the easy and successfulways to have personal level knowledge of full body and foot bath. For skin, hair cosmetic products and body utilized certain essential oils in this therapy for which it shows various effects as toning, cleaning, moisturizing, etc.

4. Olfactory aromatheraphy

Enhanced emotion wellness, calmness, relaxation or rejuvenation of people has been resulted as the simple inhalation of essential oil to give rise to olfactory aromatherapy. This therapy relaxes the stress with pleasure which unlock the odour memories (Maeda *et al.* 2012; Price, 1991, 1993).

5. Psycho aromatherapy

In psycho-aromatherapy as well as in traditional medicine as well as herbal medicines by these essential oils certain state of emotion and moods are

obtained by giving the pleasure of pleasant memories invigoration and pleasure of relaxation. These arrangements with the investigation of common fundamental oils (Perry and Perry, 2006).

(b) Plants Used in Aromatherapy

Due to the company of necessary oils in different plants resources, many plants have been recorded to be used in aromatherapy like entire plant, roots, fruit peels, barks, stem, leaves, flowers. Below in the table it has been summarised about a few of the plants used in aromatherapy.

Table 1: Essential oil yielding plants (Battaglia, 2004)

Essential Oils	Parts of the Plant Used
Cinnamon	Bark
Bergamot, Lemon, Lime, Sweet orange, Tangerine, Mandarin	Fruit peel
Jasmine, Neroli (orange blossom), Rose, Ylang-ylang	Flowers
Ginger, Vetiver	Roots
Citronella, Lemongrass, Petitgrain, Palma rosa, Patchouli	Leaves
Geranium, Lavender, Rosemary, Spike lavender	Whole plant

1. Cinnamon

Botanical name: *Cinnamomum verum* J.S. Presl

Family: Lauraceae

Description: Cinnamon essential oil is prized for its lush fragrance and linked with several and health beauty benefits. It is the variety of forms has been on infection control and blood sugar development and indicates that these oils have antibacterial, antifungal, antidiabetic and antioxidant properties. The aroma of Ceylon cinnamon has a very characteristic sweet, warm, spicy, and woody aroma, the flavor is warm, spicy and aromatic, the essential oil also has a sweet, spicy, slightly woody, and clove-like aroma. The major chemical constituents of cinnamon bark oil are cinnamaldehyde (65-80%) and eugenol (5-10%). From the documentation it is found that these oils are used to stimulate circulation, reduce stress, relieve pain, fight off infections, improve digestion, and protect against insects (Peter *et al.* 2018).

2. Lemon

Botanical name: *Citrus limon* L.

Family: Rutaceae

Description: It is a long tree. Its oil constituents in the terpenes, d- limonene and l- lemonine, all together forming about 90% of the bulk of the oil. Remaining 10% is the valuable portion of the oil which consist of oxygenated

bodies, to which the odour of the oil is large and there is 3.5%-5% odour present in the oil. Lemon essential oil is mainly used to accelerated the white corpuscle production and to boost the immune system. It is mainly effective in controlling the vomiting and nausea (Safajou *et al.* 2014; Watanabe *et al.* 2015).

3. Jasmine

Botanical name: *Jasminum sambac* L.

Family: Oleaceae

Description: This type of essential oil contains the plant's aromatic compounds which are believed by some to have various health benefits including skin care and stress reduction. By some of the documents these were recorded as indicators of the arousal level of the autonomic nervous system such as blood pressure, pulse rate, blood oxygen saturation, breathing rate, and skin temperature. Compared with placebo, jasmine oil caused significant increases of breathing rate, blood oxygen saturation, and systolic and diastolic blood pressure, which indicated an increase of autonomic arousal (Google, 2020).

4. Ginger

Botanical name: *Zingiber officinale* Rosc.

Family: Zingiberaceae

Description: Itis widely used as spice and medicinal plant in folk and traditional medicines. Ginger oil is extracted from the ginger rhizome after a distillation process and can also be used in a variety of applications in the skin and hair. Peppermint oil is documented and studied for their anti-inflammatory, fungicidal effect, digestive, stomachic properties etc. (Healthline, 2020).

5. Clary Sage

Botanical name: *Salvia sclarea* L.

Family: Lamiaceae

Description: It is perennial herb, Purple tinted large hairy green leaves. It contains mostly "linalool, linalyl acetate, germacrene D, and geranyl. It helps in controlling the sebum production, hence can be used for both dry and oily skin, along with acne, wrinkles". This oil is utilized for belly and uterus related issues, and it likewise direct the feminine periods, ease pressure and muscle squeezes alongside a tempting and love potion movement (Lis-Balchin, 2006; Sienkiewicz *et al.* 2015).

6. Eucalyptus

Botanical name: *Eucalyptus globulus* Labill

Family: Myrtaceae

Description: The incitement properties of these oils lay in their structure which is likeness to real hormones these oils are utilized to initiate and manage the various frameworks like sensory system for cerebral pain and weakness. The resistant framework supports the insusceptibility against measles, influenza, colds, and chickenpox. Eucalyptus oil helps in restoring the issues identified with respiratory frameworks like Throat diseases, catarrh, hacks, bronchitis, asthma and sinusitis, skin issues like injuries, cuts, consumes, herpes, lice, bug repellent, and bug nibbles, Treatment of rheumatoid joint inflammation, muscle and joint torments and throbs. Treatment of rheumatoid joint agony, muscle, and joint tortures, and hurts. The specialists have exhibited its cell reinforcement, calming, hostile to proliferative and antibacterial exercises, and demonstrated its viability in the treatment of different metabolic and irresistible illnesses (Maxwell, 1995; Sadlon *et al.* 2010; Aazza *et al*. 2014).

7. Citronella

Botanical name: *Cymbopogon nardus (L.) Rendle*

Family: Poaceae

Description: this is made from the distillation of the Asian grass plant. These oils have been used in China and Indonesia for centuries to treat rashes, infections, and other health conditions. Several studies the researchers found that citronella oil has certain antifungal properties that may help debilitate or decimate specific kinds of parasites that can mess well-being up. The investigation found that citronella oil had the capacity to demolish the cell mass of the parasite and execute the living beings inside the cell that can cause infection (Healthline, 2020).

8. Petitgrain

Botanical name: *Citrus aurantium* L.

Family: Rutaceae

Description: It is an evergreen tree with long but not very sharp spines and very fragrant flowers. These trees are mostly found in southern China and north-eastern India. These is unwinding and invigorating, despite the fact that it very well may be calming, contingent upon which mix of basic oils it is mixed with. It likewise assists with issue skin, ordinary burdens, and strains and is regularly used to advance a tranquil night. Petitgrain basic oil is non-poisonous, non-bothering and non-sensitizing (Battaglia, 2003).

9. Geramium

Botanical name: *Pelargonium graveolens* L.

Family: Geraniaceae

Description: This is a perennial hairy shrub which grows upto the height of 1m. The chemical constituents of this essential oil is Eugenol, geranic, citronellol, geraniol, linalol (linalool), citronellalformat, citral, myrtenol, terpineol, methone. This essential oil is used for many purposes such as to "control the emotions, dermatitis, eczema, aging skin, some fungal infections, along with anxiety, stress related problems, nerve tonic, in throat infection, to rectify the blood disorder diabetes, for menopausal associated problems and so on" (Hsouna and Hamdi, 2012).

10. Lavender

Botanical name: *Lavandula angustifolia* Mill.

Family: Lamiaceae

Description: Lavender oil shows its antibacterial and antifungal properties against numerous types of microorganisms, particularly when anti-microbials neglect to work. in fragrant healing, it is all around recorded for the treatment of scraped areas, consumes, stress, migraines, in advancement of new cell development, skin issues, agonizing muscles and boosting an invulnerable framework. It contains "camphor, terpinen-4-ol, linalool, linalyl acetate, beta-ocimene and 1,8-cineole" (Kim *et al.* 2011; Ou *et al.* 2012).

11. Peppermint

Botanical name: *Mentha piperita* L.

Family: Lameaceae

Description: there are about 25 well defined species which are raised to 600 kind of mints. The most common and important species are peppermint and spearmint this oil constituents are carvacrol, menthol, methyl acetate etc. and about 44% methanol is the primary constituent of peppermint oil. Peppermint oil is documented and studied for their anti-inflammatory, fungicidal effect, digestive, stomachic properties etc. by many researchers it has been found that Mentha oil is used for various activities but it is mostly used in aromatherapy needs more effort. This gives relief from many fungal, bacterial infections (Tassou *et al.* 1995; Ravid *et al.* 1994).

12. Roman Chamomile

Botanical name: *Anthemis nobilis* L.

Family: Asteraceae

Description: In cosmetics and aromatherapy, it is employed for many of its

anxiolytic properties. It is one of the prized plants with moderate, potential to clam and bears a deisy of strong emotions like flower. Chamomile preparation helps in the treatment of human ailment like muscle spasms, gastrointestinal disorders, wound ulcer etc. In this aromatherapy, it gives relieve from headache, insomnia, mentual disorder and ease out depression, worry, and overactive mind (Lawless, 1995; Setzer, 2009).

13. Rosemarry

Botanical Name: *Rosmarinus officinalis* L.

Family: Lamiaceae

Description: It is a plant which bears minute light blue blossoms in the pre-summer and late-spring and having three assortments (silver, gold and green stripe)which grows up to the height of 90cm and its green varieties used for are used for medicinal purpose. This oil possesses high-quality actions on the cardiovascular system. In winter, it used to get relieve from cold and rheumatic pain. Some of the other benefits of rosemary includes positive effect on menstrual cramps, provide treatment for dandruff and greasy hair, stimulates for the hair growth, improve cognitive function (Atsumi and Tonosaki, 2007).

14. Tea Tree

Botanical Name: *Melaleuca alternifolia* Cheel

Family: Myrtaceae

Description: This is a shrub of the boggy zone with yellow or purple blossom and needles like leaves. The antiviral movement is with antifungal impacts and antibacterial. It is a safe sponsor due to terpinen-4-ol while cineole is answerable for its clean character. The tea tree itself has antibacterial, calming, antiviral, insecticidal, and resistant energizer properties. The fragrant healing uses the combination of lemon, blue gum, clary sage, eucalyptus, rosemary, ginger and so forth for treatment of various afflictions. The oil is utilized in herpes, sore, rankles skin inflammation, mouth blisters, consumes, bug chomps, dandruff and sleek skin. Cold, fever, influenza and chickenpox have required its utilization (Eisenhower and Farrington, 2012).

15. Ylang Ylang

Botanical Name: *Cananga odorata* Hook. F. & Thoms

Family: Annonaceae

Description: This is a small tree. It is likewise shown in gloom, tension, hypertension, stress. The best property of this tree is fast breathing with ideal use in stun and injury situations and to impede the heartbeat. A pilot study

including 34 experts to check the utilization of ylang-ylang fundamental oil in expanding confidence alongside the modification of circulatory strain and temperature and mitigating the nervousness (Hongratanaworakit and Buchbauer, 1995).

Essential Oil Safety Issue

Most of the essential oils are harmless and either completely free from adverse effects or with minimum adverse effects when used properly with the followed instructions. U.S Food and Drug administration has provided the approval to several essential oils as the safety food additives. Some essential oils are considered to be safe if inhaled and yet may be irritating when applied to skin. The most common adverse effects are found to be eye irritation, skin ailments and sensitization, especially concerned with the oils containing asdehydes and phenols phototoxic, contact sensitization and cross sensitization are the possible effects. The essential oils are accompanied with the essential oils and bring in change about their chemical reaction when stored for a longer time (Tisserand and Balacs, 1995). This is a big dehateable topic about the safety of the essential oils. Majority of the studies explores that use of essential oils in aromatherapy is quite safe on the other studies reveals that usage of essential oil may be cause of airborne contact dermatitis, prepubertal, gynecomastia, etc.

Pharmacological Actions of Essential Oils

Many essential oils were used for variety pharmacological latency. Some of the pharma logical vacations of essential oils were documented in the below table 2&3.

Table 2

Sl. No.	Conditions	Essential Oils
1	End of life agitation	*Lavandula angustifolia* Miller (Lavender) *Santalum album* L. (Chandan)
2	Fatigue	*Citrus aurantium* L. (Madhuranarakam), *Coriandrum sativum* L. (Dhania), *Eucalyptus radiata* (Narrow leaved peppermint) *Mentha spictica* L. (Spearmint garden mint) *Zingiber officinate* Roscine (Ginger'adrak)
3	Insomnia	*Citrus limon* L. Burm f. (lemon), *Lavandula angustifera* Mill. (Lavender) *Ocimum basilium* L. (sweet basil, ram tulsi)
4	Mental disorder	*Mental piperita* L. (peppermint) *Rosmarinus officinalis* L. (rosemary)
5	Pain management	*Lavandula angustifolia* Miller (lavender) *Rosemarinus officinalis* L. (Rosemary)
6	Stress relive	*Citrus sinensis* (L.) Osbeck (Sweet orange) *Ocimum basilium* L. (Sweet basil, Ram tulasi)

Table 3: Biological activity of essential oils

Sl. No.	Activities	Action
1	Antibacterial	Effective against the gram positive and gram negative bacterial. E.g. Basil essential oil- Much impact against *Aeromonas, pseudomona, fluorescens*, etc. Essential oils show positive effect on *Streptococcus* spp, *Fusobacterium* spp, *Staphystococcus* spp.
2	Antifungal	*Melauca alternifolia* (tea tree) has major antifungal activity. Essential oils are effective against *Aspergillus niger*
3	Antiviral	Essential oil of *M. leucadendron* have the antiviral activity against herpes simplex virus type 1.
4	Anti-inflammatory	Tea tree oil reduces the histamine reaction of weal and flare in human. Application of tea tree oil have the ability to reduce the inflammation.
5	Antilice	Tea tree oil are effective against head lice. The insecticidal activity is due to its anticholinesterase potential.
6	Insecticidal action	pestrepellent or poisonousness results were capable for the essential oils of *Nepta parnassica*, on the *culex pipens molestus.*
7	Antidandruff	Many of the essential oils have anti dandruff activity but much studies have not been explored.

CONCLUSION

From the above work it's clearly visualized that aromatherapy is a non-invasive and priceless gift of nature. Starting from physiological to psychological, aromatherapy regulates the new phase of life. From acute stages to chronic stages it acts as the preventive everywhere. Proper research and experimental verification are required for synergistic effects of volatile essential oils. Investigations should be carried out about the time period during which plant contains various volatile oil.

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Chapter

5

Extraction Methods of Essential Oils from Aromatic Plants

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ABSTRACT

Essential oils being the product of aromatic and medicinal plants have drawn attention of researchers to study its phytochemistry, pharmacognosy, pharmacology and more over antimicrobial activities. Essential oils are highly concentrated and the most useful component used in the aromatherapy practice. These aromatic oily liquids are also known as volatile oils, obtained from different plant parts like, vegetative leaves, flowers, fruits, seeds buds, young twigs, hard wood, barks and roots and are extracted from different plant sources by different methods like, steam distillation method, solvent extraction, CO_2 extraction, maceration technique, enfleurage, cold press extraction, and water distillation. This chapter describes about different methods of extraction of essential oils or volatile oils.

Keywords: Aromatic plants, Extraction, Essential oils, Phytochemistry, Volatile oils

INTRODUCTION

WHO (World Health Organization) has estimated that 80% of people worldwide rely upon plant products for their primary health care needs. Essential oils are used in a number of products viz. soaps, cosmetics, pharmaceuticals, confectionary and hard drinks like alcoholic beverages. Essential oil is a highly concentrated hydrophobic volatile chemical compounds, generally liquid in form and sourced from different plants. These essential oils have their unique aromatic componential compounds. Distillation is the main method through which these essential oils are generally extracted. Essential oils are the most

useful component used in the aromatherapy practice in which these volatile components are inhaled by different methods. Near about 3000 different essential oils have been extracted from various plants which are belonging to almost 87 different angiospermic families like, Asteraceae, Geraniaceae, Poaceae, Myrtaceae, Lamiaceae, Rutaceae and Apiaceae (Kochhar, 2016). These essential oils are complex natural mixtures, may consist of near about 20–60 different components in different concentrations (Chouhan, 2017). The dataset of essential oils infers about vast number of essential oil-bearing plants in nature. However, very few essential oil-bearing plants like Lemongrass, Palmarosa, Citronella, Caraway, Rosmary, Eucalyptus, Tea Tree, Ajwain and Lavender essential oils are used by researchers for evaluating its food preservation activity (Burt, 2004) or antimicrobial properties. These extracted essential oils from different plant species are useful in different industries like medicinal, food and processing and cosmetics industries (Zhi-ling *et al.* 2011). Essential oils from different plant species have been traditionally applied in the production of different kind of foodstuffs, herbicides and insecticide production, and in perfumery for its nice fragrances. Since the ancient time periods, these essential oils have been used in different traditional medicinal uses as an agent for diuretics, digestives, sedatives, expectorants etc. (Fornari *et al.* 2012). Technology for production of essential oil is a required field to enhance the production and quality. Essential oils are aromatic and hydrophobic hydro-distillates produced from different plant parts of aromatic plants.. Essential oils are present in different specialized secretory cells and tissues and also in intercellular spaces and diffused on to the plant organ surface (Iriti *et al.* 2006).

A number of essential oils like Palmarosa, Peppermint, Orange, Eucalyptus, Cinnamon, Ajwain and many more are produced from various botanicals. Being secondary metabolites, essential oils have remarkable antimicrobial activity against many numbers of bacterial fungi and more over viruses. The effectiveness is because of presence of different alkaloids and other antimicrobial compounds. The nature, components, and arrangement of its functional groups manipulate reactivity of essential oil (Swamy *et al.* 2016). In Asia and Australia more than 100 species of plant genus occur. The volatile oils are employed in food and flavoring industry for their sweet and strong essence. Essential oils have been used for several purposes in number of cultures all over the world. Aromatic oils have been used in preparation of cosmetics, ointments, perfumes and medicines through mixture of different herbs (onion, grapes, myrrh etc.) and their form of preparations. In traditional medicine history (between 3000 and 2000 BC) in country like India and China almost 700 or more than that substances including ginger, cinnamon, sandalwood etc. were recorded, in Greek medicinal history (500-400 BC) the major source of essential oil yielding plants like saffron, thyme,

cumin, peppermint etc. were used. The active chemical substances of different medicinal plants like, caffeine, morphine, quinine, lavender, peppermint, myrrh etc. used in 18th and 19th centuries has been documented by different chemists for their important role on biological systems (Elshafie, & Camele, 2017). The *Lavandula* genus, Lavender (*Lavandula angustifolia*) is well known for its aromatherapy products like perfumes, cosmetics, food processing cultivated worldwide. The mineral- and carbon-rich plant residues act as fuel source and soil replenishment. Lavandin straws are used in industrial application for production of antioxidants and other bio-products (Elshafie, & Camele, 2017). Various aromatic compounds in the essences of wild oregano from *Origanum*, black thyme and wild savory from *Satureja* species possess strong antibacterial activity, which act as natural antimicrobial agent against food borne pathogens (Baydar *et al.* 2004).

As essential oil is constituted with a number of active constituents, authors have published about its antimicrobial activity [Feng *et al.* 2017; Kaskatepe *et al.* 2016). Further studies (Fermino *et al.* 2018; Zhang *et al.* 2016; Nabavi, 2015; Urbaniak, 2014) reported the antibacterial activity against Gram positive as well as Gram negative bacterial cells and inferred about its growth inhibitory activity against strains of *Escherichia coli, Staphylococcus aureus, Streptococcus pyogenes* and so on. It is important to bring a fact that conventional antibiotics have already conquered the throne in the antibacterial therapeutic world. When the essential oils are opted as alternative to conventional antibiotics, it is necessary to carry out comparative studies related to respective antibacterial activity. A comparative study is an essential step in drug molecule evaluation process because conventional drugs although in the priority list but certain draw backs like side effects are important factors to consider. This is further to mention that there is geographical impact upon the content and percentage of essential oil components in specific essential oil (Pattnaik *et al.* 1999) which is reflected in degree of antibacterial activity. More so the bacteria present in clinical scenario always undergo a genomic dynamism due to mutation or horizontal gene transfer events. Therefore, the antibacterial agents should be evaluated for their degree of efficacy against new strains of bacteria prevalent in hospital system. Apart from the antimicrobial activity, the essential oils is having many medicinal properties and also used in aromatherapy to get rid from different ailments (Bozin *et al.* 2006).

Extraction Methods of Production of Essential Oils

Essential oils are isolated from different plant sources when subjected to solvents by different methods like, steam distillation method, solvent extraction, CO_2 extraction, maceration technique, enfleurage, cold press extraction, and water distillation.

Steam Distillation Method

Steam distillation is the most accepted method for extraction of essential oils from plant parts. In this process, the steam vaporizes the plant materials volatile compounds after condensation. A big sized steel container is taken in which the raw plant material is kept and steam is added to it. By an open inlet, steam is inserted through the same plant material containing the target essential oils, releasing the aromatic bio-molecules and converting them into form of vapor. Then the vaporized different compounds from the plant materials move to the condenser. Here, two individual pipes are used, one to exit the hot water and another to enter cold water across the condenser. This technique cools back the vapor into liquid form. The aromatic by-product liquid drops slowly from the condenser and are collected inside a receiver, known as separator present underneath it, now the essential oil which floats on the top of the water is siphoned off and collected (Kaufmann & Christen, 2002).

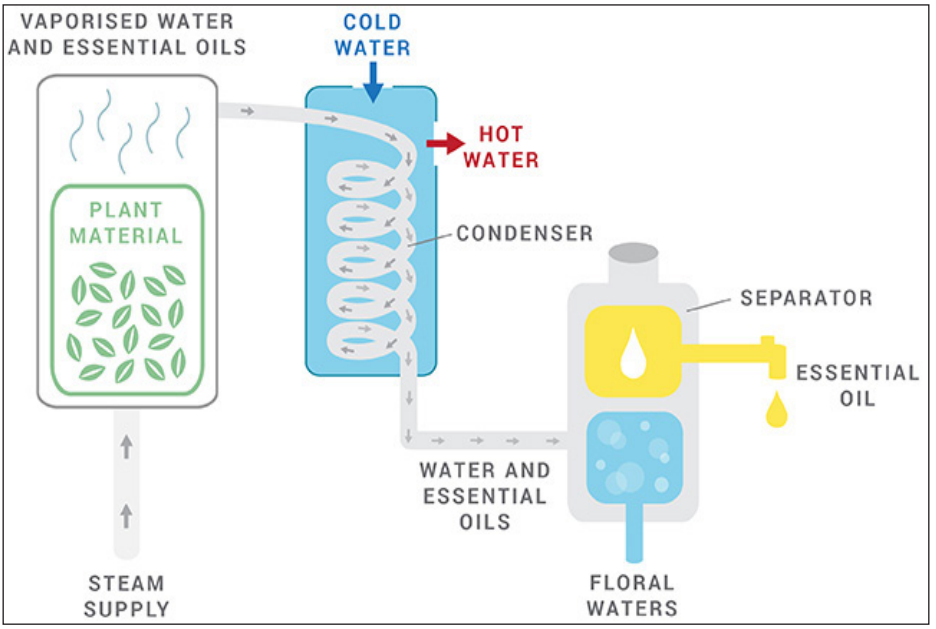

Fig. 1: Steam Distillation Process (*Anonymous, a*)

Solvent Extraction

Chemicals like hexane and ethanol is used in this method to isolate essential oils from different plant materials. This method is used when essential oil is in very low quantity inside plants. In this method a waxy aromatic compound known as concrete is formed when the plant material is treated with solvent, now this concrete is mixed with alcohol and that causes release of oil

particles. Thus, the released essential oil components are isolated by different techniques (Richter, & Schellenberg, 2007; Fig. 2).

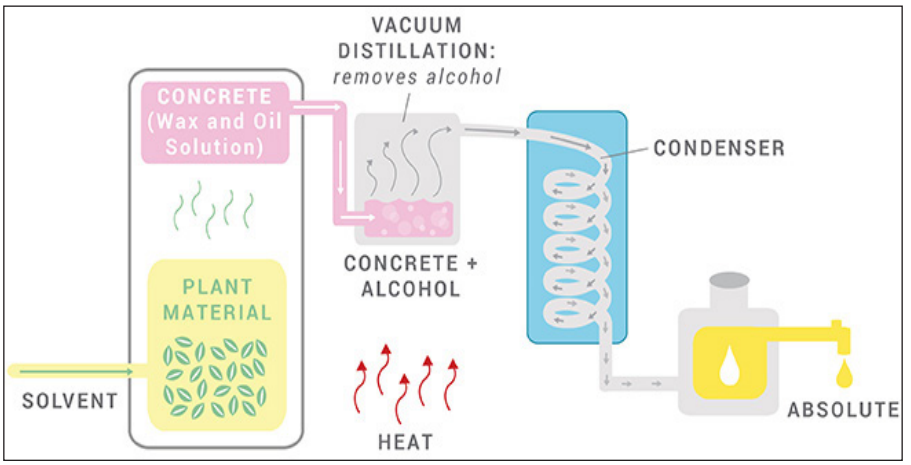

Fig. 2: Solvent Extraction Process (*Anonymous, a*)

CO_2 Extraction

It is the nearer method to normal steam distillation method but the only difference is that here CO_2 is used as a solvent in place of steam. In this method the isolated oil and plant residues are turned into different coloration due to reaction with CO_2 (Bagheri *et al.* 2014; Fig. 3).

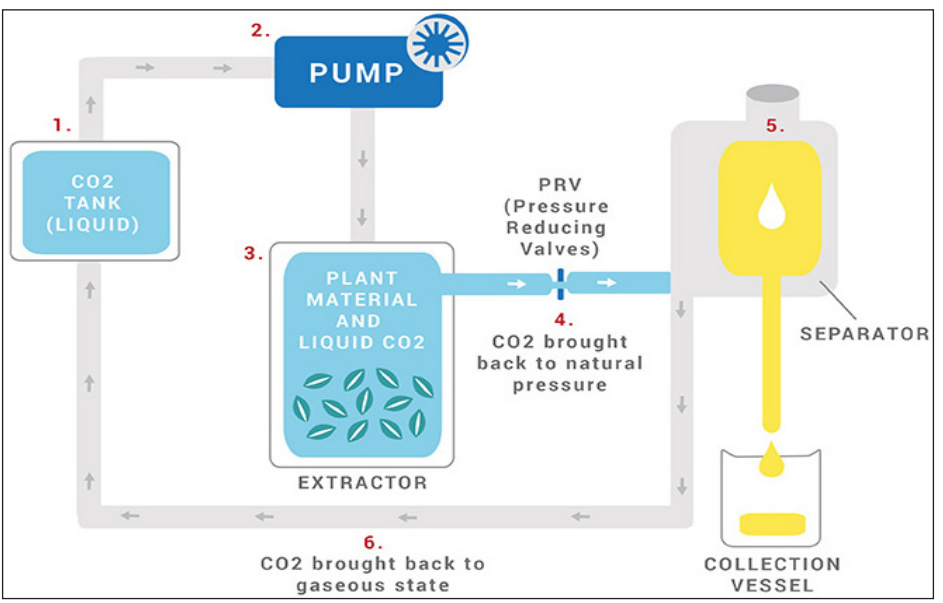

Fig. 3: CO_2 Extraction Process (*Anonymous, a*)

Maceration

Maceration is one of the unique methods of essential oil extraction, it is performed when different carrier oils are utilized as the solvent for extract the therapeutic chemicals from plants. This method is better than normal distillation method as it captures heavier and larger organic plant molecules. The collected plant materials are cut very finely and crushed into a medium type of coarse powder.

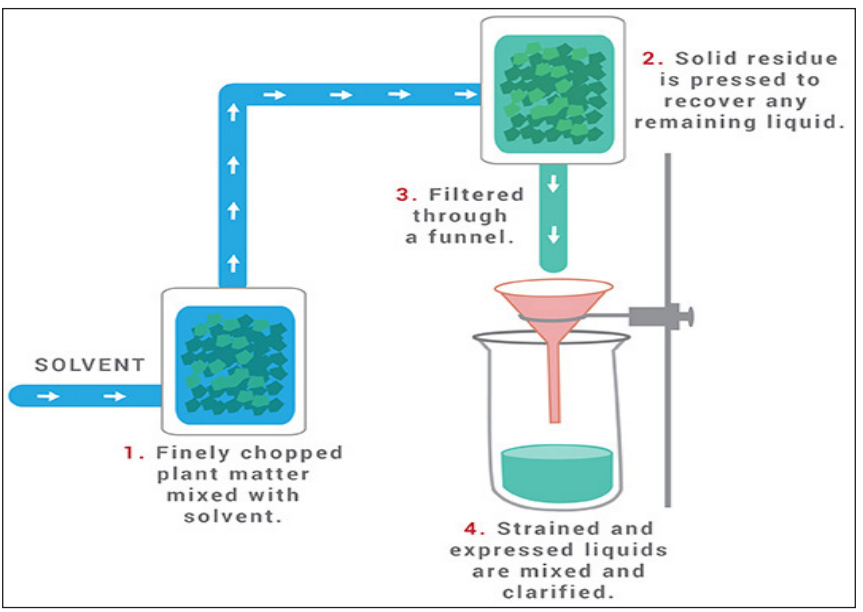

Fig. 4: Maceration Extraction Process (*Anonymous, a*)

Now the plant material is kept inside a closed vessel. On the material, solvent known as menstruum is added. The same mixture is then kept without any disturbance almost for 1 week. Now the liquid is strained and this strained liquids are mixed properly and filtrated through filtration (Veillet *et al.* 2010; Fig. 4). Hydro-distillation, solvent extraction, Supercritical fluid extraction (SFE), Gas chromatography (GC), Gass chromatography/mass spectrometry (GS/MS) are different extraction methods of aroma-active components of plants (Kokoska *et al.* 2008). Essential oils by hydro-distillation (HD) and dry steam distillation proved to be more effective to gram positive than gram negative bacteria followed by microdilution method and gas chromatography (Richter *et al.* 1996). Extraction of rosemary essential oil was carried out by steam distillation and hydro-distillation to identify the components /chemical composition of essential oils of the plant. In this experiment it was resulted that steam distillation was an acceptable process which gave more product / oils than hydro-distillation (Boutekedjiret *et al.* 2016). To extract essential oils

from lemongrass leaves, solvent extraction methodology is approached. In this experiment they used lemongrass as a sample to extract essential oil and two types of methods, these were solvent extraction and steam distillation and it was also recorded that solvent extraction produce higher amount of essential oil than steam distillation method (Suryawanshi *et al.* 2016). In the extraction of essential oil from herb cinnamon (*Cinnamomum zeylanicum*) they used two methods like steam distillation and soxhlet extraction, in steam distillation water used as solvent and in soxhlex ethanol used as solvent. In this work, it was noticed that steam distillation produced best standard of essential oil than soxhlet extraction method. In this experiment high performance liquid chromatography (HPLC) was used to determine the composition of essential oil (Wong *et al.* 2014).

Enfleurage Method

Enfleurage essential oils are very rare**.** This is an old technique of extracting aromatic oils from flowers. Petals and other fragrant plant parts are soaked in fats or vegetable oils that absorb the aromas. Extraction with cold fat is enfleurage and hot fat is known as maceration. On the early days animal fats like pork, beef and lard fats were used in 19th and early parts of 20th century. A very few producers used vegetable fats like palm oil. In the ancient time, animal fat was smeared on glass plate in a wooden frame called as chassis and flowers were kept on the purified fat and left for several days to release their oils. The process was repeated many times and the fresh flowers were added after removing the previously dipped flowers. This process was repeated until the fat on the plate was completely saturated with the aromatic oils of the flowers. The oils are recovered from the fat by washing the solution with alcohol (Website; Bauer *et al.* 2001; Fig. 5).

Fig. 5: Enfleurage Method of Essential Oil Extraction (*Anonymous, a*)

Cold Pressed Method or Expression Method

Cold pressed method or expression method is only used in the production of citrus oil. Expression refers to the physical process, in which the essential oil glands in the peel are crushed against a hard object which was placed under a large natural sponge or by bending the peel into the sponge to release the oil. The oil emulsion was removed from the sponge by squeezing in to other container (Fig. 6). This oil retains the characteristics fruit odour than the oil produced by other methods.

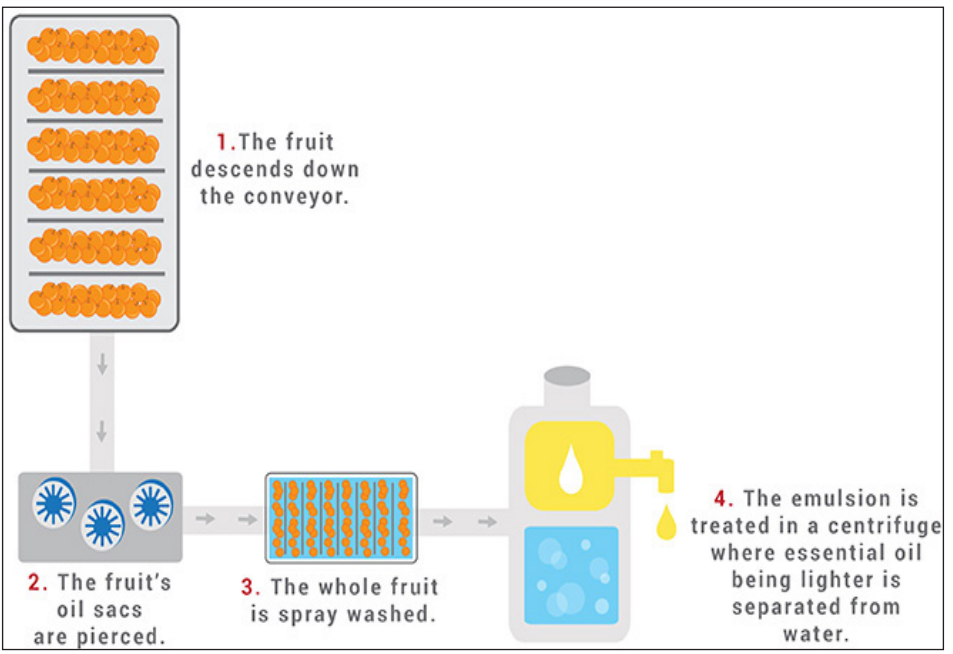

Fig. 6: Cold Pressed Method/ Expression Method of Essential Oil Extraction (*Anonymous, a*)

Super Critical Fluid Extraction

Super critical Fluid Extraction is the process of separating one component from other using supercritical fluids as the solvents. CO_2 is the most used supercritical fluid and sometimes co solvents like methanol or ethanol can be used. Conditions for extraction of super critical CO_2 are above the critical temperature of 31°C and critical pressure is about 74 bars. This condition varies after addition of modifiers. Volatile oils can be extracted from a plant with low pressure of about 100 bars. Lipids can be removed by using pure CO_2 at high pressure (Tanaka & Takeshi, 2004; Fig. 7).

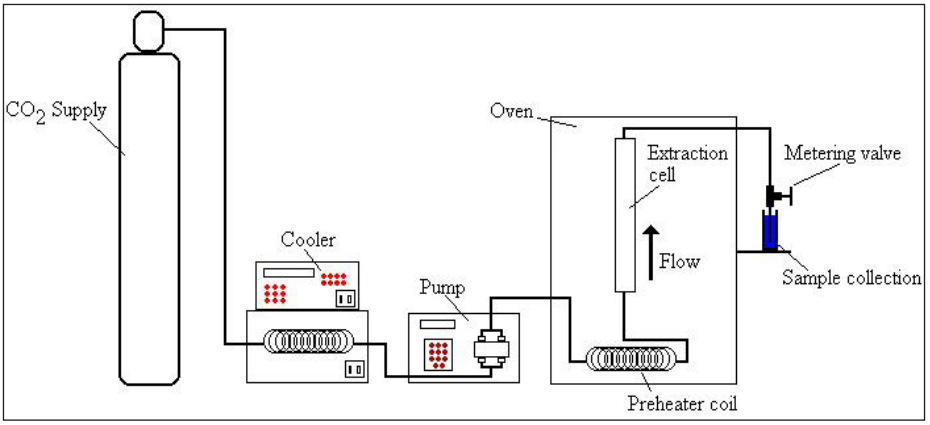

Fig. 7: Schematic diagram of Super Critical Fluid Apparatus (*Anonymous,b*)

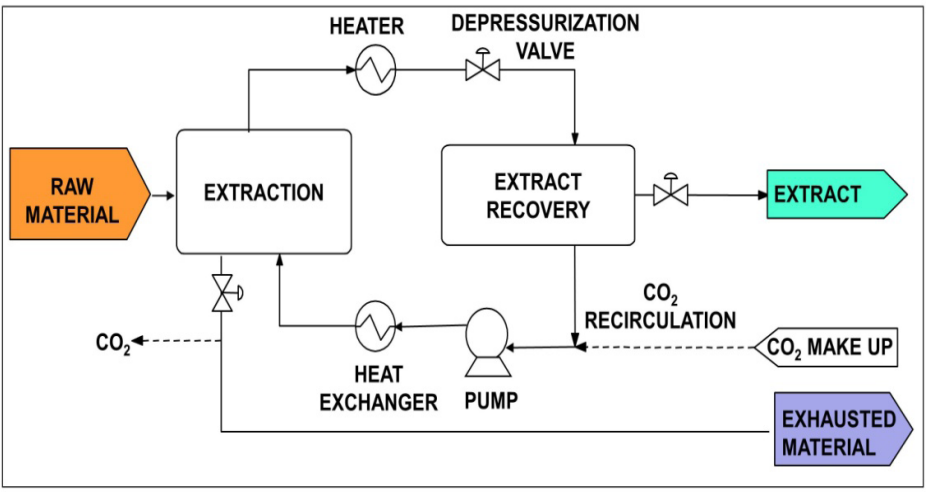

Fig. 8: Block Diagram of Super Critical Fluid Extraction (*Anonymous,c*)

Water Distillation

The most effective method of extraction is to submerge the delicate plant material in pure boiling water, as in steam distillation the delicate flowers such as roses and orange blossoms clump together when subjected to steam. The water protects the extracted oil from overheating. The liquids cool down by condensation and separated from each other. The remaining water is fragrant and known as hydrosol, hydrolate, essential water, floral water or herbal distillate (Fig. 9).

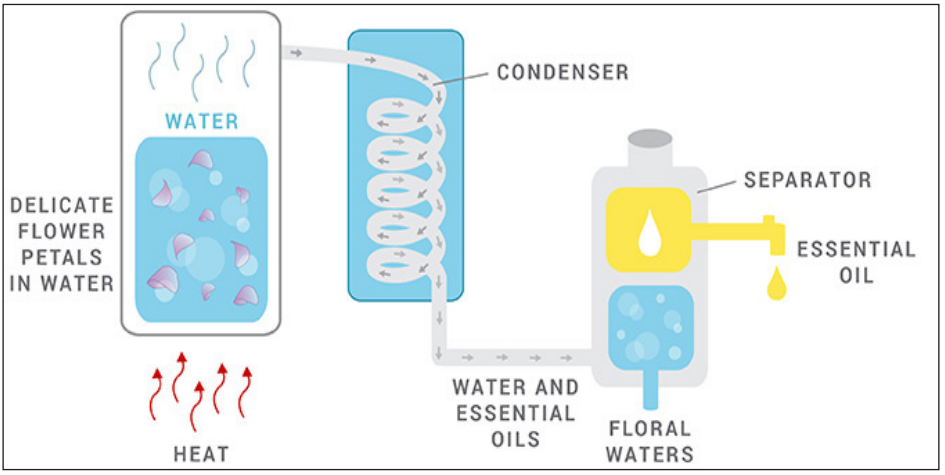

Fig. 9: Water Distillation Extraction (*Anonymous,c*)

CONCLUSION

Essential oils, one of the most useful plant products can be extracted by different biochemical a physical methods, the major concerning matter is the use of that components of essential oils in medicinal activities. Major constraints in sustainable industrial exploitation of medicinal and aromatic plants are due to poor agricultural practices of medicinal and aromatic plants. The process of extraction determines the quality and production of essential oils as the extraction process affects the physical properties and chemical composition. Efforts should be made to produce batches with quality as consistent as possible.

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Chapter

6

Essential Oils Extracted From CO_2 Extraction Method

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ABSTRACT

Essential oils are aromatic liquids composed of terpenes, aldehydes, fatty acids, phenols, sulphur and nitrogen components derived from the plant material. Essential oils are used in cosmetics, perfumes, medical industry. It has antimicrobial, antioxidant, immunomodulatory, anti-cancerous, anti-microbial activity. Oils derived from the medicinal plants are non-toxic to normal cells which modulates the immune system. They play a major role in drug discovery. It retains the aroma of the original plant. There are many methods for extraction of essential oils. Steam distillation method is one among them and considered as the most common and efficient method. Supercritical CO_2 method is used for the extraction of pure, clean and safe essential oils which separates various metabolic components from the plant material. Supercritical CO_2 is regarded as the industry's gold standard which can show both the properties of liquid and gas. This method is carried out above critical temperature of 31 degree Celsius and 74 bar of critical pressure. Its main advantages includes faster separation speed, high productivity, CO_2 can be recycled. Extracts recovered by supercritical CO_2 extraction can be analysed by GC-MS analysis method. GC-MS has the ability for separation of complex mixtures and tracing very tiny level of contamination. This study revealed the significance and usefulness of essential oil which provides an approach towards better quality product composed of superior bioactive constituents.

Keywords: Antimicrobial, CO_2, Essential oils, GC-MS, Medicine

INTRODUCTION

An essential oil is defined as concentrated hydrophobic liquid which contains volatile chemical compounds derived from plants. The term "essential" means the characteristic fragrance of the plant or the essence of the plant's

fragrance (Tyagi, 2018). Essential amino acid or essential fatty acid are nutritionally required by living organism whereas essential oil captures the plant's scent and flavour, or "essence." Hence, these are not related and have different roles to play (Reeds, 2000*).* Essential oil derived from different plant species contains varieties of chemical composition which may vary from species to species. Essential oils contain much greater levels of active ingredients which gives them stronger smell than the plants from which they are extracted. Essential oil extraction depends on the amount of plant matter as higher amount of plant needed for much finer extraction. Till today, 3000 Eos have been extracted from different plants are known (Thosar *et al.* 2013). Many medical problems has been treated since ancient times as it acts as antibacterial, antifungal, and antioxidant properties and contains many secondary metabolites (Baratta *et al.* 1998; Hammer *et al.* 1999).

WORKING PRINCIPLE (Kalemba and Kunicka, 2003)

Essential oils can only be used by inhalation or dilution method and applied to the skin. During inhalation, it stimulates sense of smell and during dilution it is applied on skin which gives medicinal effects when absorbed.

The chemicals constituents present in essential oils can associate with the body in various ways.

1. Some necessary plant chemicals are absorbed when applied on skin. Essential oil best works when applied with heat or to different areas of the bodyas this application method improve absorption of chemicals.
2. The limbic system which is a part of brain plays major role in emotions, behaviours, sense of smell, long-term memory and heavily involved in forming memories. Inhalation of aromas of the essential oil leads to stimulation of limbic system
3. The limbic system has many other functions. One among them is controlling several unconscious physiological functions, such as breathing, heart rate, and blood pressure. Therefore essential oils play a role in applying a physical effect on the body.

DO THEY WORK?

Essential oils (EOs) have been utilised in many purposes such as in treatment of various ailments to establish their efficacy and possible side effects and have gained popularity over the years (Kalemba and Kunicka, 2003). Recently, many research works shows positive results on the benefits of essential oils as mood elevators or stress relievers but there is no evidence-backed research which shows the benefits of essential oils in curing any illness. According to a study in the Journal of Clinical Psychiatry, there is evidence on the usefulness

of lemon essential oil on dementia. The study shows positive results in treating dementia by using balm of lemon oil which reduces agitation in patients.

There are many other research works regarding essential oils benefits which shows a positive results in the treatment of acne with tea tree oil and the treatment of alopecia area or hair loss with oils like thyme, rosemary, lavender and cedar wood. Studies found that citrus fruits derived essential oil shows inhibition in bacterial growth in mice when combined with Dead Sea salts and act as an anti-inflammatory agent. Another study shows results regarding the prevention and fight of the growth of common causes of food poisoning like *E. coli*, and staphylococcus by citrus essential oil bergamot. Many studies showed positive results regarding the ability of essential oils to be developed as preventive or therapeutic agents for various oral diseases. However, clinical trials are necessary to establish their safety and efficacy so that it can be brought into practice to cure diseases and potentially prescribed by physicians (Baser and Buchbauer, 2015).

HISTORY OF ESSENTIAL OILS PRACTICE

Ancient Aromatherapy: History revealed that the true birthplace of essential oils, or 'aromatherapy' was ancient Egypt. As early as 4500 BC the Egyptians cultivated many different varieties of plants for their essential oils extraction by using solvent extraction method (Enfleurage) in which animal fat is used and the extracts used extensively in their religion, in cosmetics, in ointments as well as for medicinal purposes. This method also uses aromatic essence and resins. A mixture of different sources of herbal preparations such as aniseed, cedar, onion, myrrh, and grapes in perfume or medicine was made by Egyptians (Baser and Buchbauer, 2015). During extraction process, distillation "pots" was used which have been found dating back about 3,500 BC.

Many varieties of herbs and aromatic plants were investigated by China and India. Between 3000 and 2000 BC, traditional Chinese and Indian medicine first recorded the use of more than 700 essential oils including cinnamon, ginger, myrrh, and sandalwood which shows effective for healing purposes. Hence, aromatherapy becomes an important part of the Indian Ayurvedic medical system. Ancient Greeks adopted the intelligence of the Egyptians and became the most well-known physician of that time. Hippocrates (460-377 BC) included massage in many of his therapies in treating a patient. Between 500 and 400 BC, the use of different Eos such as thyme, saffron, marjoram, cumin, and peppermint was showed first time in Greek history. Romans were great follower of hygiene to support health and therefore adopted the Greek's knowledge by taking popular aromatic baths (Pauli and Schilcher, 2010).

A great success was achieved in "curing leprosy" with plant extracts by Physician, Paracelsus (1493-1541). French chemist and perfumer Rene Maurice Gattefosse first coined the term "aromatherapy" in 1937. In 1910 while conducting experiment in his laboratory his hand was burned badly. He medicated his hand with pure undiluted lavender oil which immediately eased the pain without any sign of infection and heal the hand. During that time he found that minute amounts of essential oils which was absorbed by the body interacts with the body's chemistry and helps in curing processes. Ibn al-Baitar (1188–1248), an Al-Andalusian (Muslim Spain) physician, pharmacist and chemist used earliest techniques and methods to produce essential oils (Houtsma, 1993*).*

Modern Aromatherapy: Research work during the 18th and 19th centuries shows many active components such as caffeine, quinine, morphine, and atropine present in medicinal plants. These active substances were considered to play an important role in their biological effects (Tisserand and Balacs, 1995). Modern research works found methyl salicylate as specific chemical compounds of the essential oils rather than "oil of wintergreen". Medical applications are proposed to use medicinal oils solely based on their historical accounts which ranges from skin treatments to remedies for cancer. It is claimed that most countries regulates the efficacy of medical treatments and treatment of cancers (Klaassen and Amdur, 2013).

USES

Use in Aromatherapy: Aromatherapy is regarded as a common form of alternative medicine. This alternative medicine derived from the aromatic compounds present in essential oils and other plant extracts is useful in healing effects. There is no sufficient evidence regarding essential oils that can effectively useful in inducing relaxation. Studies lacks evidence in the treatment or curing of any chronic disease or other illnesses using essential oils. But can be used in perfumes, cosmetics, soaps, for flavouring food and drink, for adding scents to incense and in household cleaning products (Lee *et al.* 2012).

Use as pesticide: Essential oils is used as a pesticide against pests, specifically insects and select arthropods. When the oil is consumed it shows deterring effects such as repelling, inhibiting digestion, stunting growth, decreasing rate of reproduction, or death of pests (Regnault-Roger *et al.* 2012). Essential oils have been used for crop or indoor plant protection, urban pest control (Ismam, 2000*)* and insect repellents, bug spray. DEET is currently used as the most effective mosquito repellent pesticides which are effective in the vapour stage when applied to the skin (Nerio *et al.* 2010*).* Essential oils have both ecological benefits such as decreased residual actions and economical

benefits such as diverse market values (Regnault-Roger, 1997*)* and increasing popularity among organic farmers and environmentally conscious consumers *and hence used* as green pesticides (Koul *et al.* 2008)

Stress and anxiety: Aromatherapy is used by 43% of people as an alternative therapy to help relieve from stress and anxiety (De Sousa *et al.* 2015). Many studies have shown positive results towards the treatment of anxiety and stress by using the smell of some essential oils which work along traditional therapy (Goes *et al.* 2012). Many reviews show uncertain evidence on using essential oils in the stress- and anxiety-relieving effects (Lee *et al.* 2011). Hence, found out that anxiety cannot be treated using aromatherapy (Lee *et al.* 2012). While during massage essential oil uses may help relieve stress but may last during massage time only (Steflitsch *et al.* 2015).

Headaches and migraines: Research studies observed during 90's that headache pain can be relieved by mixing peppermint oil and ethanol oil and dapping on person foreheads and temples (Gobel *et al.* 1995). In addition, recent studies shows positive results that applying peppermint and lavender oil to the skin can reduce headache pain (Sasannejad *et al.* 2012). Headache remedy has been suggested by traditional Persian that headaches and migraines can be treated by applying a mixture of chamomile and sesame oil to the temples (Zargaran *et al.* 2014).

Sleep and insomnia: Studies shows that by smelling lavender oil improves the sleep quality of women after childbirth, as well as patients with heart disease (Karadag *et al.* 2017). Many research studies found out positive results on smelling the oils mostly lavender oil which help in sleep habits (Lillehei and Halcone, 2014).

Use in reducing inflammation: Essential oils has the ability to fight against inflammatory conditions. Anti-inflammatory effects is present in essential oil has been proved by studies. Research work conducted on mouse discovered that the remission of colitis can be induced by ingesting essential oil in combination of thyme and oregano. Similar results found on ingesting caraway and rosemary oil while conducting experiment on rat (Keshavarz *et al.* 2013).

Use as Antibiotic and antimicrobial: Test-tube studies show positive results regarding their antimicrobial effects when treated with essential oils, such as peppermint and tea tree oil (Yap *et al.* 2013).

Other uses: Essential oil is not meant only for Aromatherapy but can be useful in many activities such as to scent homes, to freshen up things like laundry, to add natural scent in homemade cosmetics and high-quality natural products. Another uses of essential oil is that citronella oil has the ability to provide protection against certain types of mosquitoes for around 2 hours but when

used in combination with vanillin can extend the protection up to 3 hours. Furthermore, studies regarding the properties of essential oils indicate that the shelf life of foods may extended industrially by using some oil. Essential oils may lead to allergic reactions, skin irritation and can harm children when use improperly (Vergis *et al.* 2015).

SIDE EFFECTS

Plants and herbal products are natural which does not mean that it can't be harmful. The extracts derived from natural products found to be rich in many bioactive compounds that can cause harmful effects. The possible side effects of using essential oils are as follows:

- **Its use can lead to irritation and burning**
- **Asthma attacks**: People suffering from asthma may lead to breathing problem while inhaling.
- Headaches can be relieved after inhaling essential oil but may lead to headaches problem when inhaled too much.
- It can cause rashes.
- Its uses may cause allergic reactions in the body.

The most common side effect of using essential oil is a rash which has been associated with more serious reactions, and can lead to death (Kaddu *et al.* 2001). The oils such as lavender, peppermint, tea tree, and ylang-ylang have been associated with adverse reactions. Some oils such as cinnamon are high in phenols which may cause skin irritation and therefore mixture with base oil should be used on the skin. Meanwhile, oils extracted from citrus fruits are photosensitizers which may lead to increase in the skin's reaction to sunlight and burns. Swallowing essential oils is prohibited, as it can cause harmful effects. Pregnant or breastfeeding women are usually suggested to avoid use these oils. Essential oils can cause severe irritation, allergic reaction and hepatotoxic effects when applied directly to the skin therefore it is advised to use them in diluted form (Flaman *et al.* 2001).

Flammability: Many oils have a flash point of 50–60 °C such as tea tree, lavender, and citrus oils therefore they are called as Class 3 Flammable Liquids.

Gynecomastia: Gynecomastia is an abnormally enlargement or swelling of breast tissue in prepubescent boys. In some cases, lavender oil may be involved in causing this enlargement which was concluded by two published research reports. In 2018, *in vitro* study of tea tree oil and lavender oil founds eight substances which reports estrogenic and anti-androgenic activity i.e., shows increase in the level of estrogens and decrease in the level of testosterone when tested in tissue culture experiments (Tisserand, 1978).

Handling: Dermatitismay caused by essential oilexposure. Essential oils can lead to negative impact towards rubbers and plastics handle therefore it is safe to use glass syringes. Chemistry syringes known as a positive displacement pipette in which arrangement of seal and piston is their which slides inside the pipette, wiping the essential oil off the pipette wall which resist essential oil. It facilitates quality control as these are long enough to enter deep vessels, and have fine graduations (Trattner *et al.* 2008).

Ingestion: It can lead to toxic effect in pregnant women. Some essential oil is used as GRAS flavouring agent. Foods, beverages and confectioneries flavours are given by these agents (Nordin *et al.* 2004).

Pesticide residues: Pesticides residues are present in essential oil in trace quantities. Therefore it is suggested to use the oil in tiny quantities and usually in high dilutions (Menary and Menary, 2008).

ESSENTIAL OILS EXTRACTION METHOD

Steam and water distillation method is generally used for the extraction of essential oils. Expression, solvent extraction, *sfumatura*, absolute oil extraction, resin tapping, wax embedding and cold pressing are other methods used for extraction process. Essential oils can able to hold the natural smell and flavour of their source which when obtained through mechanical pressing or distillation. For example, a pound of lavender oil is produced from 220 pounds of lavender flowers can retain the smell and flavour. When a plant material is dissolved to a solvent and becomes infused that it pulled from the source plant. The oil is extracted from the solution that remains at the end of the process. The solvents can play a role in helping plant cells to break down and release their contents and therefore act as preservatives or as agents. The extraction methods are as follows:

Steam Distillation: is widely used method for extraction and isolation of essential oils from plants. This method is also known as hydro-diffusion as it forces steam in from the plant material. This process startswith the plant material's volatile compounds vaporised by steam which eventually undergo through a condensation and collection process. When steam is allowed to pass through raw plant materials into a cooling chamber causing them to release their aromatic compounds. The vapour turns back into liquid when the steam and plant vapour allowed to cools down, this cause separation of the water and the essential oil. Floral water or hydrosol is the water-soluble parts of the plant which is used in cosmetics products to moisturize the skin. The advantage of using distillation extraction method is that at temperature below melting point distillation of volatile components can be done, denaturing of the plant is avoided and the product is easily separated from the water (Aziz *et al.* 2018).

Water distillation: This method starts in a still chamber where heat is applied to the plant material immersed in water. It is also known as hydro-distillation method as it occurs by submerging the material in water.

Solvent extraction: Food grade solvents like hexane and ethanol is used to isolate essential oils from plant material in this method. It is best suited for plant materials that yield low amounts of essential oil, that are largely resinous, or that are delicate aromatics which are too delicate to be distilled particularly delicate flowers such as jasmine and unable to withstand the pressure and distress of steam distillation. This method also produces a finer fragrance than any type of distillation method. The plant materials are dissolved in a solvent such as benzene or di-methyl ether and the solvent is then evaporated off leaving behind plant oils referred to as "absolutes". Absolutes are highly concentrated aromatic substances that resemble the natural aroma of the plant and are more coloured and viscous than essential oils. These are most often used in the cosmetic and perfume industries due to their strong aromas.

CO_2 Extraction: Supercritical CO_2 extraction method shows similar results when compared with distillation method of essential oil extraction. Both extraction products can be used in aromatherapy and natural perfumery. Recent extraction method uses a newer and increasingly popular solvent extraction by using carbon dioxide (CO_2). The process starts when CO_2 is subjected to high pressure which makes the gas turns into liquid. This liquid CO_2 will extract the aromatic molecules in a process similar to the solvent extraction for absolutes. When returned to regular pressure, the CO_2 simply reverts to gas leaving no solvent residue behind. CO_2 extraction has been used to extract essences of some aromatics that don't yield essential oils such as rose hip or calendula. CO_2 extracts have a richer more intense scent and can contain some elements not found in their essential oil counterparts.

Maceration: Macerated oils are extracted when carrier oils are used as solvents to extract therapeutic properties from plant material and therefore known as infused oils. The benefit of macerated oil above distilled oil is that more of a plant's essence is captured in the oil, because it captures heavier, larger plant molecules than the ones captured in the distillation process.

Enfleurage: Enfleurage was used by ancient Egyptians and therefore regarded as the oldest method of essential oil extraction that implements the use of fat. The fats either vegetable fat or animal fat becomes infused with the flower's fragrance compounds, are odourless and solid at room temperature. The enfleurage process can be done either "hot" or "cold." In both instances, the fat that is saturated with fragrance is called "enfleurage pomade." Since long ago, delicate flowers have been processed using enfleurage to capture their essence. The flowers are combined with animal fat and pressed between

pieces of glass and then continually replaced with fresh ones until the fat contains the desired aroma. This process has been mostly discontinued because of its use of animal products, but it is still practiced as an ancient art in the Grasse region of Southern France.

Cold press extraction: This method is used for citrus peel and also called Expression or Scarification method. Some essential oils, namely citrus oils, are obtained through expression – also known as cold-pressing. In the early time, expression was done by hand by first soaking the peels in warm water and then pressing them with a sponge. The sponge was then pressed over a container and allowed to stand for the juice and oils to separate. In today's modern method, the peels are punctured to release the oil and then mechanically pressed. The resulting liquid is then centrifuged where it separates into citrus juice and essential oils.

WORKING PRINCIPLE

There are a variety of methods involved in extraction of different essential oils from different aromatic plants.

STEAM DISTILLATION METHOD

A Still is a large container made up of stainless steel where the plant material also called the 'charge' is placed inside it in which hot steam is allowed to pass through it. Distillation process starts when the plant material containing the desired oils is treated or injected with steam through an inlet. This heat leads to break the essential oil storage chambers within the charge as a result of which the plant's aromatic molecules and the oil starts releasing into the steam turning them into vapour. The vaporized plant compounds move along to the top of the still. A condensation flask or condenser which is present at the top is a long spiral pipe surrounded by cold water. The compounds enter into the condenser which revert the water form from the steam. There are two separate pipes in which hot water can exit and cold water can enter the Condenser in which liquid form can be back from vapour cool stage. Florentine flask also known as Separator present at the end of condenser inside a receptacle collects the aromatic liquid extract i.e., the water and essential oil drop from the Condenser. Separator is container having two outflows which is specially designed to separate essential oil and hydrolat as water and oil do not mix. As a result the essential oil floats on top of the water. After the collection process, the hydrolat is allowed to drawn from the lower outflow in the Florentine flask. Overflowing is prevented from the flask during distillation by carrying out the process as oil production is less than hydrolat. Essential oils float above water and therefore considered as lighter than water. It has been found that during extraction method some

essential oils such as clove essential oil lies at the bottom of the Separator and hence considered heavier than water (Guha and Zari, 2017).

Steam distillation method is used for distillation of many common essential oils such as lavender, peppermint, tea tree oil, patchouli, and eucalyptus. In this method, the best processing conditions to increase the production of essential oil and pigments is autoclave pressure and distillation time (Manzan *et al.* 2003). Flowers, leaves, wood, bark, roots, seeds, or peel are the raw plant material which is put into a distillation apparatus over water. One exception is that fractional distillation method is involved in purification of *ylang-ylang* (*Cananga odorata*). Rose water, lavender water, lemon balm, clay sage and orange blossom water are some of the uses of hydrosols which are extracted during the process. Important parameters in steam distillation analyzed were steam flow and bed porosity, and their effects on the extraction yield and the effect of steam flow (Soto-Armenta *et al.* 2017).

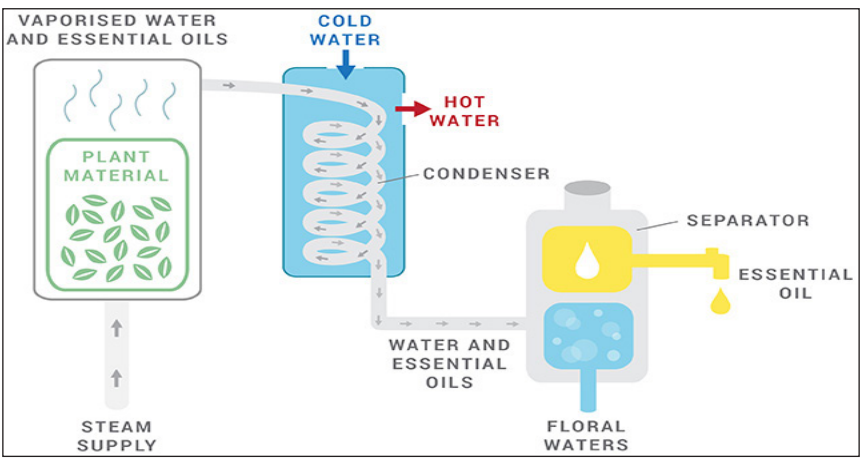

Fig. 1

WATER DISTILLATION METHOD

In this method, heat is applied to the plant material which is immersed in water in a Still. Steam is inserted from the outside to the still. In the distillation process, steam introduction leads to clumping of delicate flowers such as roses and orange blossoms. In pure boiling water submerging the fragile plant material is considered as the most effective method of extraction. The extracted oil is protected from overheating by using water which leads to cooling down the condensed liquids and helps in separation from each other. Hydrolate also known as hydrosol, herbal water, essential water, floral water, or herbal distillate is the remaining water which becomes fragrant sometimes (Guha and Zari, 2017).

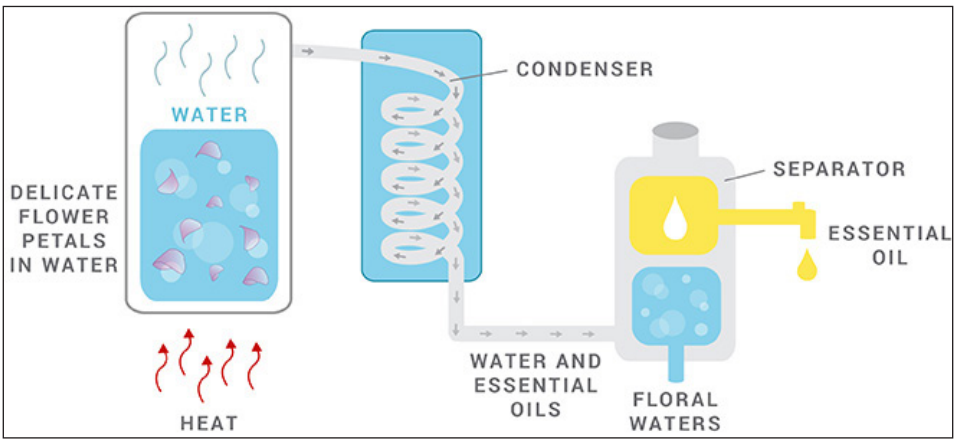

Fig. 2

SOLVENT EXTRACTION METHOD

Jasmine, rose and tuberose are some of the costly and delicate flower to which this method is mainly used and therefore considered as one of the most modern methods of extraction. This method does involve the use of harsh chemicals therefore 'absolutes' residues are produced rather than essential oils from the solvent extraction resulting in potential skin irritation.

During steam distillation, high heat causes denaturation as their chemical components are too delicate therefore most flowers undergo expression which contains too little volatile oil. Oil extraction uses solvent such as hexane or supercritical carbon dioxide. Concretes are the mixture of essential oil, waxes, resins, and other lipophilic (oil-soluble) plant material which is extracted from hexane and other hydrophobic solvents. Large quantities of non-fragrant waxes and resins and high amount of fragrance are present in concretes. Concrete fragrant oil is extracted by another solvent, such as ethyl alcohol.

The working method of solvent extraction process is as follows:

The process starts with essential oil absorbance by chemical solvent which covers the flowers. A waxy aromatic compound which is also known as concrete is produced when the flower is treated with the solvent. Mixture of alcohol and this concrete substance release oil particles. Extract is the mixture of solvent and essential oil. Next stage is solvent removal. Concrete is washed and allowed to warm in alcohol for removal of unwanted wax. This causes dissolution of the oils by distilling the extract which is achieved at a low pressure and hence boiling point of the solvent is reduced. Aromatic molecules are left behind when traded with gentle heat.

Separation of remaining waxes causes precipitation of waxes and lipids is carried out by chilling the alcohol mixture to −18 °C (0 °F) for more than 48 hours. Filtering of the precipitates and removal of the ethanol from the remaining solution is done at the lowest temperature by evaporation, vacuum distillation. This leads to solidification of waxy consistency and hence, known as a 'concrete'. Absolute is the final product. Oil contains the chemicals used during the process and used by perfume industry in manufacturing of perfumes or for aromatherapy purposes (53).

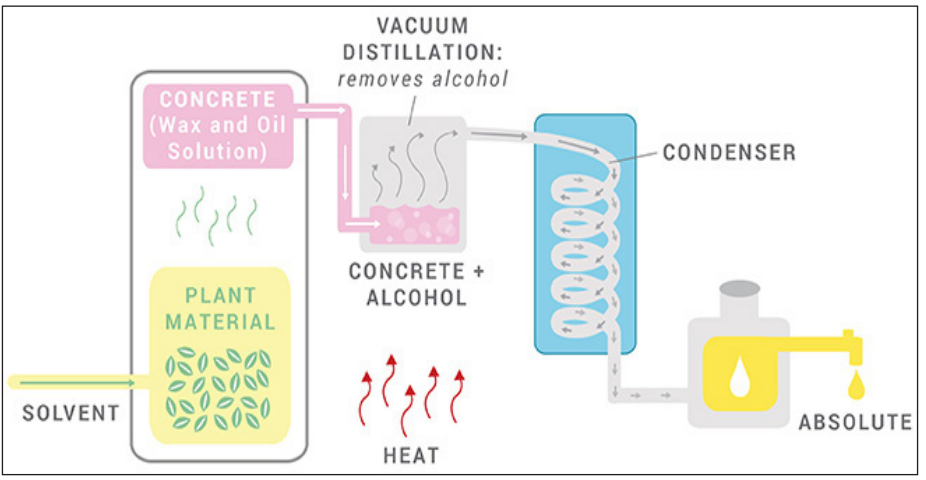

Fig. 3

CO_2 EXTRACTION

CO_2 is colourless, odourless. The pressure in the extraction chamber when released it causes easy and complete removal of CO_2. Supercritical fluid extraction uses supercritical carbon dioxide as a solvent. In this method, petrochemical residues are avoided in the product and concrete containing both the waxes and the essential oils are extracted. Supercritical stage is achieved in the extractor when temperature remains low which causes subsequent processing with liquid carbon dioxide. This makes the pressurized carbon dioxide to become liquid when still in gaseous state. Pressurized carbon dioxide is pumped into the plant matter present in the chamber. CO_2 has the liquid properties of the gas and therefore acts as a solvent on the natural plant matter. The oils and other substances such as pigment and resin are pulled from the plant matter which helps in separation of waxes from the essential oils (Soto- Armenta *et al.* 2017).

Desolation of essential oil into the liquid CO_2 is carried out. Natural pressure and gaseous state of the CO_2 is brought back. Decomposition and denaturing of compounds is prevented at low temperature process. After the extraction

process, no residue is left reducing the pressure to ambient and revert the carbon dioxide to a gas (Guha and Zari, 2017).

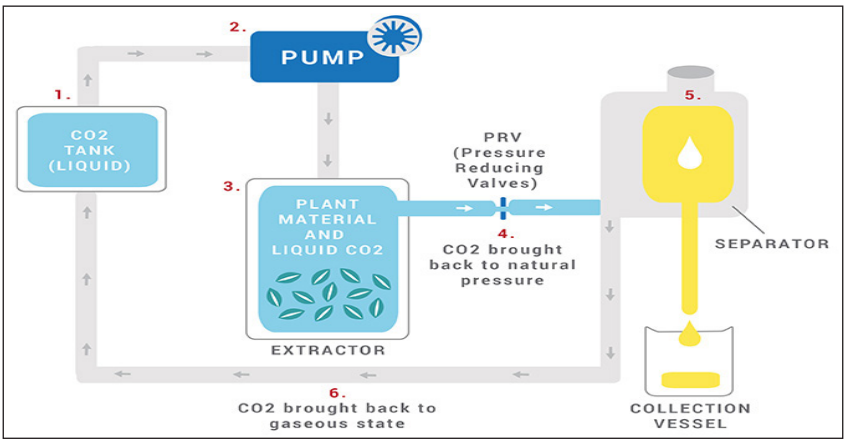

Fig. 4

MACERATION

This process involves making of essential oil in a diluted state at home. Harvested plant material to be used in the extraction process should be as dry as possible because plant moisture makes the oil rancid and encourage the growth of microbes. Rancidity is prevented by addition of 5% of Vitamin E oil or Wheat gram oil (which is high in Vitamin E). This process involves the addition of fresh plant material to the re-warmed carrier and repeats until the fat or vegetable oil is concentrated (Menary and Menary, 2008).

Maceration process overview

Rupturing of some of the oil glands or cells is done by cutting, crushing or grounding of plant material i.e. the flowers or leaves into coarse powder. Plant material is treated with solvent vegetable oil to keep it warm which is placed in a closed vessel. This makes the absorption of essential oil and straining off the plant material. Then straining of liquid is done after making the mixture to stand for 1 week and allowing it to shaken occasionally. Recovering of remaining liquid is done by pressing solid residue (Marc) and mixing of strained and expressed liquids are done. Then filtration clarifies the liquid. The base oil changes its colour at the end of maceration process. Filtration of the final maceration from its plant material is carried out. In airtight container, the filtrate material is poured and allowed in a cool, dry place for storage up to 12 months. Cloudiness and bad smelling occurs when macerated oil becomes rancid. In cosmetics, active botanical which is

composed of 5-10% of oil is used and has the ability to replace plain base oil. Hence, it is used in larger quantities (Guha and Zari, 2017).

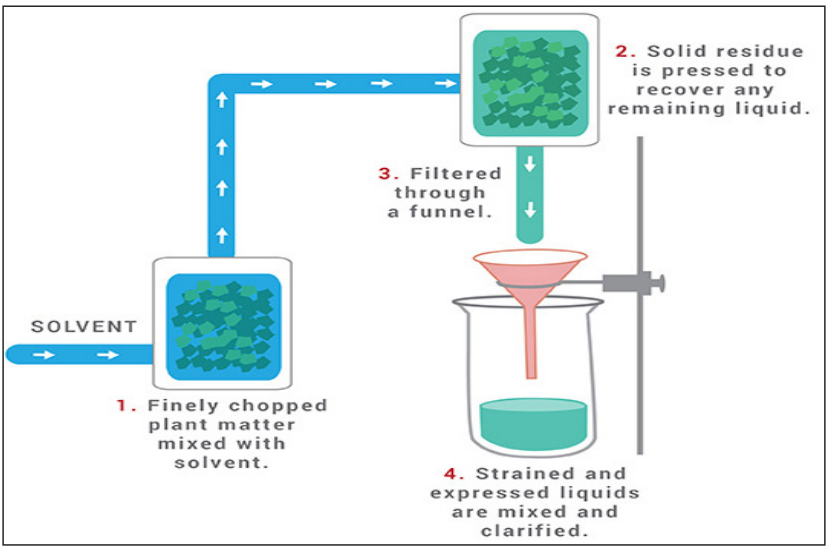

Fig. 5

ENFLEURAGE

Enfleurage is the oldest method of extracting essential oil from plant material.

Cold enfleurage: Chassis is glass plates embedded in a frame in which spreading of lard or tallow is done which is a highly purified and odourless vegetable or animal fat and is allowed to set for a while. Placing of fresh aromatic flower petals or fresh whole flowers on top of the layer of fat and pressing on is done. Depending on the flowers, this is allowed to settle down for 1-3 days or for a couple of weeks. Essential oil is absorbed from the flowers by the fat. Removal of depleted petals and replacing it with the fresh one is done after exhaustion. Saturation of fat with essential oil is achieved by repeating the above process many times which results in desirable saturation. The fat and the fragrant oil is the enfleurage pomade which is the final product. Dissolvation of pomade followed by washing with alcohol is carried out to separate the botanical extract from the remaining fat. Soap is made from that botanical extract. Essential oil easily dissolves in alcohol but fat is insoluble to it. Heating of the resultant liquid is carefully done. The pure essential oil is extracted from the mixture after evaporation of alcohol.

Hot enfleurage: This method is same as cold enfleurage method but the only difference is that heating of fats are involved (Nordin *et al.* 2004).

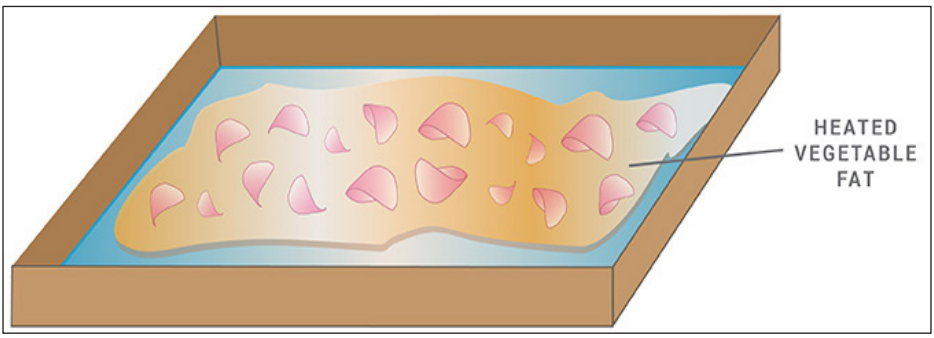

Fig. 6

COLD PRESS EXTRACTION METHOD

Expression or Scarification is the other name of this method and is used to extract essences from the citrus family in particular. Olive oil extraction and most citrus peel oils extraction process is similar which is expressed mechanically or cold-pressed (Aizpurua-Olaizola *et al.* 2015). As compared with other essential oils, citrus fruits are cheaper because growing and harvesting of the raw materials is cheaper and citrus peel contains large quantities of oil. In the citrus industry, the by products are lemon or sweet orange oils. Pressing method was used for the extraction of all essential oils before the discovery of distillation.

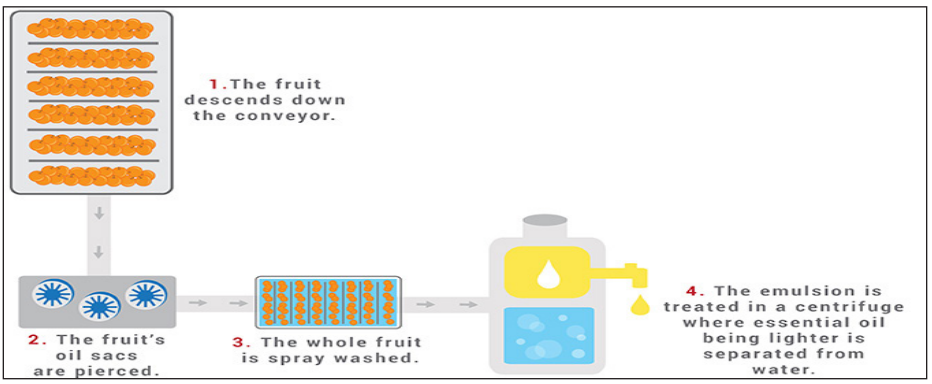

Fig. 7

The process starts with squeezing the fruit peels by hand which causes bursting of the oil glands results in releasing the oil. With the help of sponge the oil is collected. Once the saturation is achieved, squeezing the sponge into a container is carried out.

Nowadays, machines are used for extraction of this method rather than by hand.

Firstly, placing the whole fruit in a device causes rupturing of the essential oil sacs. Sacs is present on the underside of the peel. Running of the essential oil and pigments into the device's collection area is carried out. Then squeezing the juice and the oil is achieved by pressing the whole fruit. Solids such as peel are still present in the oil and juice produced from the fruits. Centrifugation should be done to filter the solids from the liquids. Juice layer and the oil separates from each other and drawn off into another receptacle (Shutes, 2019).

FLORASOLS EXTRACTION

Essential oil is extracted from another solvent known as flora sols. Development of flora sols was done to act as a refrigerant which can replace Freon.

The European Union has banned the use of Flora sol because it has a high global warming potential (GWP; 100-yr GWP = 1430) thus making it "ozone-friendly" product therefore flora sols use has been stopped from 2011 and should be complete till 2017. The extraction through this method gives positive results in producing pure essential oils with little or no foreign substances at or below room temperature and degradation cannot occur in high temperature (Ryman, 2012; Forster *et al.* 2007).

CARBON DIOXIDE EXTRACTION METHOD

What is CO_2 supercritical Extraction Method?

Supercritical fluid extraction (SFE) uses extracting solvent i.e., supercritical fluids which helps in the separation of one component (the extract) from another (the matrix). Solid matrix is usually used for extraction but sometimes liquid matrix can also be used. Supercritical fluid mostly uses Carbon dioxide (CO_2) as main solvent with ethanol and methanol as a co-solvent. CO_2 Extracts, CO_2 Supercritical Extracts or CO_2s are the aromatics compounds extracted through this method. Carbon dioxide is a gas in its normal state but can become liquid by pressurizing carbon dioxide using specialized CO_2 supercritical extraction. Botanical material containing natural components dissolved in liquid CO_2 solvent and exposed to liquefied CO_2. At the end of the extraction process, CO_2 is brought back to its normal gaseous state by natural pressurization. Healthy-looking amber-coloured oil is the CO_2 oil extracted at the end which is used as a tincture. Carbon dioxide is a versatile solvent used by manufacturers at a specific temperature and pressure range which results in clean non toxic premium quality oil benefitted by many consumers. For example, caffeine is removed from coffee beans by using carbon dioxide extraction method.

Recovering of whole oil containing the most volatile and fragile components is taking place inside completely sealed chamber. Depending upon the atmospheric pressure and temperature, carbon dioxide can be either liquid or gas. Hypercritical state of CO_2 is the state where it is too hot to be a conventional liquid and too pressurised to be a conventional gas. It is middle point between liquid and gas which occurs above 33°C and over 200 atmospheres (i.e., 200 times that of regular atmospheric pressure). Quick production of oil with no chemical residue is achieved at low temperatures by using hypercritical CO_2 extraction. Carbon dioxide returns back to its gaseous state by releasing the pressure after the extraction is complete. The whole oil left at the end. CO_2 extracts and essential oils are both sold in glass bottles but some CO_2 extracts are sold in small jars because they are very thick (Ryman, 2012).

There are two types of CO_2 Supercritical Extracts:

1. CO_2 Select Extracts-The volatile aromatic components is present in CO_2 Selects which are produces at low temperature soluble in liquefied CO_2. Different aromatic molecules have their own molecular weight. In a steam distillation method, molecular weights of some aromatic molecules are too heavy. Therefore, the smell is much closer to the aroma of the natural herb in CO_2 Selects than the steam distilled essential oils.
2. CO_2 Total Extracts- Greater pressure is needed to produce CO_2 Total extract which contain all the molecules which is readily soluble in the liquefied CO_2. CO_2 Total extracts contains the volatile aromatic constituents, natural lipids, waxes, and other CO_2 soluble molecules present in the botanical. Therefore it is much tends thicker than CO_2 Selects.

However, the fluid state of the gas is regarded as supercritical CO_2 which takes place *above* its critical temperature 89.78 degrees Fahrenheit and critical pressure of 73.8 bars. A study concludes that supercritical CO_2 is "a solvent like no other solvent." A study shows green chemistry became a major aspect by supercritical CO_2.

There is also subcritical CO_2 extraction. Subcritical is not similar process as supercritical, because of its time consuming method and production of less material. Lower pressure and lower temperature is required in subcritical CO_2. High quality products are produced containing terpenes, cannabinoids, and essential oils although it is a longer and less efficient process.

Larger molecules containing waxes, chlorophyll and omega-3 and 6 lipids are extracted at higher pressures and temperatures by supercritical system which becomes a thicker substance. Then, these substances get removed by the process known as 'winterization' which leaves cannabinoid oil behind. Hence, subcritical extraction products are similar to molasses (Peach and Eastoe, 2014).

BENEFITS OF USING CO_2 EXTRACTION METHOD

The primary benefits of using CO_2 extraction method is that it acts as a 'green solvent' that provides a cleaner and healthier product. Solvents such as supercritical CO_2 and butanol products are different from each other as supercritical CO_2 is recyclable and cost effective and contains no nasty chemical residues. The biggest benefit is dozens of cannabinoids and terpenes can be extracted from CO_2 extraction. Hundreds of terpenes and flavonoids and more than 110 identified cannabinoids are present in marijuana plant. For example, Blood-brain barrier resistance may be reduced by myrcene which leads to movement of helpful chemicals in the body through comfortable passage. There are some other advantages such as it is non-toxic, colourless and odourless. The extracted oil and CO_2 which is inert does not react chemically with each other. Lower temperatures should be maintained, so that damage of thermally labile compounds does not occur. There are more top notes which maintained the true natural odour and flavour characteristics (Tanaka *et al.* 2004).

PROPERTIES OF SUPERCRITICAL CO_2

- Supercritical CO_2 is an inert gas which is non-toxic, easily available, inexpensive and non-flammable.
- Critical constants are moderate in this process.
- Liquid's density is adjusted to tune the salvation strength.
- Large quantities of products formed in pure and organic form having low level of residue through Carbon dioxide as compared to other solvents.
- CO_2 is considered as an ideal solvent for temperature-sensitive materials.
- It isolates and removes molecule or compound with great precision
- It eliminates contamination in the heart or on the surface of a solid material (undesirable odour or taste, allergenic substance)
- It obtains molecule or compound preserving all its integrity and take full advantage of its own qualities (active ingredient)
- Selectivity-Low pressures (100 bars) are required for the extraction of volatile oils whereas removal of lipids can be achieved by liquid extraction. Pure CO_2 can be used to remove lipids at higher pressures and by adding ethanol to the solvent removal of phospholipids can be carried out. Poly phenols and unsaturated fatty acids extracted from wine wastes by using this CO_2 method.
- Speed- Extraction occurs faster in supercritical fluids because diffusivities move faster in CO_2 than in liquids. An organic liquid extraction method

takes several hours to complete, whereas 10 to 60 minutes is required for supercritical fluid extraction to complete (Aizpurua-Olaizola *et al.* 2015; Skoog, 2007).

EXTRACTION PROCEDURE

Supercritical CO_2 extraction is inexpensive. Therefore, hemp and marijuana oils are produced in best quality by many companies. Supercritical CO_2 system is mainly used by companies. This equipment has the ability to handle biggest workloads in the industry as 200 pounds of dried material is processed in each day. Hence, it is regarded as perfect gigantic manufacturers. The advantages of this equipment are supercritical and subcritical extractions can be easily perform, fully automatic machine and contains an equipped carbon dioxide storage tank. Another machine used for this method is Hi-Flo FX2 20L 5K machine in which 107-pounds of biomass can be processed each day. 3 × 2000 L model is another machine by this brand having 4.5-6 hours extraction run time and 3,000 pounds load capacity which gives 15% yield. The Super C Extractor is another machine which looks like a doll-house and is perfect for small-scale businesses available at $4,000. Ethyl acetate, methylene chloride, and trichloroethane are used as solvents by companies for decaffeination before the use of supercritical CO_2 extraction. But they realized that wastefulness, flammability, and solvent toxicity are some of the limitations while extracting different components from food products had limitations. This technology extracted natural substances products such as decaffeinated coffee, essential oils, flavours, and colour pigments. By using supercritical fluids micro- or even nano-sized particles can be modified with a defined particle size distribution – processes that are making new drugs with exact and controlled properties possible. Supercritical CO_2 act as drying agent which provides high-tech applications includes aero gels, high-performance insulation materials.

SUPERCRITICAL CO_2 EXTRACTION GUIDE

- Gaseous form of CO_2 runs in the chamber which is subjected to temperature lower than -70 degrees Fahrenheit and heightened pressure.
- Change of state occurs in which fluid form is achieved by gas.
- Heating and pressurizing makes CO_2 to show its unique properties. An intermediate property is shown in supercritical fluid *between* a gas and a liquid. For example, density is maintained in the liquid while space is filled in a gas.
- The raw hemp or marijuana material is present in the chamber through which the special fluid passes.

- ❖ Dissolvation of trichomes membranes occurs when the fluid passes through the raw material which results in capturing of the active compounds.

METHODS

CO_2 pump, sample pressure cell, pressure equipment and a collecting vessel must be present in the system. The process starts when pumping of liquid is done to a heating zone, where heating of liquid occurs to reach supercritical conditions. Then it is allowed to pass into the extraction vessel. In the vessel it becomes solid matrix and extraction material is dissolved. Separator contains the dissolved material which is swept from the extraction cell at low pressure. The extracted material settles at the bottom. The CO_2 can revert back to its original form by cooling, re-compressing and recycling method and then discharged to atmosphere. Steps involved in CO_2 method are as follows:

1. *Pumps*: Carbon dioxide (CO_2) is used as a solvent which is pumped as a liquid at temperature below 5 °C (41 °F) and at pressure 50 bars. CO_2 pumps or syringe pumps are used in small scale extractions where as diaphragm pumps are used for larger scale extractions.
2. *Pressure vessels*: Pressure vessels requires 74 bars to 350 bars pressure for extraction and ranges from simple tubing to more complex built vessel. Vegetable oils extraction requires higher pressures i.e., 800 bars. Supercritical carbon dioxide has the ability to dissolve the rubber seals therefore care must be taken otherwise it can cause swelling and rupturing of the rubber on depressurization (King, 2002).
3. *Pressure maintenance*: Pressure vessel can maintain the pressure. A simple restrictor contains either a capillary tube or a needle valve is adjusted to maintain pressure in smaller systems. On the other hand, a back pressure regulator is used which maintains upstream pressure by spring, compressed air, or electronically driven valve in larger systems.
4. *Collection*: Vessel contains supercritical solvent which is passed at lower pressure. Supercritical fluids density and dissolving power show variation with pressure. CO_2 density is lower in its solubility which can be recycled or depressurized.
5. *Heating and cooling*: Before pumping the fluid is allows to cool down to maintain liquid conditions and allows for heating after pressurization. Excessive cooling is prevented by heating when the fluid is expanded into the separator. Extraction cell is present inside oven where the fluid is pre heated in a length of tubing for small scale extractions. Thermodynamic

properties of the supercritical fluid are used to calculate each stage energy requirement for larger systems (King and List, 1996).

Two essential steps are involved in SFE

Solid particles transfer and dissolution occurs in the supercritical fluid. Extraction of material from the edge of the sphere is done which makes the concentration unchanged. Diffusion of extracts towards the edge of the sphere leads to drop in the centre concentration of the sphere when the extraction progresses. Increasing diffusion rate i.e., raising the temperature increases the rate of extraction. In some cases, increasing flow rate of the solvent increases the extraction rate (Clifford and Clifford, 1999).

OPTIMIZATION

Maximizing diffusion: Increasing temperature, matrix swelling and particle reduction leads to maximum diffusion. Increasing pressure and addition of modifiers to the solvent can increase matrix swelling. Swelling of some polymers and elastomers occurs by CO_2 which causes increase in diffusion by several orders of magnitude (Vandenburg *et al.* 1997).

Maximizing solubility: Solubility increases with higher pressure and density decreases by increasing the temperature. Increasing temperature increases solubility when pressure is above the critical pressure. Modifiers such as methanol and ethanol have the ability to increase solubility when added in low quantity.

Optimizing flow rate: Flow rate is best achieved by using coriolis flow meters. The flow rate should be completely diffusion limited and should be high enough to maximize the rate of extraction. The amount of solvent should be completely solubility limited to minimize the extraction (Jain *et al.* 2009).

Difference Between Supercritical Co_2 Extraction and Other Methods

- CO_2 extraction oil products are pure and unique quality than the products obtained from steam distillation method.
- CO_2 extracts possess an advantage over the steam distillation is that while extracting essential oil heating does not damage the constituents present in the material.
- CO_2 Extraction process produces aromatics and superior lipids (carrier oils). These products contain many beneficial materials of the plant which is difficult to extract in cold pressing method.
- Heat is generated by friction when carrier oils are pressed at very low temperatures during cold extraction process. Pesticide concentration is greater than the products obtained by other methods extracted from the original plant material.

- CO_2 extraction extracts all its constituents from the plant material. Steam distillation method derives oil which shows variation in their qualities which depends on the temperatures, pressures, and length of time.
- CO_2 is acts as a solvent in supercritical extraction whereas heated water or steam acts as a solvent in traditional distillation. Higher quality oils which cannot be altered by high heat are produced from CO_2 extraction process. This property is not found in steam distillation process.
- Temperatures ranges between 95 to 100 degrees F are required for operation of supercritical extraction process whereas steam distillation operation requires temperatures between 140 to 212 degrees F.
- In steam distillation, application of temperature can change the molecular composition of the plant matter and the essential oil. On the other hand, CO_2 extract contains a wider range of the plant's constituents therefore it is closer in chemical composition to the plant from which it is derived. For example, German Chamomile flowers extraction yields a green extract which is similar in composition to the original flower because absence of heat prevents denaturation.
- CO_2 extracts contain the aroma of the natural herb, spice, or plant. It contains many constituents which make it thicker than their essential oil counterparts. This amount is less in products extracted using steam distillation.
- "Weedy" flavour of cannabis and hemp is maintained by the CO_2 extraction method. The fragrance of the product is maintained whereas flavour gets lost using ethanol at the time of extraction.
- Pure CO_2 extracts are produced under pressure and varying temperature in which toxicity lacks. Ethanol extraction is ahead of the CO_2 process in precision and cost. Products obtained from ethanol extraction ensure 99% purity in comparison to various other methods.
- Ethanol extraction is also cost-effective if compared to the other prevailing methods of cannabis and hemp extraction that use expensive machinery. This process might use higher levels of energy to carry out its process, though it is best for extensive operations. Experts recommend it mostly for high-scale harvest extraction.

PRODUCTION IN INDIA

Vidya Herbs is a leading manufacturer and exporter of herbs and botanical extracts located in Bangalore which is known as biotech valley of India. Vidya herbs manufacture its product and check quality control by supercritical Fluid extraction (CO_2) facility. Vidya Herbs extracts are collected from the best ingredients than any other countries around the world (77).

Chemtron Science Laboratories Pvt. Ltd. is a part of fastest growing industry i.e. chemical and Electronics Industry, established in the year 1992, in Mumbai. CSL has well equipped high technology lab equipments, testing and inspecting facilities, which makes its products one of the best in the industry. The company was formed by Dr. O.P. Srivastava who is a retired Senior Scientist from BARC. Supercritical extraction provides clean and solvent free components maintain the essential phytochemicals.

GC-MS ANALYSIS

Gas chromatography–mass spectrometry (GC-MS) is an analytical method that combines the features of gas-chromatography and mass spectrometry to identify different substances within a test sample. Drug detection, fire investigation, environmental analysis, explosives investigation, and identification of unknown samples are some applications of GC-MS. GC-MS can also be used in airport security to detect substances in luggage or on human beings and can also identify trace elements in materials that were beyond identification. It allows analysis and detection even of tiny amounts of a substance like liquid chromatography–mass spectrometry. It has been regarded as a "gold standard" for forensic substance identification because it is used to perform a 100% specific test, which positively identifies the presence of a particular substance (Wilde *et al.* 2015).

The GC-MS instrument is composed of two major building blocks: the gas chromatograph and the mass spectrometer. The gas chromatography contains a capillary column whose properties depend on the column's dimensions (length, diameter, film thickness) as well as the phase properties (e.g. 5% phenyl polysiloxane). The molecules are retained by the column and then elute (come off) from the column at different times (called the retention time), and this allows the mass spectrometer downstream to capture, ionize, accelerate, deflect, and detect the ionized molecules separately. The mass spectrometer breaks each molecule into ionized fragments and detects these fragments using their mass-to-charge ratio.

These two components when used together, gives a much finer degree of substance accurate identification. Hence, combining the two processes reduces the possibility of error. The mass spectrometry process normally requires a very pure sample while gas chromatography using a traditional detector (e.g. Flame ionization detector) cannot differentiate between multiple molecules that happen to take the same amount of time to travel through the column (*i.e.* have the same retention time), which results in two or more molecules that co-elute. Therefore, analytes of interest is in the sample when mass spectrum appears at a characteristic retention time in a GC-MS.

P&T GC-MS is particularly suited to volatile organic compounds (VOCs) and BTEX compounds (aromatic compounds associated with petroleum). Purge-closed loop system is faster where the inert gas is bubbled through the water until the concentrations of organic compounds in the vapour phase are at equilibrium with concentrations in the aqueous phase. The gas phase is then analysed directly (Wang and Lenahan, 1984).

Applications

1. GC-MS uses in environmental monitoring and cleanup- This becomes the choice for tracking organic pollutants in the environment. The cost of GC-MS equipment has decreased significantly, and the reliability has increased at the same time, which has contributed to its increased adoption in environmental studies.
2. GC-MS in detection in criminal forensics- The particles can be analysed by using GC-MS from a human body to find criminals in crime cases and used in court.
3. In law enforcement- Illegal narcotics is detected by using GC-MS. A simple and selective GC-MS method for detecting marijuana usage was recently developed by the Robert Koch-Institute in Germany which involves identifying an acid metabolite of tetrahyhydrocannabinol (THC), the active ingredient in marijuana, in urine samples. GC-MS is also commonly used in forensic toxicology to find drugs and/or poisons in biological specimens of suspects, victims, or the deceased.
4. Anti-doping analysis in sports- GC-MS is used in sports to test urine samples of athletes to prevent performance-enhancing drug anabolic steroids.
5. Used in Security System- Explosive systems run on GC-MS which produces EGIS. EGIS is a GC-MS-based line of explosives detectors.
6. Chemical warfare agent detection- Modification of large GC-MS systems can be done with resistively heated low thermal mass (LTM) gas chromatographs that reduce analysis time to less than ten percent of the time required in traditional laboratory systems.
7. GC-MS in Chemical engineering- Unknown organic compound can analyse by GC-MS and can determine the composition of bio-oils processed from raw biomass. GC-MS is also utilized in the identification of continuous phase component in a smart material, Magneto rheological (MR) fluid.
8. Analysis of Food, beverage and perfume- The analysis of aromatic compounds present in foods and beverages compounds which include esters, fatty acids, alcohols, aldehydes, terpenes etc is done by GC-MS.

It is also used to detect and measure contaminants from spoilage or adulteration which may be harmful for example pesticides.

9. GC-MS in Astrochemistry- Two were brought to Mars by the Viking program. Venera 11 and 12 and Pioneer Venus analysed the atmosphere of Venus with GC-MS. The Huygens probe of the Cassini–Huygens mission landed one GC-MS on Saturn's largest moon, Titan. The MSL Curiosity rover's Sample analysis at Mars (SAM) instrument contains both a gas chromatograph and quadrupol mass spectrometer that can be used in tandem as a GC-MS. The material in the comet67P/ Churyumov–Gerasimenko was analysed by the Rosetta mission with a chiral GC-MS in 2014.
10. Used in Medicine- Detection of congenital metabolic diseases occurs by newborn screening tests, especially the testing using gas chromatography–mass spectrometry. GC-MS can determine compounds in urine even in minor concentration. It is now possible to test a newborn for over 100 genetic metabolic disorders by a urine test at birth based on GC-MS. In combination with isotopic labelling of metabolic compounds, the GC-MS is used for determining metabolic activity. Most applications are based on the use of ^{13}C as the labelling and the measurement of ^{13}C-^{12}C ratios with an isotope ratio mass spectrometer (IRMS); an MS with a detector designed to measure a few select ions and return values as ratios (Sparkman *et al.* 2011; Tsiyou *et al.* 2006; Smith *et al.* 2010; Muhamad *et al.* 2019; Krasnopolsky *et al.* 1981; Niemann *et al.* 2005; Goesmann *et al.* 2005).

Identification of Constituents through GC-MS Analysis

Thymus vulgaris (thyme), *Origanum vulgare* (oregano), and *Origanum dictamus* (dictamus) essential oils were analyzed by gas chromatography–mass spectrometry (GC-MS). Phenolic compounds were found in larger quality. Hydrocarbons, alcohols, and phenols were present in *Origanum majorana* (marjoram) oil and alcohols and esters were present in *Lavandula angustifolia* (lavender). *Rosmarinus officinalis* (rosemary) and *Salvia fruticosa* (sage) essential oils contain ethers (Daferera *et al.* 2000).

Eleven terpenoids, α-pinene (70%), β-pinene (1.94%), 3-carene (0.2%), carveol (2.18%), epoxypinene (2.15%), limonene oxide (9%), myrtenol (5.31%), limonene (0.62%), citral (5.72%), α-phellandrene (0.2%), and β-myrcene (0.3%) were present in oleoresin of *P. Atlantica* var. *Mutica* essential oil obtained from steam distillation method analysed by GC-MS (Delazar *et al.* 2004).

Potentiating activity of drugs was showed in the *P. mikanianum* essential oil and invasive infections in human tissues were caused by an inhibitory effect of virulence factors of the *Candida* genus (Carneiro *et al.* 2020).

Eugenol, estragole, linalool, α-copaene, anethole, chavicol, and caryophyllene are some of the compounds among thirty-three volatile compounds analysed by Gas chromatography mass spectrometry (GC–MS) of betel leaf (*Piper betle* L.) essential oil (EO). These compounds have biological activities and industrial applications (Madhumita *et al.* 2019).

3-allylguaiacol (65.8%) and eugenol acetate (46.6%) were the main compounds found in methanolic extract and essential oil of *Syzygium* by using gas chromatography–mass spectrometry (GC/MS) analysis (Hamad *et al.* 2019).

Constituents Present in Essential Oil Extracted From CO_2 Extarction

Extraction of essential oil using supercritical carbon dioxide (SC-CO_2) is an environmentally benign and generally regarded as safe solvent that has many advantages such as low critical temperature, low viscosity, and easy separation.

Essential oil extracted from *Citrus sphaerocarpa* Tanaka peel using SC-CO_2 yields over 13 times higher and had lower content of monoterpenes and higher content of oxygenated compounds, sesquiterpenes, which strongly contribute to the aromatic characteristics of the extracts than any other method. Auraptene, a bioactive compound was also identified in the SC-CO_2 extract (Suetsugu *et al.* 2013).

Thyme essential oil contains major constituents, namely thymol and carvacrol. Thymol have antibacterial, antifungal and anthelmintic effects, while carvacrol has been investigated for its bactericidal effect. Due to the phenolic structures of the two principal constituents, the essential oil of thyme has shown significant evidence of antioxidant function (Dapkevicius *et al.* 1998).

A maximum of 53.93% of lycopene and half of the initially present β-carotene was extracted from tomato paste waste using supercritical carbon dioxide (SC-CO_2) in 2 hrs. Freeze-dried samples of the microalga *Chlorella vulgaris* yields carotenoids and other lipids using supercritical CO_2 at temperatures of 40 and 55 °C and pressures up to 35.0 MPa which shows that carotenoids and other lipids increased with pressure. Lipid composition and FFA and tocol (tocopherol and tocotrienol) contents of flaxseed oil were determined by both SC-CO_2 and petroleum ether extraction which showed α-linolenic acid content of the SC-CO_2-extracted oil was higher than that by solvent extraction (Baysal *et al.* 2000; Bozan *et al.* 2002).

The supercritical fluid extraction (SFE) of Greek sage leaves, i.e. *Salvia fruticosa*, was investigated at the effect of pressure, temperature and solvent flow rate on the extraction yield which showed that yield increases with increase in pressure while the effect of temperature depends on the extraction pressure. The SFE extracts showed the presence of more biologically active compounds when compared with the essential oil obtained with hydro distillation. The

optimal conditions for maximum mass yield of carotenoids from carrot peels were found at 58.5 °C, 306 bar and 14.3% of ethanol, and at 59.0 °C, 349 bar and 15.5% ethanol for carotenoid recovery (86.1%) (Kavoura *et al.* 2019; de Andrade Lima *et al.* 2018).

Cnidoscolus quercifolius seeds were subjected to oil extraction with supercritical CO_2 at 40, 50, and 60 °C and 20, 25, and 30 MPa for 120 min at 5 g min^{-1} which gives highest oil i.e. tocopherols and β-sitosterol yield (41.0 wt%) at 60 °C and 30 MPa (Santos *et al.* 2020).

Hibiscus sabdariffa is used as potent phytochemical agent due to its phenolic composition. Therefore, SFE is regarded to be a suitable and selective technique to maximize the extraction of several phytochemical compounds from *H. sabdariffa* calyces. The environmental impacts of caffeine extraction from coffee beans using supercritical carbon dioxide ($scCO_2$) showed a reduction of the environmental impact which is equal to 176% in terms of human health, 10.3% in terms of ecosystem diversity and 16.1% in terms of resource availability. Analyses of fatty acids, free radical scavenging activity (DPPH), vitamin E and peroxide contents revealed that the fatty acid compositions were similar but yield, vitamin E, efficient concentration (EC50), and Peroxide value (PV) varied significantly (De Marco et al., 2018; Gustinelli *et al.* 2018).

Extraction of bioactive compounds from radish leaves using $scCO_2$ adding ethanol as co-solvent showed result at 35 °C/400 bar and 40 °C/400 bar, with values of total phenolics 1375 mg GAE/100 g d.m. and 1455 mg GAE/100 g d.m., respectively. An analysis on environmentally sustainable approach for recovering lipids from *Chlorella saccharophila* for biodiesel production indicated that when the extraction time was reduced to 30 min without drying, good T-FAME and BD-FAME content could be achieved. The extraction of oil using supercritical CO_2 and ethanol as co solvent for the vaporization of rice bran revealed that the best oil was obtained at 40 °C and 30 MPa in terms of antioxidant activity. The addition of ethanol as modifier significantly increased the amount of bioactive molecules extracted and affected the amount of fatty acids and γ-oryzanols (Goyeneche *et al.* 2018; Alhattab *et al.* 2019; Benito-Roman *et al.* 2019).

CONCLUSION

Essential oils are also known as volatile oils, ethereal oils which are liquid extracts of various potentially beneficial plants that retain the natural smell and flavour, or "essence," of their source. Unique aromatic compounds give each essential oil its characteristic essence. Each essential oil has a unique composition of chemicals, and this variation affects the smell, absorption, and effects on the body. Essential oils are most commonly used in the practice

of aromatherapy. Since the late 70's and early 80's shows a boom in the interest in natural medicine, with the popularity of aromatherapy, a branch of alternative medicine that uses essential oils and other aromatic compounds and more recently the rise in environmental concerns has kept essential oils growing in popularity– both for health and healing, and practical uses to replace harmful chemicals in the home. There has been a systemic review of 201 published studies on essential oils as alternative medicines, but only 10 were found to be acceptable methodological quality. Even these 10 studies were still weak in reference to scientific standards. Many studies have shown that essential oils have potential as a natural pesticide. Distillation is considered to be the only method to produce pure essential oils. Essential oils have been used in folk medicine throughout history.

Depending on the plant material, some methods are better than others. Large amount of essential oils present in the skins of the citrus fruit like orange and lemons therefore cold pressing method is used efficiently. For more delicate ingredients like jasmine, a more complex extraction method is used. There are also more than one way that companies produce oils using each of the methods above, resulting in varying quality of the finished oil. However, the process of distillation is the main method for extracting the aromatic parts of plants but before distillation was discovered 'expression' was one of the main methods used to extract essential oils from plants.

CO_2 extraction is a relatively recent development over the last few decades. CO_2 extraction method uses pressurized carbon dioxide to take as many desirable plant's essential waxes, cannabinoids, and terpenes from plant as possible. Supercritical CO_2 extraction is widely regarded as the industry's gold standard. Carbon dioxide has the most reliable link with the process of using supercritical fluids to separate one component from another, which is known as supercritical fluid extraction. CO_2 is the most commonly used fluid in this process, although it is occasionally modified by a co-solvent such as methanol or ethanol. Carbon dioxide presents as a gas at standard pressure and temperature. Clove bud Oil, Ginger root Oil, Turmeric root Oil, Sandalwood stem Oil, Rose wood stem oil, Rosemary leaves oil, Lavender dry flower oil, Cumin Seed oil, Jatamansi oil, Khas root Oil, Policosanol from rice bran oil & sugarcane skin wax etc., can be extracted from this method. There are almost 3500 herbal medicines listed which can be extracted with the help of Supercritical CO_2extraction System.

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Chapter

7

Role of Aromatherapy in Relieving Pain

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ABSTRACT

Aromatics can often soothe human mind, body and even relief chronic pain. Pain management medication are often very costly and have side effects and thus aromatherapy can be considered as a promising alternative. Now-a-days, combination of standard pain medication and aromatherapy is a well-known practice all over the world. The essence obtained from the extracts of leaves, stems, roots, flowers, oils of aromatic plants are used in aromatherapy. Scented perfume or candles are not considered as therapeutics and they lack the properties of the essential oils which can be only obtained from herbs. Thus, it's not the fragrance that is relieving pain. The phytochemicals that are present in the plant extracts which are directly absorbed by olfactory nerves or skin – play the major role in relieving pain. The essential oils that are used as therapeutic agent, can be inhaled directly or may be used as spray in a diffuser. Alternatively, these essential oils are often mixed with a carrier oil and can be applied on the affected area (painful joints) by gentle massaging. The phytochemicals gets absorbed through skin or nose and lungs, ultimately reaches the limbic system – the nerve network in brain that controls emotion and instinct. This can potentially reduce the perception of pain and change mood. It is medically proved that aromatherapy can lower cortisol level, can lower heart rate, can reduce inflammation and can lower depression or anxiety.

Keywords: Aromatherapy, phytochemical, essential oil, pain

INTRODUCTION

Pain is a general term, its mean that uncomfortable sensations in the body. Pain can also be described as throbbing, stinging, sore and pinching sensation

on the body. According to International Association for The Study of Pain "Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage" (Srinivasa *et al.* 2020). In medical term, pain is regarded as a symptom of an underlying condition. In most developed countries, pain is the most common reason for physical consultation (Debono *et al.* 2004). Sometimes pain arises in the absence of any detectable stimulus, damage or disease (Raj, 2007). In many medical conditions it is a very major symptom, and can interfere with a person's quality of life and general functioning (Breivik *et al.* 2008). Medically speaking, pain is an uncomfortable sensation, that usually signals as injury or illness. According to medical diagnosis types of pains are:

- **Acute pain:** Short in duration pains are called acute pain which lasts from minutes to about 3 months. It is related to short tissue injury or temporary illness.
- **Chronic pain:** Chronic pain is longer in duration, like headache, it continues over many months or years. It occurs often due to health condition like arthritis, fibromyalgia or a spine condition.
- **Neuropathic pain:** It occurs due to the damage of nervous system. It is a common type of chronic pain.
- **Nociceptive:** caused by damage of body tissue, by external injury.
- **Radicular pain:** it is a very specific type of pain that can occur when the spinal nerve gets compressed or inflamed. It radiates from the back and hip into the legs by the way of the spine and spinal nerve root.

In daily life, aches, joint pain, and inflammation are common problems which affect everyone. Taking different types of painkiller medicines may cause various side effects, so natural care with essential oils is the popular solution these days. For less serious problems, use of essential oils is recommended only as a complimentary therapy. Essential oils came to be used to reduce joint pain and inflammation, but massage of essential oils will also bring other health benefits. Ancient literature has examined the effectiveness or aromatherapy in treating pain, because aromatherapy has a significant positive effect in reducing pain. Pain always increases in age related disorders such as dementia, heart disease, diabetes, arthritis etc. People always use painkillers for pain relief, but there are other alternative therapies that can be utilized for pain relief. Aromatherapy is such type of therapy, which is the use of extracted aromatic essences from plants, usually in the form of essential oils. A 2016 study reveals that aromatherapy has a significant positive effect in reducing pain. Recent studies also reveal that aromatherapy should be considered safe for current pain management.

WHAT IS AROMATHERAPY?

The absorption of essential oil through topical application or olfactory system is called aromatherapy. The essential oils are extracted from medicinal plants and proved to be effective in treating chronic pain. Aroma therapy can treat mental stress, nausea, sleep anxiety, pain, depression, muscle tension, etc. Although it's a topic of debate about the absolute effectiveness of aromatherapy, but because of its soothing effect, natural remedy, low cost – many people are attracted to it. Most of the medicinal plants used in aromatherapy is approved by United States Food and Drug Administration (FDA). Some essential oils can be the causative agent of minor skin irritation and may prove lethal if ingested (Boehm *et al.* 2012). It should be noted that there is no long lasting effect of aromatherapy but short term improvements are reported in most of the studies. The use of distilled plant materials was started in medieval Persia, but the term "aromatherapy" was coined by Rene Maurice Gattefosse in the early 20th century in his book, Aromatherapie, Gattefosse. He claimed that herbal products can be used to treat various ailment in human physiology (Lakhan *et al.* 2016).

Essential oils are most commonly applied topically or through direct inhalation. In topical application a carrier oil is needed for massaging. They can also be inhaled through a humidifier or by soaking gauze/cotton and placing it near by the patient. Olfactory and tactile sensory stimulation are produced by these oils to enhance physiological activities like eating, social interaction, and sexual contact (Cino, 2014) relieving pain, depression, etc. There are more than forty derivatives of plants that may be used aromatherapeutic agents, such as, lavender, eucalyptus, rosemary, chamomile, and peppermint extracts.

ESSENTIAL OILS IN AROMATHERAPY

Essential oils can be used in many ways, but massage and inhalation are most effective for chronic pain, knee pain, and joint pain. Essential oils may be added in massage oils or body lotion, or aromatic baths. According to researchers, when essential oils are inhaled, or applied on skin, it enters into the bloodstream and sends messages to the brain. Now we can discuss how aromatherapy reduces different types of chronic pains. Essential oils have strong anti-inflammatory features that make them efficient for alleviating pains in joints and muscles. Essential oils have therapeutic effects. Massage of such oils can reduce muscle tension and joint pain, increase oxygen and nutrient supply to body tissue, and many other benefits. The touch of massage with aromatic essential oils relaxes the body muscles, which in turn reduces the pain. Below are some essential oils that are thought to be helpful in acute and chronic pain:

- Lavender- analgesic and antispasmodic. Reduces pain when inhaled.
- Peppermint – analgesic and antispasmodic. Reduces colon spasms.
- Ginger – analgesic and anti-inflammatory. Reduces pain of arthritis and knee pain.
- Black pepper – antispasmodic and relaxant. Decreases arthritis pain.
- Lemongrass – analgesic. Reduces muscle pain.
- Peppermint Oil- Botanical name-Mentha piperita, known as peppermint oil, is the strongest essential oil of mint family with a spicy flavor and cooling sensation. This oil has an impressive nutritional composition and it contains many essential minerals and vitamins such as –vit-A, vit-C, Magnesium, potassium and fatty acids. Peppermint oil is a natural antidepressant and muscle relaxant. It has been used to treat headache, cramps, cold symptoms, pain and nausea. This oil has 40%menthol which gives a strong smell. It is a stimulant and effective upon neck pain.

PAIN AND AROMATHERAPY

Chronic Pain in Elderly Persons

Approximately 84% of elderly persons (65-75 years old) suffer from chronic pain. Sometimes the cause of the pain is not well understood. This type of pain is more complex, persistent, and have no permanent cure. Moreover, the chronic pain results in stress and very poor adaptive abilities, which in turn leads to lack of sleep, anxiety, depression and quality of life reduces. The benefit of aromatherapy varies among different types of patients based on their pre-existing physiological condition like complaints such as hypertension, depression, heart disease, arthritis, dementia, healed injuries, and psychiatric illnesses. It was reported by Cino (2014), that the patients who got a massage with lavender oil, felt better than the placebo group. Researchers recommend that a combined treatment of mainstream medications and aromatherapy may reduce the lower back pain in short term (Yip *et al.* 2008).

Chronic Back Pain

When the senescing humans i.e.; when a person is in their sexagenarian or septuagenarian or extending to their octogenarian were considered under an experimental studies in U.S. they roughly estimated an age value when for sure they experience the triggered back pain at a minimum level of which around 70 percent to 80 percent agreed to have faced it and with 36 percent approved to have experienced lower back pain for sure once in a year may be Muscle strain or Sciatica (Sritooma *et al.* 20014). Most visitors to the top 5 healthcare institutes w.r.t pain were of the indeterminate lower back pain

as details provided by them showed. Management of this health ailment can be categorized under a bit difficulty level as less than 15 percent of the patients were seen to have been experiencing this pain due to an identified cause so, change of symptoms were the only treatment which could be done (Yip *et al.* 2004). Sometimes this chronic lower back pain aren't due to any major underlying disease but related to pitiable life style, sluggishness or little body movements or due to prolonged sitting or lying habit that further led to further problems in the work field which thus, directly affected their productivity.

The only immediate therapy is massage that can be given for the treatment of lower back pain, but when a combined aromatherapy is given with it, the outcome of it is still an unrevealed part (Sritooma *et al.* 20014).

Chronic Neck Pain

Now a days in our busy life neck pain is a common complaint. Poor posture may be the underlying cause of neck pain, where the muscles are badly strained. Osteoarthritis is one of the most common causes of neck pain. Sleeping in an awkward position is another causative agent of neck pain. Inflammation and injury can cause pain or stiffness in neck. Non-specific neck pain has a postural or mechanical basis and affects about two thirds of people at some stage, especially in middle age. Acute neck pain may resolve within days or weeks, but chronic pain is observed in about 10% of people. Whiplash injuries follow sudden acceleration-deceleration of the neck, such as in road traffic or sporting accidents. Up to 40 percent of people continue to report symptoms even after fifteen years of the accident, although the data varies between countries.

It is medically proved that aromatic essential oils actively treat several health problems without any prominent side effects. Essential oils for neck pain come from plants, roots, and herbs with medicinal properties are widely used in aromatherapy to induce relaxation and hence they may be alternative treatment for pain. Essential oils have anti-inflammatory effect that can relief neck and joint pain.

Pediatric Pain

Treatment of pediatric pain is more or less complex. The sedatives and opioids, that are suitable for adults, can damage the brain development in young ones (de Jong *et al.* 2012). Severe pain in pediatric patients is often associated with limited food and liquid intake, which in turn results in dehydration (Soltani *et al.* 2013). Moreover, most of the young children cannot accurately describe their pain to medical practitioners. Children being treated for serious illness often experience distress not directly related to their

illness; therefore a holistic approach to care is an integral part of treatment (de Jong *et al.* 2012). In 2003, a clinical study showed that when the infants were treated with lavender aromatherapy for pain associated with blood draw, infants in the aromatherapy group were soothed faster than infants in the control group - though there was no difference in pain during blood draw (Goubet *et al.* 2003). Again in 2013, Soltani *et al.* demonstrated that in a group of children recovering from tonsillectomy, those who were treated with lavender aromatherapy slept better and required 40% less acetaminophen than children in the control group (Soltani *et al.* 2013). A study of children who underwent craniofacial surgery, however, found that aromatherapy offered no benefit. This, may be due to several reasons which includes - the children being afraid of strangers massaging them or, massage was given too early after general anesthesia (de Jong *et al.* 2012).

Shoulder pain

Aftershock of a patient suffering from complete paralysis of the partial or half-side of the body experience a certain kind of stroke which is seen in around 60 percent of the patients known as hemiplegia, also continuously nag about a definite pain in their shoulder also. The shoulder pain i.e., the Hemiplegic shoulder pain (HSP) which the patients is generally accompanied with is due to certain kind of muscle feebleness, declined levels of motor strength and also feel a certain kind of dislocation of bone i.e., a kind of subluxation which is commonly medicated with various involvement of pharmacological treatments but accompanied with very unfriendly and hazardous consequential side effects. Certain physical activities or non-pharmacological alternatives like exercise, increased physical activity or biofeedback are seen to suppress the pain for a temporary time period but is not seen to have long term effects.

A small preliminary pilot experiment was conducted in 2007 for the treatment to relieve the HSP by using certain phytochemical treatments using the beneficial plants like rosemary, lavender and peppermint oils. The evaluating team regularly checked the aromatherapy acupressure for 20 minutes, twice a day to keep a check on the management of HSP. The pain levels of the treated group were compared with placebo group who didn't receive the aromatherapy. The concluding results showed the reduction in pain in either of the groups but the rate of pain reduction was seen to be better in the aromatherapy receiving group where the results showed around 30 percent pain reduction in the aromatherapy receiving group and a lesser effectiveness of around 15 percent pain reduction in the group which didn't use the aromatherapy (Shin and Lee, 2007).

Multiple Sclerosis Pain

A potentially disabling neurological disorder affecting the myelin sheath leading to its loss in the central nervous system termed as Multiple Sclerosis (MS) which further causes various communicative and inflammatory disturbances throughout the body. Various complementary problems accompanied with the MS that disturb the balance of the body is the feeling of fatigue, bladder distress , spasms, intestinal discomfort and various visual troubles, even many around three-fourth people affected with this disease also complain of unbearable kind of chronic pain which isn't controllable by various conventional methods, and even the ones who are affected with it consider it as a part of their life and get used to live with the pain. Anxiety and depression is a common trap which MS patients face due to the thought of living with the uneasiness of MS and thus, lead a stressful life (Howarth, 2004).

A qualitative study was done on the chronic pain accompanied MS patients using the aromatherapy massage which included of 50 patients and the sites of their massage varied based on the location in which they were having pain and each patient underwent a single aromatherapy massage session each month for a period of 4 months. Towards the end of the study, many patients gave a positive feedback describing the therapy to be helpful among which 78 percent still preferred to continue the therapy as it helped in reducing their pain and 88 percent of the patients said to have an improved sense of overall well-being, and 91 percent said reported have an improved relaxation and 55 percent stated to have a better sleep. On a whole, the pain medication through aromatherapy was observed to reduce the pain by 7 percent (Howarth, 2002). Absence of the placebo or control group further left a question behind that whether the better health was from aromatherapy or massage, thus decreasing the transparency of this method.

Menstrual Pain

The known pain which a woman goes through i.e., affecting around 25 to 97 percent of the women worldwide which is a very common body urge which every woman has passed through i.e., the menstrual pain (Hur *et al.* 2012) which has various intensity levels too, as about 15 percent of the young women, teens and adolescents go through is bit severe and even weakens them so much that they abstain themselves from their regular schedule and even skip their work, school, playing sports or enjoying any kind of activities during this time (Marzouk *et al.* 2013). A study done on the menstrual affected women among whom one group underwent the aromatherapy and the other were under the treatment with acetaminophen, the former group of women impressively showed a higher rate of relief as compared to the latter group, but the results remain unclear as to how the aromatherapy cab alone

ease the pain in this time (Hur *et al.* 2012). But later a randomized control group which received only massage and no therapeutic oils and the group of women receiving the aromatherapy were compared which showed that there was a considerable improvement in pain in the aromatherapy group as compared to the placebo group (Marzouk *et al.* 2013).

Post-Caesarean Section Pain

Post-surgery side effects is all face but a common complaint is all the patients is the pain they have after it. A similar pain is seen in the caesarean section where the pain bearable by the mother and the baby needs to be a safe and less painful one so, based on the pain they receive after the surgeries a study found that a single blind clinical trial done on the group who underwent caesarean section using the lavender aromatherapy was found to be effective (Hadi and Hanid, 2011) and when a similar triple, blind randomized controlled trial was done as much as 90 percent effectiveness was seen with the lavender aromatherapy treated group as compared to the placebo group which showed only 50 percent pain reduction. Heart rates were seen to be same in the both groups and the feeling of sickness and dizziness was lesser in the aromatherapy receiving group as compared the placebo-controlled group (Olapour *et al.* 2013). Individually both the studies determined that effective pain reduction was seen in the lavender group after caesarean section, the grave nature of surgery indicates that aromatherapy should be used as part of a multimodal post-surgery or after surgery pain management routine.

CONCLUSION

Aromatherapy shows significant positive report in pain reduction. The experimental data obtained in last 10 years points that aromatherapy is the safest option that can be done in combination to current pain management procedures as there are no adverse effects were reported. Moreover, the cost of aromatherapy is much less than the cost associated with standard pain management treatment. Though the reports available at present by meta-analysis indicates a large positive effect of aromatherapy for pain management, it should be kept in mind that the sample size is small. If we want to give prevalence to aromatherapy, more research with higher sample size is necessary to fully understand clinical applications of it.

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Chapter

8

Aromatherapy for Reducing Mental Stress

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ABSTRACT

Now-a-day's different types of diseases and treatments are in our knowledge, but there are some side effects which finally attacks on our physical and mental health. With poor mental health people can feel tired, restless and depressed. So, now a day's aromatherapy is being popular to get away from depressive symptoms. Aromatherapy is a holistic healing treatment that uses natural plant extracts to promote our physical and mental health and well – being. Humans have used aromatherapy for thousands of years. Pleasant smell or scent of plant products is a powerful thing. Essential oils are volatile oils, and can be used through diffusers, vaporizers, aromatic inhalers, or applied by massage. This book chapter explores some information that how aromatherapy can reduce our mental stress by inhaling, massaging, and in other ways. This information was compiled from different research works, journals, google search, etc.

Keywords: diseases, treatments, mental health people, holistic healing treatment

INTRODUCTION

In our daily runaway life, there is no time to relax and take care of our health. We are very busy in our daily life physically and in mental stress always. Physical stress can be released by proper exercise and keeping healthy diet, but mental stress is very difficult to release. Mental stress often gives a feeling of tiredness and depression. Depressive mind cannot feel good and they are attacked by many diseases like anxiety, insomnia, chronic illness, pain and other diseases.

At the same time when we feel tired and depressed, a pleasant aroma can change our mood. The delightfully charming and attractive aroma of certain

essential oils helps to inspiring happiness and to uplift the mood and makes the mind refreshed and energetic.

Aromatherapy is the use of essential oils for massage or inhaling. The essential oils are mostly used by inhaling them or by applying at the skin. The essential oils that can be used in aromatherapy are Chamomile, Tea tree, Lemon, ginger, Lavender, Rose, Jasmine etc.

Essential oils have been used for nearly 6000 years with the aim of improving a person's health or mood. According to researches aromatic oil from a plant has healing property. Essential oils are extracted either by steam distillation or expression or pressing. Distillation is the most prominent method because this technique involves steaming the plant matter until it breaks down and when it is extracted by the expression method, pressed from the plant source.

Some aromatherapy oils are concentrated which cannot apply directly in the skin, so, in this case, the oil is combined with a carrier oil to dilute its strength.

So, in the today runaway life style, aromatherapy is working perfectly to relax our mindset, and when our mind relaxes, we can feel energetic, because a pleasant smell can help to take away from depression, stress, tension, and improves our mental health. "Research has shown that aromatherapy can calm stress and is capable of affecting the nervous system, and essential oils possess various therapeutic qualities, such as anti-inflammatory, antiseptic, febrifuge [fever-reducing], and many more," says Yuan. "Holistic aromatherapy is dynamic, as various products have been created to support everything from stress, anxiety, headaches, insomnia, skin problems, musculoskeletal issues, sinus problems, and respiratory problems."

WHAT IS HAPPINESS

According to Sonia Lyubomirsky Elaborates (Positive Psychology Researcher) Happiness is "the experience of joy, contentment, or positive well-being, combined with a sense that one's life is good, meaningful, and worthwhile.

Happiness is a feeling, that describe the positive emotions, which include, joy, pride, contentment and gratitude. The term happiness always used as the factors of mental and emotional states. Mental health depends on positive emotions and sense of happy satisfaction or enjoyment. Since 1960' researches on happiness are going on and scientists research about social and positive psychology, and happiness economics (Wolfram Alpha-2011). Happiness is always a subject of debate on usage and meaning [Feldman, Fred (2010) and Smith, Richard (August 2008)]. The main factors of happiness are –the current experience of the feeling of pleasure and joy (physically and emotionally) [Wolfram Alpha-2011] and appraisal of life satisfaction such as quality of life [Graham, Michael C. (2014)].

The Nicomachean Ethics is the Aristotal's best- known work on ethics (written in 350BCE). In this work of Aristotal's happiness is defined as-Happiness is the only thing that human desire for their own sake. The term Eudaimonia, is a Greek word commonly translated as happiness –is an activity consists of the word 'eu' (good or well-being) and daimon (spirit), so it is understood that happy life is a good life.

In Buddhist teachings-there is a great role of happiness and it forms a central theam (*About.com, Religion & Spirituality.)* for them because they believe in 'Nirvana', which is a state of everlasting peace. Buddhism also encourages the generation of loving kindness and compassion, the desire for the happiness and welfare of all beings [Bhikkhu, Thanissaro (1999), Buddhanet.net.].

Patanjali, who is the auther of Yoga Sutras, wrote quite exhaustively on the psychological and ontological roots of bliss. [Levine, Marvin (2000).] In Advaita Vedanta –Happiness is the ultimate goal of life.

ESSENTIAL OILS PROMOTES HAPPINESS

In our daily runaway life, there is no time to stand and to take care of our personal life. So sometimes we feel bad and down and get stressed. Sometimes we get tired, irritate and depressed and the feeling comes that nothing is happening good. And after that anxiety attacks to our mind and we get restless. At that time massage of essential oils relaxes our body stress and a pleasant smell relaxes our mind.

Since ancient times Aromatherapy with essential oils is known to improve the mood and help us to get rid of that negative feelings. The delightfully charming or we can say attractive aroma of certain essential oils helps to inspiring happiness, and to uplift the mood and makes the mind refreshed and energetic. Essential oils not only promote happiness but also used to treat headache, stress, tension, depression and pain also.

Essential oils are volatile substances which are naturally extracted from plant parts like flowers, stem, leaf, roots, barks, etc. These are extracted by cold pressing, steam distillation or by solvent-extraction methods. The powerful and mysteriously attractive fragrance of essential oils helps to reduce stress, tention, and depression, and induces a joyful mood. Some essential oils improve blood circulation during massage. When we smell something good and pleasant our mood automatically changes. Aromatherapy products thus can be used as to improve mood and when mood is good, we already can get rid of stress and negative emotions. Aromatherapists always refer that how essential oils have power to affect a person's mood. According to researches it has revealed that when we smell an essential oil, it is possible that our mood improves with positive thoughts and we can feel stress free for some times.

Fig. 1

According to discovery of Stephen Warrenburg from oxford university, that an aroma can have a significant effect on stress reduction and it can help to improving mood condition. Since hundreds of years ago, Essential oils have been used to support overall mental health. People can use essential oils in different ways for example it can be inhaled or can be applied on skin through massage. When essential oils are inhaled it stimulates the Limbic System of Brain. Limbic System is a complex structure situated in brain that helps to regulate our emotions or emotional experiences, including our stress level. Essential oils have the power to change the body's neurochemistry, because the release of neurotransmitter serotonin can ultimately enhance mood because it reduces anxiety. But there are different types of people and their mood level are also different so they can response to specific essential oil according to their mood taste. So all essential oils are not perfect for every people.

Another question is that why our mood changes and we get stressed? There are so many factors that increases our stress level. For example, lack of quality sleep. If our sleep is incomplete, we feel restless and tired and stress is the second factor. The next one is our health and illness. If we are ill so cannot have a good mood. The next factor is our relationship level. We all are in a relationship and we have to manage between our relatives and family members. So, if our relationships are not good it gives stress. Another factor

is poor diet because in our daily routine we have not proper time to take our meal in time so it decreases our health level. The lack of proper exercise can also decrease our health level. So, there are different types of factors that make us unhappy. At that time the fragrant essential oils can change our mood and promote happiness and good health, because it has revealed that when we smell an essential oil, it is possible that our mood improves with positive thoughts and we can feel stress free for some times.

Fig. 2

Source: amaracourses.com

AROMATHERAPY HELPS TO CURE DEPRESSIVE SYMPTOMS

When we are in a bad mood feel depressive and restless, at that time inhaling of an essential oil can help to relax our mood. People always use essential oils as complementary treatment of depression. Essential oils are not cure for depression but they are drug free option that may help relieve some symptoms of depression.

So, what are depressive symptoms?

Depression is a medical condition which includes mood disorders that cause a persistent feeling of sadness and loss of interest. The common symptom of depression is the feeling of sadness. When we sad our body's energy level also decreases and it leads to tiredness. After feeling tiredness, we cannot able to concentrate on our work facing trouble on focusing, and it leads to unhappiness, which causes anger, irritability, and frustration. At that time,

we are not able to enjoy our life and loss of interest in pleasurable or fun activities became us more depressive. And finally, we are not able to sleep well and according to sleeping disorder we feel anxiety, which is a common symptom of depression. So, all these symptoms change our mood and at that time we want to leave alone. But sometimes a good smell and pleasant aroma helps to keep out of depression following cange in mood. Essential oils are not drugs but it has a power to give relaxation to our mind because it direct affects to our brain.

Aromatherapy is the use of different essential oils to improve our mood, mental state or health. Essential oils are made from the plant parts like roots, seeds, leaves and flowers. Essential oils are used alone sometimes but blended to create different combinations for different moods. People can use essential oils as room freshener, or they can take it during bath or can use as massage oil.

Now the question arrives that how aromatherapy work and what is its physiology and science?

There are lots of scientific evidences to support the topic that how it works on our sense perceptions. According to researches when aromatherapy is applied the aroma enters through the nose via the human olfactory bulb and travels to the limbic system of our brain which controls the emotions. According to researches there are numerous essential oils that can be used to reduce stress and anxiety. The popular oils are lavender, Damascus rose, Orange citrus, Lemon, Sandalwood, Jasmine etc. Here are some essential oils that promotes our good mood.

1. ***Caraway Essential Oil***: Extracted from seeds of Caraway plants which is also known as Meridian Fennel and Persian Cumin. It belongs to family Apiaceae, which is native to Western Asia, Europe and North Africa. Its fruit has a pungent aroma due to essential oils Carvone, Limonene, and Anethole [María D. López; María J. Jordán; María J. Pascual-Villalobo (2008)]. The scientific name of the plant is *Carum carvi*. The colour of its essential oil is pale yellow to brownish and has a thin consistency. Caraway essential oil has a pleasant aroma with some therapeutic compounds that have a soothing effect on the mind. After applying, it increases the feeling of harmony and trust, and decreases the mental stress and keeps energetic.

2. ***Clary Sage Essential Oil***: The botanical name of this plant is *Salvia sclarea* belongs to genus Salvia. It may be biennial or perennial native to Northern Mediterranean Basin, North Africa, and Central Asia. The plant is a herb and grown for its essential oils [Clebsch, Betsy; Barner, Carol D. 2003]. The essential oil is distilled and used in perfumes, wines and liqueurs and also used in aromatherapy [Kintzios, Spiridon E. 2000]. This oil is used in stress reduction because its power of scent calm the mind and reduces the feeling

of anxiety, stress, and tention. It can boost confidence, mental strength, hope and thus fights from depression due to loneliness.

3. ***Fennel Essential Oil***: The botanical name of this plant is *Foeniculum vulgare*, which is a flowering plant of carrot family Apiaceae [US Department of Agriculture]. Its flowers are yellow and leaves are feathery. It is indigenous to Mediterranean region but cultivated all over the world. Its flavor is aniseed or liquoric which comes from Anethole [Nyerges, Christopher (2016)]. Anethole is an aromatic compound also found in anise and star anise, and its taste and aroma are similar to their [Katzer's Spice Pages]. Fennel oil is believed to support a person's responsibility both spiritually and emotionally, so it is commonly used as an essential oil.

Fig. 3

Sources: www.gardeningknowhow.com/www.gardeningchannel.com

4. ***Levender Essential Oil***: It is one of the most useful and versatile essential oil for aromatherapy. It extracted from steam distillation. It is a flowering plant of the mint family-Lamiaceae. It is native to old world, found in Cape Verde, Canary Island, from Europe across the northern and eastern Africa, Mediterranean, South West Asia and South East India [www.hgtv.com. HGTV. Retrieved 19 October 2018]. The oil is clear to pale yellow in

colour,and it has a sweet, gentle, and floral scent. It is useful for easing the symptoms of anxiety, stress, melancholy, and insomnia. It is a great tonic for nerves because of its relaxing smell.

5. ***Rose Essential Oil:*** Rose is a perennial flowering plant which is woody in habit and belongs to genus Rosa in the family Rosaceae. There are more than 360 species of roses. Most species are native to Asia but also found in Europe, North America, and North Western Africa [Stevens, Donovan, and Daxton Ware 2018]. Rose flowers are characterized by a pleasant aroma which has anti-depressant property, helps to relax mind and body, alleviates all signs of pain, stress, tension, and depression. So, it is used as essential oil for aromatherapy.

AROMATHERAPY

We can use essential oils in different ways. Aromatherapists suggests to apply essential oils as massage, olfactory or used as cosmetics. In cosmetics essential oils can be used as facial, skin care, body and hair care products. But in massage when essential oils are applied in skin it gives a healing touch and relaxing effect.

In olfactory aromatherapy essential oils can be released into environment as room fresh nor, or they can be inhaled. Since ancient times aroma therapy is used to improve our emotional level. When scent of essential oil is spreaded through the air the pleasant smell activates smell receptors inside the nose, which sends message to brain and then our emotions and nervous system influenced [Sowndhararajan K, Kim S. 2016].

Aromatherapy refers to use scent of essential oils for therapeutic purposes. It is generally believed that different types of aroma activate our mind and emotions in different level. Today in market different types of aromatherapy inhalers are available. Aromatherapy inhalers are great way to use essential oils for various health benefits. According to researches aromatherapy essential oils not only improve our emotional level but it also affects in our physical workout. Our sense of smell is directly connected to that part of brain which controls memories, emotions and hormones. So, inhaling of essential oils are very powerful process to control and improve our emotions. Inside the aromatherapy inhalers concentrated amounts of essential oils are found and the inhalers are portable and convenient way to use essential oils.

The system of the body's involved in the sense is called the olfactory system. The olfactory system is very old, according to evolutionary history of life, so its connection to the oldest areas of the brain is relatively direct. For aromatherapy, essential oils work by affecting our sense of smell. The human brain is easily influenced by the smell around it. These senses can induce wakefulness, relaxation, focus and more. One of the main benefits of essential

oils is their ability to reduce anxiety and stress. Here are some common essential oils -----

- Spearmint-----Reduces Headache and Nausea
- Lavender ----calms, relaxes and aids with sleep.
- Sweet Orange---Boosts mood and soothes anxiety.
- Clary sage---Reduces Depression, balances hormones and boost circulation.

Another type of using aromatherapy is to use as massage. Aromatherapy massage is used for a variety of different reasons. Aromatherapy massage can help in relaxation, pain management and improved mood. Massage therapy itself consists of the manipulation of muscle and lymph nodes through professional pressing and rubbing techniques. The overall purpose of aromatherapy is meant to improve our physical and mental health.

There are several types of massage that focus on different parts of the body or healing approaches. Massage is the practice of rubbing and kneading the body using the hands. Aromatherapy massage are best for people, because it gives an emotional healing. This type of massage can help boost your mind, reduce stress and anxiety, reduces symptoms of depression, relieve muscle tention and relieve muscle pain.

In aromatherapy massage a soft and gentle pressure put on muscle with the use of essential oils. The most common use of aromatherapy massage is to relieve stress. Aromatic compounds are not only known as relaxants but also sooth the mind and eliminate anxiety. Some common essential oils for massage are---lavender, lemon oil, peppermint, vetiver, ylang-ylang etc.

Fig. 4

CONCLUSION

The conclusion of above discussion is that Aromatherapy is the practice of using the natural oils extracted from flowers, bark, stem, leaves, roots, and other parts of the plant to enhance physiological and physical well-being. When essential oils are inhaled, it is believed widely that, it stimulates brain functions and when applying massage, it is absorbed through skin, and travel inside blood stream to promote whole body healing. Aromatherapy is popular as an alternative medicine, because it is used for a variety of applications, including pain relief, mood enhancement, and increased cognitive functions. Many types of essential oils are available but each oil has its own healing property. For example- Jasmine oil's aroma has a pleasing, uplifting effect on mind and fights depression.

But sometimes Aromatherapy carries a number of risks of adverse effects (Posadzki P., Alotaibi A. and Ernst E. 2012). Most oils can be toxic to humans, and can be extremely toxic when taken internally. According to report ingestion of sage, hyssop, thuja, and cedar oils can damage liver [Millet, Y; Jouglard, J; Steinmetz, MD; Tognetti, P; Joanny, P; Arditti, J (1981)]. There are no medical evidence that aromatherapy can prevent and cure any disease but it strongly helps to improve our mood and take out of depression and stress. Because the delightfully charming or we can say attractive aroma of certain essential oils helps to inspiring happiness, and to uplift the mood and makes the mind refreshed and energetic. Essential oils not only promote happiness but also used to treat headache, stress, tension, depression and pain also. So that Aromatherapy is popular in our daily runaway life for taking care of our mental health.

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Chapter

9

Plant Resins Used in Aromatherapy

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ABSTRACT

Plant resins have become important in recent years for their use in aromatherapy. This chapter deals with different types of resins, their sources with the characteristics along with medicinal values. The plant resin is used for improving sleeping quality, reducing headaches, migraines, labor pain, relieves from stress and anxiety, improved digestion and also responsible for building stronger immune system. About 33 different types of oleo resins with their plant sources are reported here. Essential oil or volatile oil is distilled by steam distillation from the resins from some plants are also used to treat bronchitis and arthritis.

Keywords: Aromatherapy, Resins, Traditional healing system, Volatile oil

INTRODUCTION

Aromatic and medicinal products are generally derived from all the plant parts like stems, roots, tubers, stem barks, flowers, fruits, seeds, and roots and also derived from animal sources. Several plant species produce aromas which is present in resins, gum resins and oleo gum resins. Many species also produce aromatic resins that can be used in aromatherapy. Aromatherapy has been used from thousands years ago as a major part of holistic healing that is used for healing of the mind and body. The plant resin is reported to have many health benefits viz. improving sleeping quality, treatment for headaches, migraines, relieves from stress and anxiety, reduces labor pain, improved digestion and responsible for building stronger immune system (Website, 1). Natural resins are produced as a thick, sticky and sometimes solid substance from the injured parts of some plants. Natural resin provide therapeutic effect and some are used in aromatherapy. Resins are commonly

used for loose incense. Hard resins can be powdered and added to infused oils and incense powders for medicinal uses. A resin is the sticky ooze exuding from the tree, mostly from the plant species belonging to Pinaceae family. It is formed as an oxidation byproduct of essential oils and oozed out from the bark of the tree and then hardened after exposure in air. Resins are insoluble in water but dissolves in alcohol and other solvents. Resins are used to make glues, waterproof varnishes and aromatic and medicinal products. Resins are enriched with amazing aromas and many plant species produce aromatic resins.

ESSENTIAL OILS FROM RESINS

Plant resins can be used in aromatherapy for their powerful natural smell and that can calm a head ache or can change the mood. Aromatherapy has been used as a major part of holistic healing from more than thousand years. Most essential oils are extracted from leaves, barks, stems, roots, flowers and fruits, but few essential oils are also derived from resins like elemi, mastic, benzoic resinoid, frankincense and myrrh. Most popular way of using this essential oil is the use of diffuser for dispensing the essential oils in to the air as a result it can be inhaled and absorbed by the body. Essential oils are used in cosmetic products viz. shampoos, perfumes, and bath products. As the essential oils is generally diluted with carrier oil as these are highly concentrated. Essential oils can also be applied to the skin to treat burns. Essential oils viz. frankincense, myrrh and elemi are distilled from resin and are used in aromatherapy, perfumery and to fragrance the rooms and enhance calming the mind and spiritual feelings. Mastic essential oil is distilled by steam distillation from the resins from mastic tree and this oil is used to treat bronchitis and arthritis.

Types of Resins

Different types of resins are found from natural resources. Resins are secreted in particular cavities and oozes frequently through the bark. Commercial resins are derived from fossil material. Generally these are derived from Anacrdiaceae, Leguminoceae, Umbelliferae, Liliaceae and Pinaceae. The resins are attributed with the characteristics that can be dissolved in alkali to soap. Resins are also used as medicines and for making incense and perfumes. Four types of resins are there viz. gum resins, hard resins, oleoresins and gum resins. The characteristics attributed to different resins along with their uses are enumerated in Table 1. Different types of resins and their sources are depicted in Table 2.

Table 1: Types of resins and their characteristics

Types of Resins	Characteristics	Solubility in Water	Solubility in Alcohol	Composition	Uses	Example
Gum resins	Naturally occurring as milky exudates	Partially	Mostly	Combination of gum and resin	Perfumery, and also used medicinally	Galbanum, Myrhh
Hard resins	Unusual hard aromatic fossil resin	No	Yes	Non volatile with very little essential oil	Varnishes, Adhesive	Amber
Oleo resins	Liquid or semi solid	No	Liquefy with alcohol	Contain resin and significant amount of essential oil	Falvours, Perfumes and also used medicinally (Website 2)	Turpentine balsam, benzoin, elemi, copaiba
Oleo gum resins	Solid Plant Exudation	Partly soluble in water	Partly soluble in alcohol and oil	Combination of volatile oil, gum and resin	Used by herbal industries	Bdellium Asafoetida, Myrrh, Amoniacum, Turmerric

Table 2: Plant Sources of Different Resins

Types of Resins	Names	Examples	Uses
Resin	Pine	*Pinus sylvestris* L.	Used as insecticides/Cosmetics/Aroma and flavor compounds, food additives (Swift, 2004, Tholl, 2006; Bohlmann & Keeling 2008)
	Copaiba	*Capaifera pauper* (Herzog) Dwyer	Used as anti-inflammatory and healing agent(Carvalho, et al., 2005) / Antineoplastic/bronchitis/Skin diseases and ulcer (Brandao, 2008)/ Analgesic/Cosmetic industries in making shampoos, soaps, lotions, creams, bathing foams(Gomes et al., 2008; Paiva, et al., 2002; Pieri, et al., 2009; Santos, 2008)
		C. glycycarpa Ducke	Skin and inflammatory diseases/Cosmetics industries/Soaps, perfumes/ Respiratory diseases (Arruda, et al., 2019)
	Fir	*Abes balsamea* (L.) Mill.	Used to relieve from cold/Incense/Air freshner (Website,3)
	Spruce	*Picea mariana*	Used for treatment of acute and chronic wounds, burns and fungal infections/Has antimicrobial, wound healing and skin regeneration effect/ Chewing gum/ calming, elevating mood/Anti-inflammatory (Website, 4)
Oleo resin	Pine	*Pinus sylvestris*	Source of Aroma and used in flavor and fragrance industries
	Balsam of Peru	*Myroxylon pereirae*	Used for healing wounds and skin diseases, antiseptic effect on mucus membrane/relives coughs and bronchitis
	Balsam of Tolu	*M. balasamum*	Used as expectorant and antiseptic in the treatment of coughs, colds and bronchitis/Used as fixative in perfume and soap industries
	Elemi	*Canarium luzonicum*	Hardens with air exposure/Perfumes/Medicine in plasters and ointments (Website 5)
	Damar	*Dipterocarpus alatus* Roxb. Ex. G. Don	Mixed with bees wax and used as bandages for ulcerated wound/Fixative in perfume
	Copal/ Dammar gum	*Agathis dammara* (Lamb.) Rich	Used in industry especially in varnish production, used in oil painting and medicine

Gum resin	Frankincense	*Boswellia sacra* Flueck.	Used in perfumes, Face powder, pastilles and in fumigating powders (Website 5)
	Myrrh	*Commiphora myrrha* (Nees) Engl.	Perfumery/Used in medicinal purposes as tonic, stimulant, antiseptic and also used in mouthwashes and dentrifrices (Website 5)
		Commiphora erythraea	Used in making incense, perfumes (Website 5)
	Bdellium (Guggul)	*Commiphora wighti* (Arn.) Bhandari	Used in incense and Perfumery/promotes physical well being (Website 6) medicinally used in rheumatism, arthritis, thrombosis/it has carminative and antispasmodic properties
		C. African (A. Rich.) Engl.	Perfumery industries
Oleo gum resin	Myrrh	*Commiphora myrrha* (Nees) Engl.	Used as incense, perfumes/Analgesic for toothaches, sprains [18]/relives cold, cough, asthma, lung congestion and arthritis pain (Al Faraj, 2005)
	Frankincense (Olibanum)	*Boswellia sacra* Flueck.	Relives from cough/Anti-inflammatory/Antiathmatic/Immuno-modulatory (Rashan, et al., 2019)
	Opopanax	*Opopanax chironium* W.D.J. Koch	Used to treat spasm/Asthma/chronic visceral infection(Remington & Wood, 1918; Website, 7)
		Commiphora kataf	Perfumery and medicinlly
	Asafoetida	*Ferula foetida* L.	Used as nerving stimulant in nerve disorders/carminative/Laxative
	Ammoniacum	*Dorema ammoniacum* D. Don	Used as stimulant/expectorant in chronic bronchitis/Also used as plaster of Paris plaster to stimulate the skin (Website 8)
Hard resins	Courbaril	*Hymenea courbaril* L.	Used in making incense and varnish (Ripley et al., 1879)

Sources of Oleoresins

Natural occurring oleoresins are known as balsam. Oleoresins are obtained from flowers and most oleoresins are used for flavor and fragrance or perfume (Website, 9). Oleoresins are a combination of resin like viscous liquid or semi solid materials and volatile oil which is naturally present in plants. Volatile oil releases the aroma and resin components contain non volatile matter such as fat, pigments, wax and pungent constituents. Oleoresin can be extracted from finely powdered plant materials with a hydrocarbon solvent. Oleoresin possesses the aroma and flavor of its source. The solvent is removed completely by vacuum distillation. This solvent can be reused in this process. Oleoresins are stronger of about 5-10 times in flavor than the corresponding spices but are weaker than their essential oil. Oleoresin contains essential oils, fixed oils, pigments, pungent components and natural antioxidants. Physical characteristics range from viscous oil to thick paste like substance. Heavy oils in oleoresin contain important flavor notes that are absent in volatile oil. A one stage or two stage extraction is required for extraction of oleoresin. In the first method the oil along with the resin is extracted by solvent extraction process and in the second method, the oil is extracted by steam distillation followed by solvent extraction to recover the oleoresin. The yield of volatile oil of Frankincense obtained by hydro distillation of the finely powdered oleo gum resin derived from *Boswellia sacra* was 5.5%. The oil was colourless, with a balsamic slightly spicy and perfumery odor (Al-Harrasi, & Al-Saidi, 2008).

The pharmacological activities of frankincense, as crude extracts, the distilled essential oil and the isolated compounds have been investigated. According to several published reports the frankincense essential oil exhibits *in vitro* antibacterial, antifungal and immune-modulatory activity (Mikaeli *et al.* 2003; Hamm *et al.* 2005; Kumbmarawa *et al.* 2006; Mathe *et al.* 2004; Frank & Unger, 2006; Umezu *et al.* 2000; Sharma *et al.* 1988; Singh & Atal, 1986). Balsam is aromatic oleoresins and from this essential oils can be extracted by distillation process. Balsam is extracted from Balsam of Peru (*Myroxylon pereirae*) and Balsam of Tolu *M. balasamum belonging* the family Fabaceae. Benzoin also is an oleoresin with vanilla aroma and comes from Sumatra benzoin (*Styrax benzoin*) and Siam benzoin *Styrax tonkinensis* belonging to family Styracaceae. But Elemi is one type of oleoresins that hardens in exposure to air. Copaiba is also aromatic oleoresin from *Copaifera* species of Fabaceae family. Copaiba is obtained by boring holes in to the heartwood (Website, 1 Resinoid is used in perfumery as a fixative and is less volatile than essential oil. It is extracted using the solvent from resinous plant material. Resins and gum resins are extracted from plant sources. Several other studies investigated the anti-inflammatory, anti-leukotriene, antiacetylcholinesterase, and anticancer activity of the resin and especially its major components, the boswellic acid

derivatives (Ali *et al.* 2008; Wahab *et al.* 1987; Ammon *et al.* 1993; Ammon *et al.* 1991; Gupta *et al.* 1997; Gupta *et al.* 1998; Shao, *et al.* 1998).

Table 3: Oleoresins and Plant Sources

Sl. No.	Oleoresin	Scientific Names	Family
1	Black Pepper Oleoresin	*Piper nigrum* L.	Piperaceae
2	Capsicum Oleoresin	*Capsicum anum* L.	Solanaceae
3	Cardamom Oleoresin	*Elettaria cardamomum* (L.) Maton	Zingiberaceae
4	Cassia Oleoresin	*Cinnamomum cassia* (L.) L.J.Presl	Lauraceae
5	Celery Oleoresin	*Apium graveolens* L.	Apiaceae
6	Clove Oleoresin	*Syzyzium aromaticum* (L.) Merr. & L.M. Perry	Myrtaceae
7	Coriander Oleoresin	*Coriandrum sativum* L.	Apiaceae
8	Cumin Oleoresin	*Cuminum cyminum* L.	Apiaceae
9	Fennel Oil	*Foeniculum vulgare* Mill.	Apiaceae
10	Fennel Oleoresin	*Foeniculum vulgare* Mill.	Apiaceae
11	Fenugreek Oleoresin	*Trigonella foenum-graceum* L.	Fabaceae
12	Garlic Juice	*Allium sativum* L.	Liliaceae
13	Garlic oil	*Allium sativum* L.	Liliaceae
14	Ginger Oleoresin	*Zingiber officinale* L.	Zingiberaceae
15	Green Chilli Oleoresin	*Capsicum anum* L.	Solanaceae
16	Green Tea	*Camellia sinensis* (L.) Kuntze	Theaceae
17	Horse Radish oil	*Cochlearia armoracia* L.	Brassicaceae
18	Lemongrass oil	*Cymbopogon citratus* (DC. ex Nees) Stapf	Poaceae
19	Mace oil	*Myristica fragrans* Houtt.	Myristicaceae
20	Mustard oil	*Brassica nigra* (L.) Koch.	Brassicaceae
21	Nutmeg Oleoresin	*Myristica fragrans* Houtt.	Myristicaceae
22	Onion juice	*Allium cepa* L.	Liliaceae
23	Onion oil	*Allium cepa* L.	Liliaceae
24	Oregano Oleoresin	*Oreganum vulgare* L.	Lamiaceae
25	Paprika Oleoresin	*Capsicum anum* L.	Solanaceae
26	Pimento Oleoresin	*Pimenta dioica* (L.) Merr.	Myrtaceae
27	Rosemary Oleoresin	*Rosemarinus officinalis* L.	Lamiaceae
28	Sage Oleoresin	*Salvia sclarea* L.	Lamiaceae
29	Tamarind Oleoresin	*Tamarindus indica* L.	Fabaceae
30	Thyme Oleoresin	*Thymos vulgaris* L.	Lamiaceae
31	Turmeric Oleoresin	*Curcuma longa* L.	Zingiberaceae
32	Vanilla extract	*Vanilla planifolia* Jacks. Ex Andrews	Orchidaceae
33	White pepper Oleoresin	*Piper nigrum* L.	Piperaceae

Applications of Oleoresin

Most oleoresins are used as flavors and perfumes. Oleoresins are used as coloring agent in food industries to make snacks, butter, cheese and meat products. It is required in the preparation of jelly, jam, and gelatin to give a desired color and also it is used in the preparation of medicines and also in cosmetics industries particularly for making soaps, cosmetics, candle, and hair lotions. Oleoresins are easy to store, more heat stable, and longer shelf life because of low moisture content and have same properties as the original spice.

Oleo gum resin

Oleo gum resin resins contain resins, gum and volatile essential oils and have medicinal values. It is solid exudates from specific plant species and they are used in culinary as well as have medicinal properties. Different oleo gum resins are asafoetida, ammoniacum, myrrh etc. Asafoetida is the exudates from the rhizome after decapitation of *Ferula assafetida* L. and *F. foetida* L. Asafoetida contains 8-16 ^{0}C volatile oil, about 25% gum and rest 40 to 60 percent resins. It is attributed with many medicinal properties viz. carminative, expectorant, laxative and also antispasmodic. Ammoniacum is derived from the stem after flowering and fruiting from *Dorema ammoniacum* D. Don belonging to family Umbelliferae (Website, 9). It is used in the treatment of bronchitis as an expectorant.

CONCLUSION

Resins are not used in only making varnishes, paints and culinary uses rather different aromatic resins, oleo resins and oleo gum resins are also used in cosmetics, soap industries, perfumery as a fixative and also used in making incense. Apart from that the essential oils and the aromatic compounds present in resins also plays an important role in treatment of various ailments viz. improving sleeping quality, treatment for headaches, migraines, relieves from stress and anxiety, reduces labor pain, improved digestion and responsible for building stronger immune system. This chapter will help the researchers to know about different essential oils produced from resins for keeping the psychological and physiological wellbeing.

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Chapter
10

Commercial Perspective of Essential Oil

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ABSTRACT

Essential oils are liquid aromatic volatile compounds from plants which are a good source of natural products, which possess antimicrobial and antioxidant properties. In addition to it essential oils have been used as medicine and as the natural additives for the shelf-life extension of food products. It is also incorporated into packaging, in which they can provide multi functions termed "active or smart packaging." Essential oils (EOs) are highly concentrated materials extracted from leaves, stems, flowers, seeds, roots, fruit rinds, resins, or barks. EOs are frequently used for their therapeutic, odoriferous, and flavor properties, in an extensive selection of products like cosmetics, foods, and medicines. Which includes different methods like maceration, cold pressing, solvent extraction, effleurage, hydro distillation, carbon dioxide (CO_2) and super critical CO_2 extraction, turbo distillation, and steam distillation which are previously discussed in other chapters. The essential oil is good source of natural products.

Keywords: Essential oil, Supercritical (CO_2), Antimicrobial, Hydrodistillation

INTRODUCTION

Essential oils are volatile aromatic liquids extracted from plants which are a good source of natural products. Different parts of plants such as roots, stems, bark, leaves, flower and bud are the origin for the oil. Essential oils found in different aromatic plants, vary in odour and flavour, which are controlled by the types and amount of constituents present in oils. The amount of essential oil from various parts of the plants is different which is a cheap factor for the price of essential oil. Apart from the aroma of the essential oil (Abdollahi *et al.* 2003 and Kanikkannan *et al.* 2004). The indigenous pigments impart

various colors' to essential oil. Therefore it can be widely used in the food industries as a colorings agent. Essential oils have been known to possess antioxidant and antimicrobial activities and this therapeutic properties has a broader application in the pharmacological industry. Which comprises its use in aromatherapy and healing the disease (Gaysinsky, 2005). In addition to the above said, it can be found its application as a packaging material for its hydrophobicity property (Hennesy *et al.* 2004 and Panchagnula *et al.* 2004). Essential oil has also shows physiological effect on plant as it is able to seduce pollinators and help in the process of pollination. This property of essential oil is less explored which should be given due importance in terms of commercial perspective (Burt, S. 2004 and Croteau, 2000).

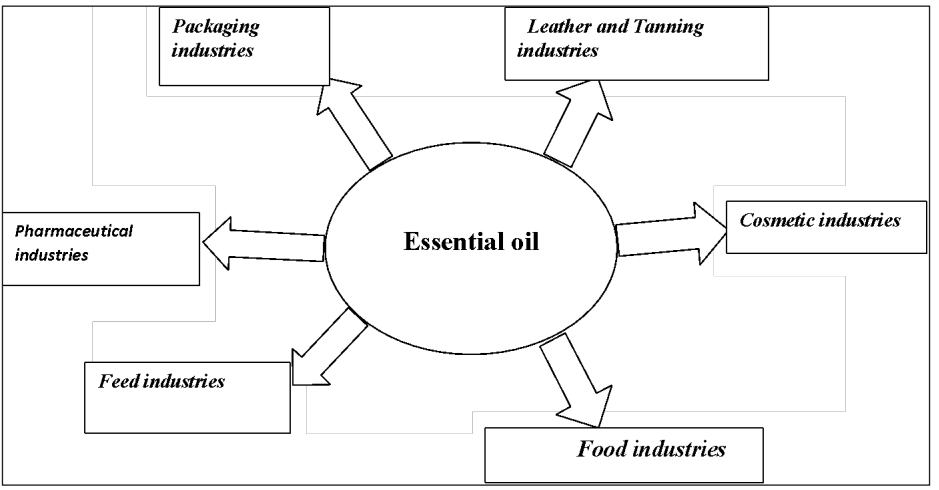

Fig. 1: Graphical representation of Industrial Application of Essential oil

APPLICATION OF ESSENTIAL OIL

Leather and Tanning industries

Microorganisms can quickly colonize on dress and footwear. Most of them are infectious causing harm to people. Leather, which is a natural product, serves as a medium for the growth of microbes. In current times the leather industry is using pentachlorophenol as a biocide (Calcabrin *et al.* 2004 and Dale *et al.* 1981). However, most of the countries has banned the use of this compound as it is toxic to human health. Now most of the consumers have a higher preference for natural products than the synthetic (Amnuaikit *et al.* 2005 and Isman *et al.* 1990). From the literature review it has been well proven that Essential oil has antibacterial, antifungal and antiviral activity. Also due to low molecular weight it can easily penetrate into cells of microbes and can

work effectively (Isman *et al.* 1990 and Hennessy, B. & Joyce, A. 2004). Due to presence of above mentioned criteria it can be used effectively as biocide in the leather and tanning industry. For example now a days the leather and tanning industry is using Eucalyptus and Lavender as Natural Preservative

Cosmetic industries

The skin of human beings are constantly exposed to ultraviolet radiation, pollutants and chemical oxidants. All these produce reactive oxygen species which is the major contributor for depleting antioxidant defence of the skin, and thus enhancing the skin ageing process. However, exogenous application of antioxidants can be a preventative measure to minimize the endogenous antioxidant depletion. This approach will decrease the ROS induced ageing process (Barocelli *et al.* 2004 and Al-Hader *et al.* 1994).

More recently claims that Essential Oil used for aromatherapy have antioxidant activity and can easily penetrate the skin is well proved (Al-Hader *et al.* 1994). Generally the antioxidant property of EOs can be attributed to the presence of phenolic compounds and phenolic terpenoid compounds. Thus increasing the efficacy of the Essential Oil in cosmetic industries. For example, Essential oil from citrus shows free radical scavenging activity due to which it shows a wide array of application in the cosmetic industry (Kanikkannan *et al.* 2004).

Food industries

Generally previously the EOs are used for flavoring and colorings agents in food industries. However in the present time a new role has been played by EOs in food industries. It acts as a preservative and increases the shelf-life of processed food. Food borne disease is a major concern for the world. The antimicrobial activity of essential is well explored and documented therefore the EOs could be effectively used as preservative in food (Hennessy, B and Joyce A. 2004). The major constituents of essential oil which are responsible for antioxidant properties are phenols, terpenoid and polypropene.

From literature review it has been proven that EOs such as citral, citronella, citronellol, eugenol, farnesol, and nerol could protect chili seeds and fruits from fungal infection for up to 6 months. Essential oil from *Ageratum conyzoides* successfully controlled rotting of mandarins by blue mold and increased mandarin shelf-life by up to 30 days (Cheng *et al.* 2001). It has been well established by investigation that essential oils from *Cymbopogon nardus, C. flexuosus*, and *Ocimum basilicum* that they could significantly control anthracnose in bananas and increased banana shelf-life by up to 21 days. *Cymbopogon flexuosus* essential oil is capable of protecting against rotting of Moushumi fruits for up to 3 weeks (Keravis, G. 1997).

Feed Industries

Essential oil are a good alternative to the synthetic growth promoter. They represent the major groups of phytogenic feed additives. Generally, it is safer than antibiotics which act as a factor in growth promotion. The essential oil has a huge potential in the feed industry. They can be widely used as feed additives (Mathew, B. *et al.* 1996 and Narishetty, S. & Panchagnula, R. 2004). As antibiotics are giving drug resistant pathogens which have a deleterious effect on the health of humans. They are used in feed industries as flavoring agents and appetizers. In investigation supported by the result it was found out that Essential oil such as caraway, cinnamon and clove could be effectively used as feed additives in pigs. It has been well documented that EOs can improve the digestion of pig and poultry. Pig prefer garlic and rosemary in feed than ginger (Seymour R. 2003 and Safir, O. *et al.* 1998).

Pharmacological Industries

Essential oil has a wide array of applications in medicine and aromatherapy. Aromatherapy is the use of fragrances to cure the disease. For example in Chinese folk there is a claim that inhalation of *Aconus gramineus* rhizome will cure epilepsy. The fragrance compounds, jasmonate, which characterized the aroma of *Jasminum grandiflorum* have a tranquilizing effect on the brain upon inhalation. Lavender essential oil demonstrated an analgesic activity, mainly relevant after inhalation at the doses devoid of sedative side effects (Ghoulami, S. *et al.* 2001 and Thomas N. *et al.* 2003).

Essential oils are known for their therapeutic properties hence, used in the treatment of various infections caused by both pathogenic and non-pathogenic diseases. Strong *in vitro* evidence indicates that essential oil can act as antibacterial agent against a wide spectrum of pathogenic bacteria strains including; *Listeria monocytogenes, Linnocua, Salmonella typhimurium, Shigella dysentria, Bacillus cereus* and *Staphylococcus aureus* (Hulin V. *et al.* 1998 and Zhang Y. *et al.* 2016). The presence of phenolic hydroxyl group in carvacrol particularly is credited with its activity against pathogens such as *Bacillus cereus* Essential oil with high concentration of thymol and carvacrol e.g. oregano, savory and thyme, usually inhibit gram positive more than gram-negative pathogenic bacteria (Yang, X.N. *et al.* 2015 and Loutrari H. *et al.* 2004).

Essential oils show bactericidal activity against oral and dental pathogenic microorganisms and can be incorporated into rinses or mouth washes for pre-procedural mouth control. Mouth rinses containing essential oils with chlorhexidine gluconate are commonly used as preprocedural preparations to prevent possible disease transmission, decreases chances of postoperative infections, decreases oral bacterial load and decreases aerosolization of

bacteria (Swanson K.M., Hohl, R.J. *et al.* 2006 and Ultee A., Kets W., Smid E. *et al.* 1999).

Besides their antibacterial and antifungal activities, essential oils have also been reported to possess interesting antiviral activities alternative to synthetic antiviral drugs. They have demonstrated virucidal properties with the advantages of low toxicity (Ultee A., Kets W., Smid E. *et al.* 1999 and Wagstaff A., Faulds D., Gona K. *et al.* 1994).

Essential oils can also be used for the treatment of non-pathogenic diseases. Essential oil from garlic significantly lowered serum cholesterol and triglycerides while raising the level of high-density lipoproteins in patients with coronary heart diseases. Essential oils and their individual aroma components showed cancer suppressive inactivity when tested on a number of human cancer cells lines including glioma, tumours, breast cancer, leukaemia and others (Yamada K. *et al.* 2005 and Zinoviadou K.G. *et al.* 2009).

Recent trends in market of Essential Oil

The essential oil market was estimated to be $808.6 million in 2018 and going to increase at the rate of 8.7% to $ 15,618.8 million in 2026 (Yildirim M., Hettiarachchy N.S. *et al.* 1997 and Smet, H., Van Mellaert, H., Rans, M. *et al.* 1986 and Smet, H., Van Mellaert, H., Rans, M. *et al.* 1986).

Based on the essential oils market forecast by application, the food & beverage segment was the most prominent segment accounting for maximum share in the global market. This can be attributed to strict government regulations regarding food safety and limit in usage of synthetic flavours and essence food stuff. The rise in adoption of essential oil as a natural ingredient in preparation of food acts as the major driving factor (Ouhayoun, J.P. 2003. and El-Kattan, A., Asbill, C., Kim, N. *et al.* 2001). The cleaning and home segment was the fastest growing application segment and the growth of this segment can be attributed to rise in affinity of the consumers toward chemical free solution for cleaning. Moreover, the pleasant fragrance of the essential oil based cleaning products makes it more popular among various consumer profiles (Saxena, B.P., Koul, O. *et al.* 1987 and Koo B., Lee S., Ha J. *et al.* 2003).

CONCLUSION

The use of essential oil is immense and it is widely applied in several fields such as pharmacy, cosmetic and aromatherapy. In this era of climate change there is an increase in multidrug resistance pathogen at an alarming rate. It is one of the greatest challenges to combat the situation. Therefore, therapeutic properties of Essential Oil can be widely used in pharmacological industries and in naturopathy. Whereas its flavoring and colorings agent will find its application in food industries Antimicrobial activities and antiviral

activities are shown by essential oil which are useful as natural remedies. Essential oils can be used as a suitable therapy for many pathogenic and non-pathogenic disease. In the cosmetic and in the food industry, essential oils use is an integral part, as they may play different roles. Therefore, economic importance of essential oils is indispensable.

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