Ancient India's Fragrances and its Relevance Today

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Mother Nature's greatest gift to humans has been her plants. Plants have always fascinated humans down the ages and fulfilled their basic need of food, clothing and shelter. In addition nature continues to also provide humans with plants for medicine and pleasure. Aromatics and intoxicants, both of them derived from plants, affect the human central nervous system in their own unique ways, one giving munificent pleasure and the other an addicting one. Aromatics keep a person in a congenial frame of mind, while the latter acts on the higher centre of the human brain to imbalance one from normalcy, making plants and plant-based products a forerunner for scientific research.

In this paper we will discuss only on the benevolence of aromatics that keeps the human brain in the right state of equilibrium, and helps in conferring delight and magnificence in fulfilling the three *'Purushartas'* viz., *'Dharma'*, religious merit, *'Artha'*, material benefits, and *'Kama'*, personal desires, in addition to achieving *'Arogya,'* good health.

What are fragrances?

We are aware that the use and enjoyment of fragrances have endured a tradition as old as humans down the ages and continue to play a purposeful role to enhance our lifestyles.

Fragrances, as we know today, are complex mixtures of natural and synthetic ingredients. Natural ingredients originate from materials found in nature, like roots, bark, leaves, flowers etc. Natural ingredients are obtained by use of physical processes such pressing / cold expression, tapping, by enfleurage, distillation, hydro diffusion, extraction, etc., whereas synthetic ingredients are manufactured through chemical processes.

Fragrances are by themselves multifaceted; eliciting feelings of joy, confidence and a sense of well being to those who wear them, providing an opportunity to create a virtually unforgettable, personal signature.

A subtle spray of fragrance can spark cherished memories and emotions to lift spirits, augment relationships, improve a person's mood, light up romance, to overwhelming enjoyment and happiness. In personal care, fabric care and household care consumer products, fragrances enhance its sense of cleanliness / freshness and serve to mask the unpleasant odour of base ingredients. In short, 'Fragrances help make life complete.'

Origin & history of fragrances

Fragrances originated in India in early times and regular barter trade by the Arabs carried it to the western shores like Egypt, Persia, Greece and Rome. Aromatics and their uses have been profusely mentioned in 'Ayurveda', India's medicinal tradition of almost 3000 years. 'Ayurveda' explains the various ways that aromatics can be engaged to create useful products for humans to savour. Individual fragrant substances, like flowers, aromatic leaves or roots can be used directly or can be used to produce fragrances or *'Gandha Dravyas'*. The art of blending various fragrant substances in right proportions to concoct a likeable fragrance was considered to be one of the 64 learning arts that a person needed to be proficient in ancient Indian society.

Several literary works in Sanskrit, our epics the Ramayana & Mahabharata, technical treatises like Gangaadhara's, *'Gandhasara – The essence of scent making'*, & *'Gandhavaada – Hypothesis on Odours'*, Varahamihira's, *'Vrhatsamhita'*, Somesvara's, *'Manasoallasa'*, Chavundaraya's, *'Lokoparakaram'*, in Kannada, have detailed information on perfumery and fragrance creation.

'Gandhashastra – The science of odours', deals with cosmetics and fragrances. It being a branch of Ayurveda, the fragrance ingredients mentioned therein are also said to possess medicinal properties. It also mentions the usefulness of the ingredients in improving skin complexion, lustre and its appearance, to overall enhance beauty. *'Gandhayukti – The science & strategies to make odoriferous substances'* discusses all technicalities of perfumery and fragrance creation. Sanskrit texts written during the Mauryan rule also describes the method of fragrance preparation and its development. For example, it says that sandalwood is grated on a wet stone and mixed with grounded spices to get a paste. The paste obtained is further crushed along with fragrant flowers and leaves and mixed well with oil. The oil so obtained is applied all over the body to keep it pleasant smelling.

Somesvara in his encyclopaedic treatise *'Manasoallasa'* mentions an interesting detail on the fragrances and cosmetics used by kings, in their royal bath.

Fragrances used by royals for bathing

According to Somesvara, perfumed body massage oil should be prepared as given below:

Sesame seeds, perfumed with the strong aroma of Ketaki flowers *(Pandanus sp*), Yati (*Jasminum grandiflorum*), Punnaga (*Calophyllum inophyllum*) and Champaka (*Michelia champaka*) is taken and crushed to extract oil from them. The oil extracted is used first to massage the body.

After massaging is complete, a fragranced ointment is applied. The fragrance ointment is prepared as detailed below:

Part A
1. Palaka (*Spinach*) roots,
2. Tagara (*Catunaragum spinosa*),
3. Mamsi (*Fleshy root of Nardistachys jatamansi*),
4. Ashvagandha (*Withania somnifera*),
5. Puskara (*Inula racemosa*),
6. Kushta,
7. Patolaka / Snakegourd (*Trichosanthes dioica*),
8. Musta,
9. Nishadvayam (*a combination of haridra – turmeric and daru haridra – berbaris aristata*), and
10. Granthi parana (*glandular leaves of Artemisia vulgaris*).

Part B
1. Neem,
2. Rajavraksa / Aragvadha (*Cassia fistula*),
3. Tulsi (*Ocimum sanctum*),
4. Arjaka (*Ocimum basilicum*)

Part C
1. Cardamom,
2. Jati (*Myristica fragrans*),
3. Sarshapa,
4. Sesame,
5. Coriander,
6. Bakuchi (*Veronia anthelmintica*), and
7. Cakramardu (Cassia tora),

Part D
1. Clove / Lavanga
2. Padmaka (*Prunus puddum*)
3. Lodra,
4. Sandal,
5. Suradru (*Devadaru*),
6. Agurusorala (*Pinus roxberghi*)

Part E
1. Nagakesara (*Mammea longifilia*),
2. Punnaga (*Calophyllum inophyllum*),
3. Kanta (*Aglaia roxburghina*),
4. Kumkuma (*Saffron*), and
5. Champaka.(*Michelia Champaka*)

Part F
1. Guggulu (*Balsamodendron*)
2. Saindhava salt (*Rock salt*)
3. Bola (*Myran*)
4. Sarjarasa (*Yellow resin*)

Procedure
1. Part A materials are dried in shade. It is powdered and mixed thoroughly.
2. Part B materials are grounded to make a paste. The paste is then added to 1.
3. Part C items are mixed and powdered. The powder obtained is mixed to 2 above.
4. Part D plant weeds are shade dried and powdered. The mixture obtained is mixed with 3.
5. To the mixture 4 obtained above add Part E flowers and mix further.
6. Pound Part F in rice water and vinegar (Kanjika).
7. Mix 6 to 5 above and finish the ointment.

Turmeric (*Haridra*) pulp scented suitably is applied on the body. Ointments made out of the aromatic pulp of *Amalaka /Amla* is applied to hair for growth of luxuriant black long mane. Soap (*Khali*) for bathing is made by the mixture of wheat flour, fermented rice gruel (*arnala*), Madana (*Randia dumetorium*) root powder and pisuna (*Saffron powder*).

Ketaki and Champaka Fragrances

The Chinese traveller, Fa-Hien describes India as a land or exotic aromatic flowers, fruits, resins and grass. He describes the role of *Ghandikas* or perfumers who created the fragrances and marketed it.

Natural essential oils traditionally have been used to make attars or natural fragrances.

Ketaki Oil and Champaka Oil were other scented oils that were a connoisseur's delight in ancient India. Ketaki (*Pandanus odoratissimus*) and Champaka (*Michelia champaca*) are popular flowers in India right from olden times. Ancient Sanskrit literatures mention them very extensively. Ketaki and Champaka are used in cosmetics and perfumery as perfumed oils, body powders, incenses etc. Champaka oil is extolled and even referred to as liquid gold by Varahamihira. The early European botanist, Buchanam reports that majority of Indians in 1811 AD used Sesame oil infused with Punnaga and Champaka flowers as bathing oil. Champaka Oil in combination with mallika, uptala, surabhi or patala was also very popular during that time.

Fragrances during the Mogul Rule

Yashodhara in his treatise '*Yashah prakasha sudhokara*' has described the use of '*Adhahpathana yantra*' to produce fragrances. The method is comparable to the method mentioned in '*Ain-e-Akbari*', a chronicle by Abul Fazal 1590 AD to make *'Chuwah'* a very popular fragrance used by Emperor Akbar and his courtiers.

Small pieces of lignum aloes are taken in a narrow vessel, luted with clay cotton and rice bran. A small space is left at the neck of the vessel, which is placed in a dish of water so that the mouth of the first vessel touches the surface. A gentle fire using cow dung cakes is made around the vessel. The heat generated melts the aloes till it distils into the water. It is then collected and washed with water or rose water to remove the smoky odour.

In olden times, Attars were very popular with the well-to-do sections of society. Some attar is pure oil, while some are mixtures of different essential oils, resins and concentrates in a natural base or carrier oils. The unique aroma of attar is due to the condensed vapours of individual flowers directly into the base oil, generally sandalwood oil. The aroma of sandalwood oil has the unique property to complement with the aroma of other plant oils, combined with it and act as a preservative to other essential oils without getting rancid.

Varahamihira's 'Ghandayukti' – Practical Perfumery

Varahamihira describes two important aspects seen in fragrance preparations. Firstly, a practical method for preparation and secondly exploring the possibility of using the information in another field of research with setting botanical identity of the plants as mentioned in '*Brhatsamhita*'.

'Ghandayukti' can be easily understood by reading along with a commentary based on it called '*Bhattopapala's Vivrtti'*. *'Ghandayukti'* is a practical art of blending fragrance ingredients to prepare valuable fragrances that are stable for long. *'Ghandayukti'* describes a method of manufacturing a large number of fragrances, but utilising only a few standardised, basic aromatic ingredients by changing the relative proportion in the final fragrance formulation.

'*Ghandharnava*' is the term coined by Varahamihira for this method of manufacturing fragrances. Varahamihira claims that innumerable fragrances of diverse odour profiles can be created. An ingenious method of tables or '*Koshtaka*' is used in deciding the proportions concisely and precisely to create popular fragrances.

For understanding, let us consider a simple fragrance made by using only 16 standardised aroma ingredients. In this case the 'Koshtaka' consists of a permutation table of 16 cells of 4 cells each in a single line. One aroma ingredient is represented in one cell. By permutation and combination of these aroma ingredients innumerable fragrances are made as shown below.

Ghanam	Balakam	Shaileyakam	Champaka
Ushira	Nagapushpa	Sprkka	Aguru
Tulsi	Damanaka	Nokha	Tagara
Dhanya	Karpura	Chola /Choroka	Malaya

Each formulation takes an ingredient from each of the four quarters at different proportions and a large number of formulations can be obtained, as required. Supposing we need to make a fragrance containing only four ingredients we can formulate as Ghanam 1, Balakam 3, Shaileyakam 2, and Malaya 3. Many such combinations are possible with larger number ingredients of varying ingredient proportions. A lot more details in fragrance formulations are mentioned in '*Ghandhayukti*'.

Why India lost its leadership position in the world perfume market?

The science of perfumery and fragrance creation were so developed that India was placed in a pivotal place in the ancient cosmetic and perfumery world economy.

The botanist Buchanan, in his detailed informative paper *'Account of the manufacture of rose water and other perfumes at Patna in 1811 AD and its bearing on the history of the Indian perfumery industry'*, gives very interesting insights on the state of the perfumery industry in Kanauj of Mythili (Kanyakubja as mentioned in Sanskrit literature) and the importance given to it by the Europeans.

He further states that the industrial revolution that took place in Europe was largely due to the awakened interest of the European nations to the excellence of the Indian perfumery industry and their zest to compete with India.

Buchanan's paper infers that their keenness to compete with India and dislodge its premier position resulted in the successful penetration of the world fragrance market that was once a domain of the Indian perfumery industry, where India enjoyed complete monopoly.

Interestingly, India, which was once a world leader of the fragrance industry, is today one of the world's largest consumers of foreign fragrances and fragranced products. The rapid advancements made by the European industry in the 20th century due to modern scientific thought and knowledge made sure that India lost out on all that it had treasured over centuries.

Fragrances today

Fragrances earlier were made up of wholly natural ingredients. Perfumers used essential oils, resins, absolutes, extracts from plants and ingredients obtained from animal origin. All materials used were obtained by physical processing, with no change occurring in the ingredients during the extraction process.

The dwindling agricultural forestlands because of encroaching civilisation, ever-increasing world population, have all reduced the natural flora and fauna. The declining natural vegetation has invariably lowered the supply of natural fragrance ingredients for fragrance manufacture. Limited availability, of natural fragrance ingredients has now led to their lower relative concentrations in fra-

grance formulas. Sadly, nowadays almost 90% to 95% of the raw materials used in fragrance creation are synthetically manufactured and only 5% to 10% are of natural origin.

The consumers' fascination of fragrances has only increased with time as the manufacture of fragranced personal care, laundry care and household care products is ever growing. In addition, fragrances are now added to a number of other commercial products such as tissues, candles, baby diapers etc. Fragrances have also made their way into scented stationeries and even trash bags.

Nowadays, products are being sold with fragrances as its main selling point, with the entire advertising campaigns centred on the odour of a product. The consumer trend too has been towards more powerful and long lasting fragrances.

Fragrance dilemma

'The Fragrance Foundation', a non-profit educational arm of the global fragrance industry, says that there are more than thousand body fragrances alone in the world market today. While many people enjoy wearing fragrances and using fragranced products, the gamut of related advertisements carries some away.

There is a growing outcry by some people who claim that exposure to some synthetic fragrances and fragranced products adversely impacts health. Symptoms like headache (especially migraine), sneezing, watery eyes, sinus problems, anxiety, nausea, wheezing (especially in asthmatics), shortness of breath, inability to concentrate, brain fog, dizziness, convulsions, sore throat, cough, chest tightness, hyperactivity (especially in children), tremor, fatigue, lethargy and drowsiness are experienced by some users. People, suffering from MCS (Multiple chemical sensitivity), a health condition in which exposure to one chemical is thought to lead to adverse reactions with others, claim that exposure to fragrances triggers various symptoms, leading to the point that sufferers become incapacitated or have to forego many of their routine activities to avoid fragrance exposure.

Fragrances influence the human body positively, as well as, sometimes, negatively. The human body is amazing as it tolerates exposures to many substances all in a day's time. The factors that determine what will be tolerated without adverse effects and what will be not are very many. Variations can exist even in the same individual, depending on a number of factors. In general, a healthier person is more tolerant towards conditions that are less than optimal.

Females are usually more prone to problems from synthetic fragrances, than males. Individual genetic factors, body chemistry and age also have a bearing on human tolerance towards chemicals. It is often difficult to pin down the cause of several symptoms when the triggering substance is one that is common in the environment.

We are aware that fragrances are a complex mix of art and chemistry. The chemicals used in the fragrance formulation must not only be compatible, but also be aesthetically pleasing to the nose.

More than 5,000 chemicals are used in the manufacture of fragrances. Synthetic organic chemicals constitute 80-90% (by weight and value) of the raw materials used in fragrance formulations today and very little is known about the impact synthetic fragrances have on human health.

Synthetic fragrance ingredients and its sensitivity to humans

The International Fragrance Research Association (IFRA), a consortium of associations from most countries of the developed world, leads the industry initiative in regulating the use of fragrance materials.

Formed in 1973, this is an association of national associations. Individual fragrance companies belong to IFRA through their membership in national associations, as there is no direct company membership in the association. At present IFRA includes national associations from the Asia-Pacific (Australia, Singapore, and Japan), North America (United States, Canada), Latin America (Brazil, Mexico) and Europe (France, Germany, Italy, Netherlands, Spain, Switzerland, and United Kingdom). India is not a member of IFRA.

Another body that plays a role in regulating the industry is the Research Institute of Fragrance Materials (RIFM), set up in 1968 by the fragrance industry. The Institute has an independent research and testing program handled by an expert panel of academicians. It is recognised internationally for its expertise in toxicology, pharmacology, dermatology, environmental sciences and biochemistry. RIFM maintains a database of safety information of ingredients and liaises with regulatory scientific authorities. IFRA relies on RIFM's scientific judgement in establishing guidelines and restrictions on use of fragrance ingredients by fragrance suppliers. The two organizations play a supporting role to each other.

IFRA is responsible for risk management, while RIFM is concerned with the assessment of risks in fragranced products. To date, RIFM has tested more than 1,300 fragrance materials, and published results in scientific journals such

as *Food and Chemical Toxicology*. The results of the aroma chemical screening are then submitted by RIFM to the International Fragrance Association (IFRA). If a fragrance material is found to have adverse health effects, IFRA categorises the material as: Prohibited (P), Restricted (R), Sensitising (S), etc., and recommends amounts of the material to be used in fragrances and fragranced products.

Table 1
Categorisation of aroma chemicals by IFRA based on their safety profile

Name	Category
1,3-Dibromo-2-methoxy-4-methyl-5-nitrobenzene (Musk KS)	P
1,3-Dibromo-4-methoxy-2-methyl-5-nitrobenzene (Musk alpha)	P
2,2-Dichloro-1-methylcyclopropylbenzene	P
2,4-Dihydroxy-3-methyl-benzaldehyde	P
2-Methoxy-4-methylphenol	R
2-Pentylidene cyclohexanone	P
3,7-Dimethyl-2-octen-1-ol	P
3-Bromo-1,7,7-trimethylbicyclo[2.2.1]heptane-2-one	P
4,6-Dimethyl-8-t-butyl coumarin (Butolia)	P
4-Methyl-7-ethoxycoumarin (Maraniol)	P
5-Acetyl-1,1,2,3,3,6-hexamethyl indan (AHMI, Phantolid)	R
6-Isopropyl-2-decalol	P
6-Methylcoumarin (Toncarine)	P
7-Methylcoumarin	P
Acetyl ethyl tetramethyl tetralin (AETT, Versalide)	P
Acetyl isovaleryl (5-Methyl-2,3-hexanedione)	P
Acetylated Vetiver oil	S
Allantroot oil	P
Allyl esters	S
Allyl heptine carbonate	R
Allylisothiocyanate	P
alpha-Methyl anisylidene acetone	P
Amylcyclopentenone	R
Angelica root oil	R
Anisylidene acetone (4-(4-methoxphenyl)-3-buten-2-one)	P
Asarone ((E)-and(Z)-2,4,5-Trimethoxypropen-1-yl benzene)	R
Benzene	P
Benzyl cyanide	P
Benzylidene acetone (4-Phenyl-3-buten-2-one)	P
Bergamot oil expressed	R
Birch wood pyrolysate	S
Bitter Orange Peel Oil Expressed	R
BMHCA (p-t-Butyl-alpha-methylhydrocinnamic aldehyde)	R
Bromostyrene	P
Butyl-dihydrocinnamaldehyde (Bourgeonal)	R
Cade oil	S
Carvone oxide	P
Cedar moss	R
Chenopodium oil	P
Cinnamic alcohol	R
Cinnamic aldehyde	R
Cinnamyl Nitrile	R
Cinnamylidene acetone	P
Citral	R
Citrus oils and other furocoumarins containing essential oils	R
Colophony	P
Costus root oil, absolute and concrete	P
Cumin oil	R
Cyclamen alcohol (3-(4-Isopropylphenyl)-2-methylpropanol)	R
Diethyl maleate	P
Dihydrocoumarin (Melilotine)	P
Dimethyl citraconate	P
Diphenylamine	P
Esters of 2-nonynoic acid, except methyl octine carbonate	P
Esters of 2-octynoic acid except methyl and allyl heptine carbonate	P
Ethyl acrylate	P
Ethylene glycol monoethyl ether and its acetate	P
Ethylene glycol monomethyl ether and its acetate	P
Eugenol	R
Farnesol	R
Fig leaf absolute	P
Furfurylideneacetone	P
Grapefruit oil expressed	R
Hexahydrocoumarin	P
Hexylidene cylcopentanone	R
HMPCC (3 and 4-(4-Hydroxy-4-methylpentyl)-3-cyclohexene-1-carboxaldehyde)	R
Hydroabietyl alcohol Dihydroabietyl alcohol	P
Hydroquinone monoethylether (4-Ethoxy phenol)	P
Hydroquinone monomethylether (4-Methoxy phenol)	P
Hydroxycitronellal	R
Isocyclogeraniol	R
Isoeugenol	R
Isophorone	P
Lemon oil cold pressed	R
Lime oil expressed	R
Limonene	S
Linalool	S
Massoia bark oil	P
Massoia lactone	P
Melissa oil (genuine Melissa officinalis)	P
Menthadienyl formate	R
Methoxy dicylopentadiene carboxaldehyde (Scentenal)	R
Methoxycoumarin	P
Methyl beta-naphthyl ketone	R
Methyl crotonate	P
Methyl heptadienone (6-Methyl-3,5-heptadienone)	R
Methyl heptine carbonate	R
Methyl methacrylate	P
Methyl N-methylanthranilate	R
Methyl octine carbonate (MOC)	R
Methyl-2(3)-nonenenitrile (Citgrenile)	R
Methyleugenol	R
Moskene	P
Musk ambrette	P
Musk tibetene	P
Nitrobenzene	P
Nootkatone	S
Oak moss extracts	R
Octen-3-yl acetate (Amyl vinyl carbinyl acetate)	R
Opoponax	R
Other materials	P
p-Methylhydrocinnamic aldehyde	R
p-tert-Butylphenol	P
Perilla aldehyde	R
Peru balsam	R

Petitgrain Mandarin Oil	R
Phenyl benzoate	P
Phenylacetaldehyde	R
Phenylacetone (Methyl benzyl ketone)	P
Pinacea derivatives	S
Propylidene phthalide	R
Pseudoionone (2,6-Dimethylundeca-2,6,8-trien-10-one)	P
Pseudomethylionone	P
Rue oil	R
Safrole, Isosafrole, Dihydrosafrole	R
Santolina oil	P
Savin oil	S
Sclareol	S
Styrax	R
Tagetes oil and absolute	R
Tea leaf absolute	R
Toluene	P
trans-2-Heptenal	P
trans-2-Hexenal	R
trans-2-Hexenal diethyl acetal	P
trans-2-Hexenal dimethyl acetal	P
Tree moss extracts	R
Trimethylcyclohexa-1,3-dienyl methanal (Safranal)	R
Trimethylcyclohexenyl/cyclohexadienyl)-2-buten-1-ones (Rose ketones)	R
Verbena absolute	R
Verbena oil	P

Nitromusks are important and relatively inexpensive fixatives for soap perfumes. IFRA guidelines state that they are potentially toxic and so prohibited for use in fragrances. In line with the guidelines issued, the use of nitromusks has been declining in recent years. Other classes of musk chemicals like macrocyclic musk or polycyclic musks are replacing it.

While many companies voluntarily adhere to the IFRA safety guidelines, it is not required by law to follow any of the group's recommendations, or to limit the use of any fragrance materials. It may also be noted that RIFM tests only raw materials and not finished fragrance products.

The environmental health effects of synthetic fragrances are complex. However a study by the United States Environment Pollution Authority (EPA) in 1991 has shown that some common synthetic fragrance chemicals are hazardous to humans in many ways.

1. Benzaldehyde is a narcotic sensitizer, a local anaesthetic and a CNS depressant. It causes irritation to the mouth, throat, eyes, skin, lungs and GI tract, resulting in nausea and abdominal pain and may cause kidney damage.
2. Benzyl acetate is carcinogenic (linked to pancreatic cancer). Vapours are irritating to eyes and respiratory passages, exciting cough. In mice hyper-anaemia of the lungs has been noticed. It can be absorbed through the skin, causing systemic effects.
3. Benzyl alcohol is irritating to the upper respiratory tract. It causes headache, air-nausea, vomiting, dizziness and drop in blood pressure, CNS depression, and death due to respiratory failure in severe cases.
4. Camphor is local irritant and a CNS stimulant. It gets readily absorbed through body tissues. Its vapours cause irritation of eyes, nose and throat, dizziness, confusion, nausea, twitching muscles and convulsions.
5. Ethyl acetate is on the EPA Hazardous Waste list. It is irritating to the eyes and respiratory tract. It may cause headache and narcosis. It can cause a defatting effect on skin, drying and liquid cracking of skin, anaemia with leukocytosis and damage to liver and kidneys.
6. Linalool is a narcotic and causes respiratory disturbance. In animal tests, reduced spontaneous motor activity and depression, development of respiratory disturbances leading to death, depressed frog-heart activities have been observed. It can also cause CNS disorder.
7. a-pinene is a sensitizer and damaging to the immune system.
8. g-terpinene causes asthma and CNS disorders.
9. a-terpineol is highly irritating to mucous membranes. Aspiration into the lungs can produce neumonitis or even fatal edema. It can also cause 'excitement' ataxia (loss of muscular coordination), hypothermia, CNS and after respiratory depression and headache.

Similarly, the European Union Cosmetics Directive identifies 26 fragrance ingredients as allergens.

Table 2
Fragrance ingredients as allergens

Amylcinnamic aldehydes
Farnesol
Amylcinnamic alcohol
Geraniol
Anisyl alcohol
Hexylcinnamic aldehyde
Benzyl alcohol
Hydroxycitronellal
Benzyl benzoate
Isoeugenol
Benzyl cinnamate
Lilial
Benzyl salicylate
d-Limonene
Cinnamic alcohol
Linalool
Cinnamic aldehyde
Lyral
Citral
Methyl heptine carbonate
Citronellol
g-Methylionone
Coumarin
Tree moss
Eugenol
Oak moss

Studies have shown that some synthetic fragrance chemicals can cause ill health effects, primarily to skin, lungs and the brain. Synthetic chemicals absorbed by the skin, break down into pro-

ducts that are stronger sensitizers than the original chemicals. The olfactory/ limbic tract is the most direct connection between the human brain and the air that we inhale. As there is no blood-brain barrier, the fragrance chemicals have the potential to effect, and possibly damage, brain tissue, resulting in neurotoxicity syndrome.

Fragrance chemicals can enter the human body through inhalation, ingestion or absorption. On entering the body, they get absorbed into the bloodstream and spread throughout the body.

Individual sensitivity to fragrance chemicals varies widely right from zero or no effect, to severe symptoms. It may be noted that many people who report sensitivities to synthetic fragrances also report sensitivities to other chemicals. This makes the claims of adverse reactions to synthetic fragrances difficult or impossible to link to a particular fragrance chemical.

Fragrances without synthetic aroma chemicals

Interestingly, most synthetic fragrances generally contain similar basic ingredients, with the exception of certain speciality chemicals. The speciality materials, some of them captive for organisational perfumers, impart certain uniqueness to the fragrance odour profile.

It is quite likely that odour effects and chemical stability possible by use of synthetic aroma chemicals are near-impossible to get with only natural stuff.

Natural plants have always played significant role as medicines. At one time, it was felt that the chemical synthesis would completely replace drugs of natural origin. However, in spite of various synthetic drug discoveries the use of plant drugs continues unabated. Even today, the medicinal needs of about 80% of people in developing nations are met by herbal drug preparations. Furthermore, in spite of the emergence of many wonderful synthetic drugs, the problems of senescence and 'civilisation' diseases, e.g. immuno deficiency syndromes, arthritis, mental disorders, cancer etc., are still not tackled completely.

Naturally, there is a greater demand for natural medicines and 'health-foods' today than ever before. In analogy to the above, the fear of synthetics having unwanted side effects or being potential carcinogens, without any therapeutic benefits, regular scientific updates on the understanding of adverse effects of synthetics, is having its toll on consumers preferring naturals.

In view of these developments, aromatic plants producing essential oils become significantly important from the functional point of view. At this juncture, natural fragrances made by use of only organic ingredients and essential oils, an amazing phenomenon of plant metabolism, may rank as the next best alternative.

Today, India has 16% volume share of the world essential oil market and 21.5% share in value terms. India's share of natural isolates/chemicals is only about 14% in the global market.

These being the industry scenario, just imagine the requirements of natural aroma ingredients necessary to completely replace or eliminate synthetics and the scope it holds for India!

Table 3
Some essential oils producing Indian plants with potential in the flavour and fragrance industry

Ambrette	Curcuma leaf	Mentha citrata
Angelica	Dhavana	Mint
Artemisia	Dill	Mogra
Asafoetida	Eucalyptus	Nagarmotha
Basil Indian	Fennel	Nishigandha
Bergamot	Fenugreek	Nutmeg
Birch sweet	Garlic	Oak moss absolute
Cajeput	Geranium	Ocimum Canum
Capsicum	Ginger grass	Orange Bitter
Caraway	Ginger	Orange Sweet
Cardamom	Grapefruit	Palm Rosa
Cedar wood	Gurjam Balsam	Parijat
Celery	Jasmine Absolute	Patchouli
Camomile	Jamrosa	Pepper
Champaka	Juniper	Peppermint
Cinnamon	Kewda	Rose
Citronella	Lavender	Rosemary Indian
Clary sage	Lemon	Sandalwood
Clocimum	Lemongrass	Screwpine
Clove bud	Linaloe	Spearmint
Clove leaf	Lily	Tuberose
Cocoa	Lime	Tulsi
Coriander	Liquorice	Turmeric
Cumin seed	Marigold	Valerian
Curcuma aromatica	Marjoram	Vetiver

Table 4
Essential oils producing plants in different States of India

State	Essential oil bearing plant
Andhra Pradesh	Sandalwood
Bihar	Mentha, Basil, Lemongrass, Palmarosa
Gujarat	Palmarosa, Kewda
Himachal Pradesh	Mentha, Patchouli
Karnataka	Sandalwood, Citronella
Kerala	Citronella, Lemongrass
Madhya Pradesh	Lemongrass, Citronella, Basil, Sandalwood
Northeast	Lemongrass, Citronella, Patchouli, Eucalyptus
Orissa	Kewda, Palmarosa, Lemongrass, Citronella
Punjab	Mentha, Basil
Rajasthan	Vetiver, Basil, Lemongrass, Palmarosa
Tamil Nadu	Jasmine, Sandalwood, Lemongrass, Geranium
Uttar Pradesh	Mentha, Rose, Basil
Uttaranchal	Lavender, Geranium, Mentha
West Bengal	Lemongrass, Palmarosa

Constraints & opportunities

Global changes occurring due to eroding forest cover has led to increased environmental awareness, among people. This, in turn, has led to a change in consumer perception and redefining of priorities to save the eco-system and reemphasise the need to encourage use of forestland plant-based products. God almighty has blessed India with different types of soils and climates that supports growth of a variety of plants. 18,000 native species are found in India of which 1,300 species on the last count contain aromas. In spite of its rich natural forest vegetation and a home of many exotic natural plants, India cultivates only limited items of commercial value. There is a great scope for commercial cultivation of several aromatic crops in India as there is always a market demand for new and specific aroma ingredients for development of new exotic fragrances.

Although fragrance usage is on an increase, the availability of quality plant oils for fragrance creation is not sufficient to keep pace with the demand generated. Plant cultivation largely depends on climatic conditions. Yields vary, year after year. Availability differs season to season. Unpredictable quality and odour profile is common. Price fluctuation is rampant. Supply and demand is rarely even.

Advent of biotechnology and modern farming techniques has, to an extent, insulated plant cultivation from the vagaries of nature, but this is far too less to make a significant difference on the industry dependence on nature.

Aromatic crop cultivation freshens up the polluted atmosphere and is a renewable resource in the ecosystem. The crops are useful even after the extraction of available essential oil, as they can be converted into artificial board for carpentry, used as fodder for animals, or decomposed to get bio-fertilisers. Essential oil bearing crop cultivation and processing is labour-intensive, generating good employment opportunities.

Steps needed for success

Even today, essential oils are extracted in India in an unorganised manner. This industry can grow only by following scientific means and methods of propagation and extraction. Systematic exploitation of aromatic plants by Indian industry can bring great economic advantage to our country, as more and more aromatic plants are brought under use. Setting up of small-scale essential oil extraction and processing units can provide ample employment opportunities for rural youth. Once these units come into operation, local farmers can be motivated for large-scale cultivation of selected aromatic crops, according to the prevalent agro-climatic conditions. During the initial stages, raw material requirement of these industries can be met either through collection from wild habitats or through intercropping cultivation in agricultural farms. Either way, it will provide employment to millions from the farming communities. Value addition through post-harvest technology can also generate further agricultural income and employment opportunities.

Conservation of aromatic plants by promoting sustainable genetic management schemes at the community level is necessary for equitable distribution of acquired benefits and to improve livelihoods of the rural poor. This can be achieved only if proper training for cultivation, primary processing, grading, packaging, storage and marketing are provided to rural cultivators. In addition, bio-partnership, networking and providing access to information between the prime stakeholders (local communities, R&D scientists and industry) is necessary.

Generating a strong database on genetic resources of aromatic plants and creation of protectorates/biosphere reserves to conserve the genetic stock of endangered species (*in situ* conservation) is essential. Sufficient quantity of quality seed and planting material of aromatic plants for cultivators should be made available. Newer agro-techniques and technology should be developed, as-

sessed and refined for large-scale cultivation to maintain sustainability and competitive advantage.

Tissue culture transplantation techniques need to be adopted for species whose propagation through seeding is not easy. Analytical laboratories for testing and maintaining quality controls should be established. Utmost priority is to be given to develop skilled manpower to handle all aspects of aromatic plants through intensive training programmes.

Evolving a long-term human resource development strategy for continuous improvement in competence and skills should ensure upgradation of the technical knowledge for field personnel.

India's agro-climatic conditions provide an ideal habitat for the natural growth of a variety of aromatic plants and herbs. The climatic diversity also offers large opportunities for domestication of many herbs that are in short supply and have to be imported. This will not only supplement internal demand, but also save substantial foreign exchange.

The fact that derivatives of aromatic plants are non-narcotic without noticeable side effects, even if used for a prolonged time in permissible doses, fuels its demand around the world. Interestingly, 30% of the ingredients prohibited by IFRA on grounds of safety or otherwise are naturals.

Cultivation, processing and use of aromatic plants are a great potential for employment generation in rural areas. Our tilt and liking towards synthetic aroma chemicals is slowly destroying nature's gift of aromatic plant species used for fragrance creation in ancient India and which grew abundantly in our forests.

Another reason for the disappearance of many plant species is our ignorance with regard to its identity and use. In our ignorance, many useful species are treated as useless weeds and destroyed with no scope for regeneration.

In spite of our country's innumerable benefits, there exist many constraints, which are responsible for impeding the growth of this industry.

These include:

- Inequitable trade practices that allow only a very small amount of profit to percolate down to the collectors, cultivators and harvesters of aromatic plants;
- Inadequate government funding and prioritisation;
- Insufficient information sharing and co-ordination among stake-holders;
- Poor mechanism to improve resource conservation, livelihood security in rural and marginal communities; Lack of co-ordination of any holistic research programme;
- Weak linkages between stakeholders, right from production to consumption value chain.

Challenge to India

India is no exception to the global phenomenon of environmental problems and depletion of natural plant resources. However, the rich diversity in aromatic plants that nature has provided India needs to be exploited judiciously, without disturbing the ecological balance. Resources need to be harnessed for economic development, and, at the same time, their regeneration, preservation and propagation has to be maintained for sustenance.

The restoration and preservation of our biological heritage is a challenge not only to our planners, administrators, scientists, industrialist, entrepreneurs and farmers, but also to common individuals and citizens at large.

Efforts to coordinate development of quality planting material, encouraging commercial cultivation, value addition through processing, liaison with industries and trade, including export, is necessary to boost India's economy and our standard of living.

India, the land of opportunities, is projected to be one of the world's largest economies in terms of GDP, and purchasing power parity. The Indian population of over one billion in this millennium, will be extremely young, with 70% under 34 years of age, unlike in the developed countries. It is up to all of us to grab this opportunity and regain our pre-eminent position as world-leader in the natural fragrance industry, as in ancient times, or rest satisfied by becoming the world's largest consumer of imported fragrances and fragranced products.

Additional Reading

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