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Review article

A review on essential oil extraction from ornamental crops : method & prospects

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ABSTRACT

Essential oils are secondary metabolites composed of terpene derivatives an accumulated in trichomes (outgrowth from the epidermis of plant). According to the industry sources more than 3,000 essential oils are known, out of which 300 use for commercial purposes. Essential oil is known to occur in leaves of some plants like marigold and lavender and in flowers of rose, jasmine, champaka and tuberose. Essential oil contains on an average 100 chemical components, some are antibacterial, antiseptic, antidepressant. Oil is used in aromatherapy, perfumery, pharmaceuticals and carminative. Major constituents in rose are 1-Citronellol, Nerol, Geraniol, Linalool and Eugenol used in moisturizer, perfume whereas in jasmine are Benzyl ethanoate, Salicylic acid methyl ester, Methyl 2-aminobenzoate, Benzoic acid benzyl ester used in antiaging creams. In tuberose Eugenol, Benzyl Alcohol, Farnesol and Methyl benzoate are the major constituents used in aphrodisiac.Essential oil is extracted through various methods including distillation (Rose, Jasmine, Chrysanthemum), solvent extraction (Rose), soxhlet extraction (Chrysanthemum), Maceration (Jasmine), Enfleurage (Tuberose), CO_2 extraction (Jasmine, Marigold). A lot of exogeneous (light, temperature, seasonal variation and soil), endogenous factor (part of plant, age of plant) effect the quality of essential oil. Estimated world production of essential oil is 2,50,000 tones, global export of essential oil increased about US$ 8254. In this review paper we have discussed the importance of essential oils of common flowering plants, their extraction methods, marketing and prospects.

***Keywords*:** Antiseptic,aromatherapy,distillation, essential oil, perfumery, solvent extraction

INTRODUCTION

Floral essential oils are essentially derived from the flowering parts of plants, capturing the naturally sweet and floral scents found in flowers. These oils, renowned for their aromatic qualities, are commonly utilized in perfumes and other fragrances, and are readily available for both fragrant and medicinal purposes. The growing global interest in natural and nature-based products has propelled a green movement, contributing to the expanding applications, ensuring a promising future for the essential oil and aroma industry.

There are total of 3,000 known varieties, find applications in diverse fields due to their complex compositions, containing various chemical components with different functions(Sankarikutty *et al.,* 2003). These are secondary metabolites, vast mixtures of organic substances primarily composed of terpene derivatives and phenyl propanoids, and are accumulated in specialized structures like glandular cells and glandular trichomes. Regardless of the source, essential oils have intricate compositions, including alcohol, alkanals, acetone, hydroxybenzene, organic esters, alkoxy compound, terpenoids, *etc*. Commercially extracted oils commonly come from flowers like jasmine, rose, tuberose, marigold, plumeria, champak, magnolia, millingtonia, and ylang-ylang.

Essential oils and their uses

Chemically, essential oils are volatile compounds with varying therapeutic effects, influenced by factors like extraction methods and plant growth conditions. Physically, environmental factors such as altitude, geographical location, and harvesting methods can alter the chemical components. Aromatically, true essential oils have

subtle, plant-like scents, while spiritually; each plant is believed to have a healing element, historically used for protective purposes (Halder *et al*., 2018).Essential oils find diverse applications, such as in aromatherapy, skincare products, massage, relaxation, and household cleaning. Aromatherapy utilizes essential oils to promote relaxation and well-being, with specific oils believed to have therapeutic properties. Essential oils with beneficial skin properties are commonly incorporated into skincare products, while their use in massage oils helps relieve muscle tension and induce relaxation. Additionally, some essential oils with natural antimicrobial properties serve as alternatives in household cleaning products Chouhan *et al.,* 2017). For example, tea tree oils are commonly used for their disinfectant properties in homemade cleaning solutions(Carson *et al.*, 2006).Certain essential oils, such as citronella, lemongrass, and eucalyptus, are known for their insect-repellent properties. They can be used as a natural alternative to chemical-based insect repellents (Trongtokit *et al.,* 2005).

Characteristics of essential oil

Essential oils are highly concentrated. These are liquid at room temperature due to presence of oleates which is unsaturated fatty acid. They have characteristics aroma. Essential oil does not rancid due to presence of high vitamin E. Essential oil volatilize without undergoing decomposition. They do not leave greasy stain on paper due to high vapor pressure. These oils are generally insoluble in water due to hydrophobic nature. These are generally soluble in organic solvents, fatty acid, mineral oils. These have high boiling point. Most of the essential oils have a high refractive index which means degree of thickness. (Duarte *et al.,* 2017).

Different methods of oil extraction are:

1. Distillation: a. Water distillation; b. Steam distillation; c. Steam and water distillation

2. Solvent extraction;

3. Expression;

4. Maceration;

5. Soxhlet extraction;

6. Enfleurage;

7. Supercritical fluid extraction

Sindhu and Saha (2010) suggested different oil extraction methods for floriculture as:

Rose- Steam distillation; **Jasmine -** Solvent extraction; **Tuberose-** Solvent extraction; **Marigold -** Solvent extraction; **Geranium -** Steam distillation; **Lavender** - Stem distillation;***Viola odorata-*** Solvent extraction

1. a) Water Distillation: Silva *et al*. (2005) described following steps are used in water distillation.Round bottom flask containing plant material into it and water is added into it just to cover the plant material which 10 % more than material. Connect the condenser one side to the material containing flask and other side of condenser to another empty flask which receive the oil.**Advantages:**It is easy to constructandit is suitable for field operation (Mohammad Azmin *et al.*,2016).**Disadvantages:**Extraction process is slower. Development of objectionable odour due to charring of plant material at bottom of still.Producing pollutant in the processing area**.**It is expensive method(Mohammad Azmin *et al.*,2016)

Example: Extraction of Jasmine essential oil. In astudy, Dinh Phuc *et al*. (2019) foundthat the optimal distillation temperature was120 ^{0}C in 6 hours, the water-material ratio of 2:1.The laboratory-scale yield was determined to be 0.092%. The analysis of compound content in the jasmine essential oil should be conducted using GC-MS.

1. b) Steam distillation: The plant material is heated at not >100ºC.Steam boiler is used to generate steam which id passed through distillation tank.Over perforated grid plant material is tightly packed (Kanat *et al.,* 2020).

Advantages of steam distillation: Amount of steam can be readily controlled. Process is ideal for heat sensitive essential oils.No thermal decomposition in oil constituents.Oil is superior in quality (Shankraswamy, 2020).

Disadvantages: Capital expenditure is high (Shankraswamy,2020).

Methods for essential oil extraction from roseand marigold: Verma *et al*.(2001) noted thatmean oil was highest in hydrodistillation method which was 0.37% and highest pH, ester value, carbonyl value were recorded in steam-distillation method.

Table 1: List of major flower crops for essential oil and their chemical constituents

Crop	Scientific name /species	Family	Major constituents	Reference
Rose	*Rosa damascena, Rosa bourboniana Rosaalba, Rosagallica, R. centifolia, R. rugosa*	Rosaceae	1-citronellol (40-65%), Nerol, Geraniol, linalool, eugenol (*variety*: Noorjahan, Rose Sherbet, Jwala , Himroz, Arka Sukanya, Arka savi, Madhosh	(Harrie *et al.*, 2003)
Jasmine	*Jasminumauriculatum*	Oleaceae	Benzyl acetate, Methyl salicylate, Methyl anthranilate, Benzyl benzoate (*variety*: CO-1 Mullai , CO-2 Mullai, Parimullai)	
Jasmine	*J.grandiflorum*	Oleaceae	(Variety) CO-1 Pitchi, CO-2 Pitchi	
Jasmine	*J.sambac*	Oleaceae	(*variety*: Single Mogra,Double Mogra, Gundu Malli, Iruvatchi, Madenban, Ramabanam)	(Temraz *et al.*, 2009)
Marigold	*Tagetes erecta* (African marigold) *T.minuta,T.lucida T.patula,T.tenuifolia*	Asteraceae	Piperitone,D-limonene Estrugol Tagetone	(Krishan *et al.*, 2004; Verma *et al.*, 1999;Ogunwande& Olawore, 20006)
Tuberose	*Polianthes tuberosa*	Agavaceae	4- Allyl-2-methoxyphenol, Phenylmethanol, trans-farnesol, n-butanoic acid, Benzoic acid methyl ester, cis-3,7-Dimethyl-2,6-octadien-1-ol, Methyl 2-aminobenzoate (variety:Calcutta Single, Pune Single, Mexican Single, Hyderabad Single, Coimbatore Single, Bangalore Single, Shringar, Prajwal, Rajat Rekha, Arka Nirantara).	(Rakthworm *et al.*, 2009)
Raat ki rani	*Cestrum nocturnum*	Solanaceae	The major constituents were β-phellandrene (12.1%), linalool (11.3%), α-phellandrene (9.2%), (E)-β-ocimene (9.1%).	(Reza *et al.*, 2013)
Carnation	*Dianthus caryophyllus*	Caryophyllaceae	Linalool (34.65%); Farnesene (10.24); α-Terpineol (6.27%); Geraniol (5.79%);Cembrene A (5.77); cis-3-hexenyl tiglate (3.13 %);Tau-Cadinol (1.77%)	(Kirillov *et al.*, 2017)
Magnolia	*Magnolia grandiflora*	Magnoliaceae	Extraction of fresh flowers through petroleum ether yields 1.2 to 1.6 % flower concrete. 0.1 to 0.15 % volatile oil obtained from leaves. The leaf oil contains Phenols, Carbonyl compounds and Sesquiterpenes.	(Yahaya*et al.*, 2022)

Crop	Scientific name /species	Family	Major constituents	Reference
Michelia	*Michelia champaca*	Magnoliaceae	The constituents of flower concrete are Phenylethyl alcohol, Ionones, Dihydroionones, Dihydro-β-ionol, Indole and Methyl anthranilate. The constituents of absolute are Phenyl ethyl acetate, β-ionone, Methyl anthranilate, Methyl palmitate, Methyl linoleate.	(Kai Cheng*et al.*, 2020)
Gardenia	*Gardenia jasminoides*	Rubiaceae	Linalool (34.65 %), Farnesene (10.24 %), α-Terpineol (6.27 %),Geraniol (5.79 %), Cembrene	(Zhang *et al.*, 2020)
			A (5.77 %), cis-3-hexenyl tiglate (3.13 %), Tau-Cadinol (1.77 %)	
Geranium	*Pelargonium X hortorum*	Geraniaceae	Citronellol (37.5); Geraniol (6%); Caryophyllene oxide (3.7%);Menthone (3.1%);Linalool (3.0%); β-bourbonene (2.7%); Iso-menthone (2.1%); Geranyl Formate (2.0%)	(Lis-Balchin 2004)
Calendula	*Calendula officinalis*	Asteraceae	Thirty compounds were found in common in both essential oils, with the sesquiterpene alcohol, α-cadinol as the most abundant compound (leaf: 32.3% and flower: 31.3%, respectively).	Gunes *et al.*, 2021
Chrysanthemum	*Chrysanthemum indicum,*	Asteraceae	Camphor, Isoborneol, α-Terpinene, Caryophyllene oxide	(Fadia*et al.*, 2020)
	Chrysanthemummorifolium		Camphor, Curcumene, τ-Eudesmol, Pentacosane, Borneol	(Fadia*et al.*, 2020)
Lotus	*Nelumbo nucifera*	Nymphaeceae	Palmitic acid methyl ester (22.6%);Linoleic acid methyl ester (11.16 %);Palmitoleic acid methyl ester (7.55 %);Linolenic acid methyl ester (5.16%)	(Songhee Jeon,2009)
Daffodil	*Narcissuspoeticus*, *N. tazetta*	Amaryllidaceae	The flower contains 0.20 to 0.26 % concrete. The concrete contains 2.2 to 3.5 % volatile oil.The principal constituents are Eugenol, Benzyl alcohol, Cinnamyl alcohol, Benzaldehyde and Benzoic acid.	(Zarifikhosroshahi *et al.*, 2021)

Table 2: Effects of different storage temperatures and durations on essential oil content of *R. damascena* Mill (*source:*** Kazaz *et al.,* 2009)**

Time of storage (Days)	0^0C	Oil Content %3^0C	Mean
0	0.043	0.043	0.043
7	0.040	0.037	0.039
14	0.030	0.029	0.030
21	0.021	0.024	0.023
28	0.021	0.022	0.022
Mean	**0.031**	**0.031**	

1. c) Steam and water distillation: Over grid plant material is kept and water if filled beneath.Condensate oil separated in oil separator due to their differences in specific gravity.Total time for distillation is 6-8 hours (Shankaraswamy, 2020)

Advantages: Obtain maximum oil; Component of the volatile oil are less susceptible to hydrolysis and polymerization; Oil quality is superior (Shankaraswamy, 2020).

Disadvantages: Oils of high boiling range require a greater quantity of steam for vaporization; Plant material become wet which slow down distillation(Shankaraswamy, 2020).

2. Solvent extraction: Should have low boiling point: Should be chemically inert(Souyi, 2023).

The following solvents are used: Petroleum ether; N-Hexane; Benzene

To extract oil from concrete, generally ethyl alcohol is used. The alcohol is removed by evaporation.Solvent extraction resulted in the production of 39 g of concrete oil from *Rosa damascena*, accounting for 0.19% based on petal weight, as reported by Younis *et al*. (2008). Additionally, *Rosa centifolia* yielded 30 g (0.15%) of concrete oil, while *Rosa bourboniana* and Rosa 'Gruss en Teplitz' produced 19 g (0.09%) and 12 g (0.06%) of concrete oil, respectively.

3. Expression (Cold fat extraction): Essential oil is obtained by using high mechanical pressure to squeeze the oil from plant material.Cold press machine has one inlet from where material was feed andtwo exits that obtained oil and non-oiled cake was exit (Souyi, 2023).

Advantage: Simple to use, short duration process, low cost, use small quantity of raw material, by product in the form of presscake is also obtained (Souyi, 2023).

Disadvantage: More than7% of oil remains in seed. (Souyi, 2023).

4. Maceration: Coarsely powdered material placed in a stoppered container with solvent allowsstanding at room temperature for 3 days.When material is completely dissolved the mixture is strained out and pressed (Verma, 2012).

5. Soxhlet Extraction: Dried sample was placed in thimble which is attached to Soxhlet extractor. In a round bottom flask petroleum ether is filled.Then place it over heating mantle for boiling.Collect the pure oil after distillation (Zygler *et al.,* 2012).

6. Enfleurage: It requires fixed oil such as lard or fat.In this process, a thin film of fat is spread on the both side of glass plate mounted one above other to form air tight compartment within wooden frame called "Chassis".Freshly harvested flower is scattered on the top of fat layer, left for 24 hours.After removing withered blossom replace by fresh one and procedure being repeated for 30 or 40 times. Fat becomes saturated with fragrance of flower, final productcalled "Pomade"(Souyi, 2023, Shanakaraswamy,2020).

Extraction Methods for tuberose oil and their chemical components: The objectives of the project were to compare essential oil extraction methods from the double flower variety of tuberose (*Polianthes tuberosa* L.). The chemical composition of absolute was analyzed by gas chromatography-mass spectrometry (Rakthaworn *et al.,* 2009)**.**

Cold enfleurage:Palm wax was heated to 80^0C for 2h and poured into rectangular glass trays. Following the cooling process, allow the wax to return to room temperature. Subsequently, place tuberose flowers on the wax within each tray and cover them with another waxed tray. Fresh flowers were swapped every 24 hours. The extraction of

floral scents from the wax was achieved using ethanol, with the subsequent evaporation of ethanol leaving behind the absolute de enfleurage (Rakthaworn *et al.,* 2009).

Hot enfleurage; Palm oil heated at 60^0C, flower are warmed at 30 min, cooled down at room temperature. At 8-10^0C overnight palm oil is again heated at 60^0C. It is then filtered and substituted along fresh blossom (Rakthaworn *et al.,*2009)..

7. Supercritical Fluid Extraction: Supercritical $CO_2$is an excellent organic solvent to extract essential oil. When extraction is complete the pressure is reduced to ambient and Carbon dioxide reverts to a gas leaving no residue (Inzendy *et al*., 1998).

Example: Supercritical CO2 extraction of *Narcissus poeticus* L.flowers for the isolation of volatile fragrances compounds. Baranauskiene *et al*. (2022) developed a method with the primary objective was to assess the impact of pressure and the inclusion of a co-solvent in the supercritical CO_2 extraction (SFE-CO_2) process applied to freeze-dried *N. poeticus* flowers. Increasing the pressure from 36 to 48 MPa and incorporating 5% co-solvent ethanol into the CO_2 flow significantly boosted the yield of the lipophilic fraction in the extraction of freeze-dried *N. poeticus* flowers. A total of 116 volatile compounds were identified in the extracts through GC-TOF/MS analysis. Key constituents contributing to the fragrance of *N. poeticus* included benzyl benzoate (9.44–10.22%), benzyl linoleate (1.72–2.17%), and benzyl alcohol (0.18–1.00%). The addition of ethanol as a co-solvent facilitated a decrease in the proportion of higher alkanes, accompanied by an increase in the concentration of recovered benzyl aromatics.

Deg and Bhapka Method: It is a kind of a hydrodistillation method. The distillation apparatus is divided into three main parts i.e. Deg (Still), Bhapka (Receiver), and Chonga (Condenser cum Connecting Pipe) (Shukla *et al*., 2023).

Phase-wise manufacturing procedure (*Source:* https://www.dcmsme.gov.in/tcsp/Program%20 Overview/Kannauj_V1.pdf

Phase 1: Preparation of equipment andraw materialin **deg**.

Rose petals are plucked in early morning and submerged with the requisite amount of water. The lid is then sealed with an amalgamation of cotton and clay.The Bhapka is filled with a base oil or carrier oil such as sandalwood oil, then sealed using cotton cloth strips and earthen clay. Subsequently, this Bhapka is immersed into a compact tank constructed from bricks and concrete. The Deg and Bhapka are interconnected through a Chonga and tightly sealed using cloth and earthen clay.

Phase 2:Heating and condensation process; The Deg is heated using both wood and cow dung cakes. The inclusion of cow dung cakes is essential for regulating and monitoring the temperature during the heating process.There is a need to increase the pressure inside the Deg considerably. Further pressure is used to seal the deg. The major tool as condenser is chonga.

Phase 3:Cooling phase: In this phase, the Bhapka demonstrates a holding capacity exceeding 5-10 kg of the base material. The Bhapka's temperature is gradually lowered within a water tank to facilitate the extraction of Attar**.** After 4-5 hours when the required quantity of vapor arecondensed, then a wet cloth is rubbed all over the Bhapka to stall the distillation process and is replaced by another Bhapka. The Bhapka is then allowed to cool.

Phase 4:Separation process: Once the temperature of the mixtures have lowered, this mixture of water and oil is segregated by two possible methods: i.)Via a perforation at the base, directly from the Bhapka and ii.) By pouring the mixture in an open trough.

Phase 5: Purification of essential oil: Insoluble material can be removed by filtration. Anhydrous sodium sulphate is added to oil to remove the water. After 5hrs, the oil is filtered.

Phase 6: Storage of essential oil: Essential oil can be stored in small amber glass bottles, large stainless steel or aluminum containers**.** To prevent darkening, essential oil should be stored in cool area away from light and heat.

The effects of storage temperature and duration on essential oil content and composition oil rose (*Rosa damascena* Mill.).

Stein (1990) observed the impact of varying storage temperatures (0°C and 3°C) and durations (7, 14, 21, and 28 days) on the oil yield and essential oil components of *Rosa damascena* Mill. Rose oils were extracted through hydrodistillation using a Clevenger-type apparatus, and the components

within the rose oil were subsequently analyzed using Gas Chromatography-Mass Spectrometry (GCMS).

The highest oil content values were obtained from the rose petals distille dimme diately after the harvest (0.043%) ~and oilcontentsofthe petalsstored for 7 days (0.039%) at both storage temperatures **(**Kazaz *et al.*, 2009). Analysis revealed a rise in the citronellol content in oils derived from immediately distilled petals during storage, accompanied by a decrease in the rates of geraniol and nerol (Kazaz *et al*., 2009). Optimal results in both rose oil content and quality were observed in oils obtained from promptly distilled petals. This study suggests that the adverse changes mentioned can be mitigated by storing petals at 0°C for up to 7 days.

According to Mirzaei *et al*.(2015) damask rose (*Rosa damascena* Mill.) essential oil is affected by short and long-term handling. Given the perishable nature of the flowers, effective post-harvest handling is crucial in the context of rose essential oil production. To assess the impact of various storage conditions on damask rose essential oil (EO) yield and quality, petals were subjected to three storage conditions: packaging in LDPE and poly-film PET/EVOH/LDPE bags, and immersion in water containers at room temperature (RT) or in a refrigerator (4°C) for 1–3 days (short-term storage). Over an extended handling period (7, 14, and 21 days), the assessment focused on petals packed in PET/EVOH/LDPE bags, examining frozen, active, and passive Modified Atmosphere Packaging (MAP), as well as RT conditions. It is found out thatapplying PET poly-film bags used in the short-term handling of petals at RT for1 day, with an appropriate concentration of geraniol and citronellol in the EO, would be suggested as an effective method.

Effect of carnation essential oil: Study has been conducted about effect of carnation essential oil extracted from carnation calli on extending shelf life of yoghurt. Yoghurt is the coagulated milk product obtained by lactic acid fermentation through the action of *Lactobacillus delbreukii* sub sp. *bulgaricus* and *Streptococcus thermophilus*. Fragrance is predominantly due to eugenol, β-caryophyllene and benzoic acid derivatives. The cultivar 'Ellat', indicated that levels of these compounds rise during flower development (Zuker *et al*.,2002). Screening of essential oils for antibacterial activity was done by disc diffusion method (Prabuseenivasan *et al.,* 2006) using pathogenic strains incubated at 37 ºc for 24 hrs. Eugenol in carnation essential oil was added to milk, at the percentages of (0.2, 0.4, 0.6, and 0.8 µl/ml milk, respectively before using the milk in the yoghurt manufacture. Assem *et al*. (2019) showed that *S. aureus* was found to be highly sensitive to the eugenol in carnation essential oil action with different concentration which the diameter of inhibition zone ranged between 7.00 and 12.00 mm, followed by E. coli, *L. monocytogenes* and *S. typhamurium*.

Prospects in essential oil

Top companies in essential oil market (*Source:*https://www.pharmaadda.in/top-essential oil-manufacturers-in-india.

1.Young Living: Young Living is a popular essential oil company known for its wide range of high-quality essential oils. They have a strong commitment to purity and sustainability in their sourcing and production processes.

2. doTERRA: doTERRA is another prominent essential oil company that emphasizes rigorous testing and quality control. They source their oils from around the world and promote sustainable practices.

3. Plant Therapy: Plant Therapy is a family-owned essential oil company that focuses on providing affordable, high-quality oils. They have a transparent approach to their sourcing, testing, and manufacturing processes.

4. Mountain Rose Herbs: Mountain Rose Herbs is a well-respected company that offers a diverse selection of organic essential oils. They prioritize sustainable and ethical practices in their sourcing and packaging.

5. Aura Cacia: Aura Cacia is known for its extensive range of essential oils, including both single oils and blends. They offer oils that are sourced sustainably and provide detailed information about their quality testing.

6. Rocky Mountain Oils: Rocky Mountain Oils is a reputable company that provides high-quality essential oils sourced from around the world. They prioritize purity, quality, and customer satisfaction.

7. Edens Garden: Edens Garden is a popular essential oil company that offers a wide variety of oils, including organic options. They focus on transparent sourcing and quality assurance, along with affordable pricing.

8. Plant Guru: Plant Guru is known for its affordable essential oils without compromising on quality. They offer a range of oils sourced from various regions and promote sustainable practices.

9. NOW Foods: NOW Foods is a well-established company that provides a broad selection of essential oils. They emphasize quality and purity, and their oils undergo extensive testing.

10. Florihana: Florihana is a French company that specializes in organic essential oils. They are known for their commitment to sustainable agriculture, eco-friendly packaging, and rigorous quality control.

Top essential oil manufacturers in India (*Source :* https://www.pharmaadda.in/top-essential-oil-manufacturers-in-india)

1. Essential Oil Association of India, Shakarpur Delhi
2. Kshrey Essential oils and Ayurveda, Gurugram, Haryana
3. Moksha Life style Products, Karnal Road Delhi
4. BMV Fragrances Private Limited, Greater Noida UP
5. Shiva Exports India, Kannauj UP
6. Fragrance Palace, Janpat New Delhi
7. Indian Aroma Exports, UP
8. Natures Natural India, Delhi
9. Vinayak Ingredients (India) Pvt. Ltd., Mumbai
10. India Essential Oils, Delhi

Scenario of essential oil :

Global scenario : Essential Oil Industry business in global is estimated to about US$14 billion. While, India's share is just about 10% though potential is much more (Singh, 2014).In 2022, the market size of essential oils worldwide reached USD 21.79 billion, with an expected CAGR of 7.9%.from 2023 to 2030.This is attributable to the increasing demand from major end-use industries such as food & beverage, personal care & cosmetics, and aromatherapy. Encompass intricate and volatile chemical compounds renowned for their antifungal, antibacterial, anti-inflammatory, and antiviral attributes.(*Source:*Anonymous, 2022).

Sales channel insights : Other sales channel dominated with the highest revenue share of 63.4% in 2022. Its high share is attributable to the increasing awareness of essential oil among people has given rise to more retail sales especially through convenience stores.

However, key players have adopted multi-level marketing strategies to expand their business and improve their sales (*Source :* https://www. skyquestt. com/report/essential-oils-market) For instance, doTerra has managed to achieve 5 million global customers of which 70% are wholesale customers.

Application insights : The global market was predominantly led by the Spa & Relaxation sector, capturing the highest revenue share at 40.17% in 2022 *(source :* https://www.skyquestt.com/report/essential-oils-market). This dominance is a result of the evolving lifestyles of consumers worldwide. In the realm of perfume applications, essential oils are classified as base notes, middle notes, and top notes based on their volatility.

Regional Insights: The European region asserted its dominance in the global market, securing the highest revenue share at 43.3% in 2022. The presence of influential entities like the European Federation of Essential Oils (EFEO) has played a pivotal role in fostering industry growth within Europe*(Source:* Anonymous, 2022).

Nations in the Asia Pacific region, including India, China, and Indonesia, stand as industry trailblazers and have established themselves as primary exporters of some of the most valuable oils and extractsin the world such as champaca extract, jasmine extract, davana oil, frankincense oil, sandalwood oil, spice oils, etc. (*Source:* https:// www. transparen cymarket research.com/essential-oil-market.html)

Indian scenario : The collective share of flavors in the food, dental, and pharmaceutical sectors amounts to approximately 22,000 MT, while the remaining portion is dedicated to perfumery. The estimated annual production of perfumery raw materials stands at around 57,252 million tons, valued at Rs. 175 billion US$. Noteworthy among the essential oils currently produced in India are

citronella, lemongrass, basil, mint, sandalwood, palmarosa, eucalyptus, cedarwood, vetiver, geranium, rose oil, lavender, davana oil, and khus oil. The export of essential oils reached 170 US $ in the year 2010-2011, compared to 150 US $ in the previous fiscal year 2009-2010. The production of certain oils like mint, aromatic grass, linalool, geranium, lavender, and rose oil during 2010-2011 contributed to an annual saving of Rs. 601 crores in foreign exchange (*Source:* https:// www.kenresearch.com/industry reports/india-flavor-fragrance-industry).

Future Prospects : Indigenous production fulfills around 90% of the current essential oil demand in the country, with the remaining 10% sourced through imports. This growth has been characterized by both vertical and horizontal expansions in essential oil production. (Pujari *et al*., 2020). Antibiotic multi-resistance has become a global emergency in recent decades.The broad-spectrum antimicrobial activity manifested by EOs, in a similar context, must be noticed. Microbial growth related to food industry and cultural related artwork which can be controlled by use of essential oil. Their nature as a complex chemical mixture, which varies in terms of the quantity of their individual bioactive components, makes them resistant to any mechanism of microbial resistance. The use of these natural compounds for inhalation and their interactions with the central nervous system are still topics of fascination that, however, require more robust scientific confirmation, which we expect in the near future. (Napoli *et al.*, 2021).

CONCLUSION

With the fast-changing scenario in floriculture trade, availability of different climatic zones, knowledge of different method of extraction, cheap Labour and skilled manpower, our growers can do extremely well in the competitive landscape, strategically entering the essential oil extraction sector as a business is imperative to navigate the rapidly evolving industry dynamics.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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