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Natural & Synthetic Perfumes in the Fragrance Industry

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Abstract - Natural fragrances are perfumes created from environment friendly, natural, and organic materials. The aromatic compounds included in these natural fragrances are used by the human body either via the skin or through the sense of smell. Due to the low toxicity of these chemicals and the rising consumer knowledge of the usage of natural and synthetic perfumes, these fragrances are in high demand. Due to growing health awareness, fragrance consumers are choosing natural goods to guarantee better lives. The majority of consumers seeking natural fragrances are adults and seniors. The worldwide market for natural fragrances is being driven by changing consumer behaviour, expanding activities for sourcing ingredients, and certification. Natural sources continue to provide flavour and fragrance elements that are distinctive and efficient, despite the widespread usage of flavour and scent from artificial sources. Traditional harvesting of wild crops and fermentation of natural substrates utilizing cutting-edge biotechnological processes are two different production methodologies. Research into the chemistry of natural product analysis advances our knowledge and enjoyment of the substances in the fragrance industry.

Keywords - Natural Product, Analysis, Fragrance Industry, Chemical constituents, chemicals, flavor compounds.

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INTRODUCTION

Flavorings and Fragrances Flavorings and fragrances play a crucial role in the cosmetics and food industries. Absolutes, oleoresins, isolates, attar, essential oils, aroma compounds, and specific aroma components are just some of the elements that go into making these blends. The home and personal care and food and beverage sectors in industrialized nations rely heavily on the taste and fragrance industry, which has matured there. Although India is still in its infancy with respect to the penetration of flavour and fragrance finished goods, the flavour and fragrance ingredient production business in India is highly developed (1). Yet the rising purchasing power of the Indian middle class and the expansion of fast moving consumer goods and food and beverage (F&B) giants into rural areas are giving the taste and fragrance business with a much-needed boost.

To put it simply, natural scents are colognes and perfumes derived entirely or primarily from organic and natural materials. Aromatic molecules included in these natural scents are absorbed by the skin or used by the sense of smell. Due to rising consumer education about the benefits of both natural and synthetic fragrances, as well as the relative safety of these chemicals, there is a brisk market for these scents. Substrates and perfume often get their all-natural aroma from essential oils and extracts. Natural scents are sometimes more precious than synthetic ones since they are so hard to come by (2).

Future of Natural Fragrance Ingredients Market

It is anticipated that soaring demand from millennials and developing regions would drive the global market for natural fragrance ingredients to expand at a healthy CAGR. Key growth factors in the Natural Fragrance Ingredients market include technological developments that allow for more efficient manufacturing, a broader range of products, more refined design and packaging, more reliable operational maintenance, and closer tracking of sales. But some of the Natural Fragrance Ingredients market restraints over the forecast period include complying with stringent regulations and varying standards around the world, rising competition, inflation estimated to remain above the upper band during the short term in key nations, and fluctuating raw material prices (3).

Natural Fragrance Ingredients Market Analytics

The factors, both immediate and longer-term, that may affect the supply and demand in the Natural Fragrance Ingredients industry. Evaluations are made of the "parent," "derived," "intermediary," "raw," and "substitute" markets. To make the most accurate market forecasts for Natural Fragrance Ingredients, we wisely weigh available data from geopolitical research, demographic analysis, and

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porters' five forces analysis. What effect, if any, recent transactions and events may have on Natural Fragrance Ingredients' future operations are taken into account. Threat of New Entrants, Threat of New Substitutes, Product Differentiation, Competition, Suppliers, Distribution Channel, Capital Required, Entry Barriers, Government Regulations, Beneficial Alternative, and Substitute Cost are also examined in the Natural Fragrance Ingredients market. The international market picture for Natural Fragrance Ingredients is better understood by a review of trade and pricing data, which includes information on the most significant exporters, suppliers, and customers. Our customers benefit from the data and research by better planning their purchases, narrowing in on promising vendors/clients, gaining insight into price trends and patterns, and discovering untapped avenues for selling Natural Fragrance Ingredients. The study will be brought up to date to the most recent month to account for how recent events, such the conflict between Russia and Ukraine, have affected the Natural Fragrance Ingredients industry (4).

Hair oils, essential oils, perfumes, deodorants, soaps, and detergents all contain natural scent compounds, which are sourced from natural resources such fruits, flowers, grasses, and spices. Due to rising concerns about the health risks posed by synthetic compounds including butylated hydroxyanisole (BHA), acetaldehyde, benzophenone, butylated benzyl salicylate, and hydroxytoluene, consumers are more interested in purchasing perfumes made from natural ingredients (BHT). Market demand is being fueled by these causes. Aromatherapy practitioners have long believed that natural smells have healing benefits of their own. The essential oils of flowers including jasmine, rose, lavender, moonflower, chamomile, rosemary, and lilies are utilized for a variety of medical purposes, including as anti-inflammatory agents, preservatives, skin condition treatments, and sleeplessness remedies. Because of these considerations, the industry is seeing rising demand for natural fragrance compounds. Natural perfumes are non-toxic, therefore they don't create any respiratory problems. Laundry detergents with natural smells also help soothe skin. These factors significantly contribute to the rising interest in natural over synthetic perfumes. More and more people are opting for natural fragrances over synthetic ones because of the positive effects they have on health and the durability of the scent they impart. Rare natural smells, such as those derived from earth and musk, are also experiencing high demand and widespread acceptance in the realm of luxury perfumes. Because of these advantages, the market is expanding rapidly (5). Market expansion is anticipated on account of many causes, including rising interest in using cosmetics to enhance one's look, rising incomes, and the rising desire for eco-friendly, natural, and custom fragrances. Premium perfume lines that employ natural fragrances must have their goods certified by appropriate bodies to ensure the quality and safety of their consumers. In turn, this boosts confidence in high-end products and encourages more people to try natural aromas. All of these factors have contributed to the product's meteoric rise in popularity. Air fresheners including aerosol sprays, room fresheners, and automotive air fresheners have seen rising demand thanks to technological advancements, widespread product promotion across several social media platforms, and general public interest in the category (6).

Natural Fragrance Ingredients Market Competitive Intelligence

The market structure and competitive landscape for Natural Fragrance Ingredients are shown by using a proprietary company revenue and product analysis methodology. Detailed company profiles, including a company overview, product offerings, SWOT analysis, financial analysis, and major strategies, are provided for the most important market participants. Natural Fragrance Ingredients market leaders are revealed (7). Our clients are provided with the most recent information on the Natural Fragrance Ingredients market in terms of new product launches, investment and funding updates, mergers and acquisitions, collaboration and partnership, awards and agreements, expansion, and other developments. To help readers better understand the company's approach to the Natural Fragrance Ingredients market, the company's product and service offerings are broken down by region, including Asia-Pacific, Europe, the Middle East, Africa, and South and Central America. In order to increase their share of the market, users may examine the tactics of their competitors and better match their own talents and resources based on the results of the competition study (8).

Indian Industry Overview

Global flavour and fragrance companies dominate the Flavor and Fragrance industry in India, producing 60% of all flavour and fragrance blends there. India is one of the top providers of the flavour and fragrance ingredients in the worldwide market, accounting for 30–35% of the overall supply of Flavor and Fragrance components and exporting roughly 85% of the entire output. According to research, the domestic market for flavours and fragrances in 2015 was worth $0.81 billion, while the Flavor and Fragrance ingredient market was worth around $3.4 billion. There are around a thousand local Indian businesses, but only four global players control more than two-thirds of the flavour and fragrance industry in India. The current value of India's food and beverage ingredient export industry is estimated at USD 3.8 bn, rising to USD 4.8 bn by 2016. India is becoming a major hub for the flavour and fragrance industry in South and Southeast Asia because to the rising demand in the Indian market and the growing acceptability of Indian Flavor and Fragrance components. India is a major player in the global raw material and base ingredient export industry. The country is a major producer of essential natural resources such as mint, ginger,

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chilly and pepper, spices, anise, fennel and coriander, lemongrass oil, nutmeg, mace, and cardamom, and eucalyptus oil. All-natural and artificial flavours and fragrances start with these components (9). Aroma chemicals, in contrast to essential oils, can be generated either from petrochemical compounds or from various natural sources. Despite the obstacles posed by seasonality and variations in production, ingredient producers who rely on natural resources have an advantage due to the limited negotiating power of natural resource suppliers in the nation. Those in the industry who rely on synthetic sources face a different landscape, as there are fewer of them.

Key Challenges faced by Indian Firms

Although there are many Indian companies competing in the food and beverage industry, the vast majority operates only in the component production sector and has little impact on the blending market (10). One of the primary difficulties encountered by Indian companies is the increasing demand from FMCG businesses to lower costs, which has lead to a reduction in investment in R&D operations:

- **Progression in Value Chain:** The majority of Indian firms serve as manufacturers for both international and domestic Flavor and Fragrance brands. Most of the market participants produce synthetic aroma compounds; but, because of insufficient investment in R&D, they are unable to differentiate their products from the competition and must instead rely on pricing. Moreover, the rising rivalry from the Chinese companies has further heightened the pricing competition, hence forcing the Indian players to operate on low profit margins (about 10-15%). Because of this, they are unable to invest in product development, which slows their development and prevents them from moving up the value chain (11).
- **Barriers to Entry:** No substantial technological obstacles to entry exist in the Flavor and Fragrance blending arena; but, smaller firms cannot compete with the existing Flavor and Fragrance power houses when it comes to customer connections and social capital. Analysis of the market indicates that Flavor and Fragrance houses get the bulk of their income from FMCG companies, a sector that is inaccessible to smaller firms owing to intense pricing competition. Further hindering Indian companies' capacity to differentiate themselves from the large FMCG giants is their lack of resources.
- **Adherence to International Standards:** Markets in Europe and North America are working on creating required standards with a greater emphasis on carbon neutral and environment friendly practices. Many businesses operating in the export-oriented Indian market have been affected by the adoption of these rules. The enormous expenses associated with complying with these regulations create an already challenging environment for competitors.
- **Availability of Raw Material:** Since many perfumes and flavours are created using natural components, the Flavor and Fragrance business is heavily reliant on agricultural output, which presents difficulties including low yield and seasonality with regards to herbal raw materials. The price and availability of raw materials are significantly affected by this. To put it another way, this affects their whole cost structure, which lowers their margins even further (12).
- **Limited R&D Investment:** Few businesses are able to engage in research and development to create alternatives of critical fragrance compounds due to poor operating margins.

RESEARCH METHODOLOGY

Many different types of analytical methods are applied to F & F materials for many different purposes. Complex Flavor and Fragrance materials have a broad range of chemical structures, and understanding these structures can shed light on how to synthesize artificial Flavor and Fragrance materials. Understanding the chemical causes of undesirable aromas and flavours might inform better techniques of manufacturing and storage. Due to autooxidation (hexanal created by vegetable oil rancidity) and photoxidation, oxygen and light cause foods to develop unpleasant aromas and flavours (the skunky note in sun-struck beer, 3-methylbut-2-ene-l-thiol). Manufacturers can be guided in setting appropriate product shelf life and in controlling degradation processes when possible if they have a scientific understanding of the chemistry behind Flavor and Fragrance material spoilage and deterioration. Growers can maximize the yield of their plants by harvesting at the peak of the Flavor and Fragrance components' concentration. The influence of packaging and its capacity to safeguard or taint the meals and perfumes it contains may be gauged through analysis. In particular, polyethylene plastic packaging can "scalp" aromatic compounds from the items it encloses. Less strongly than polyethylene, polyvinylidene chloride (Saran), polyester (PET), and oriented polypropylene emit odours from the scalp. Flavor may also be altered by packaging materials other than plastic. When wine is left to age in oak barrels, oxygen from the air can seep in and oxidize (age) the wine's constituents over time. Plant-based Flavor and Fragrance materials are vulnerable to contamination from agricultural pesticides and processing aids, but wine may also take molecules from the oak, such as whisky lactone (beta-methyl gamma-octalactone), which gives the wine a woody aroma. Chlorinated teipenes, teipene chlorohydrins, can be present in orange oil reclaimed after juice production if too

much chlorinated water was used to wash the fruit. Tiny variations in chemical make-up can be used as identifiers of the provenance of the same plant growing in different parts of the world. Compositional analysis is useful for determining whether or not a product meets quality, purity, and other requirements set by regulatory organizations. By identifying minute impurities unique to synthetic Flavor and Fragrance materials, GCMS may verify the natural origin of Flavor and Fragrance materials, distinguishing them from low-cost synthetic analogues. Using this procedure, you can tell if the sweet birch oil, which includes methyl salicylate naturally, also contains 1–5% of the chemical from manufactured sources.

One or more of the chemical centres in some Flavor and Fragrance compounds are asymmetric (chiral). Asymmetrically centred natural materials are not often racemic. Racemic mixtures of the same molecules can be made from petrochemicals. Natural authentication can be improved by analyzing natural Flavor and Fragrance compounds for their enantiomeric composition using GC columns with optically active stationary phases like heptakis(2,3,6-tri-0-methyl)-beta-cyclodextrin. Multi-dimensional GCs, which allow for the "heart cutting" of individual GC peaks before they are separated on a chiral GC column, are frequently used to improve the accuracy of chiral GC analyses. The enantiomeric ratios of the two forms of a chiral chemical found in nature can be used in conjunction with chiral GC for source differentiation during natural authentication. Among citrus oils, bergamot oil has a chiral ratio of 14(S):86(R) for limonene, whereas lemon oil has a chiral ratio of 1(S):99(R) and citronella oil has a chiral ratio of 96(S):4 for limonene (R). If the oil in question contains various chiral components with different chiral ratios, then chiral analysis can be used to verify the oil's natural origin. Alphapinene, which contains a chiral centre at the 1 position, is present in bergamot, lemon, and citronella oils as well. Bergamot oil has 72(S):28(R) alpha-pinene, whereas lemon oil contains 62(S):38(R) and citronella oil contains 23(S):77(R) alpha-pinene (16).

METHODS OF ANALYSIS

Evaluation of food and beverage (Flavor and Fragrance) products often begins with a sensory study. All the main food and fragrance companies base their marketing tactics on the opinions of panels of professional tasters and odour assessors. Apprenticeships lasting seven years or more help aspiring perfumers and flavorists hone their sense of smell and taste in preparation for the certification exams required by professional associations in these fields. The human sense of smell and taste is not replicated in many commercially accessible analytical instruments (or many animals for that matter). Researchers face a difficult task in separating Flavor and Fragrance details from the massive amounts of data produced by the various analytical methods. Blending the analytical prowess of a GC column with the sensing power of the human nose is one of the most effective methods for detecting odours. The resultant GC-olfaetometry (GCO) can help food and beverage (Flavor and Fragrance) scientists quickly determine which GC peaks have the desired odour attributes. Finding the most potent olfactory components in an extract calls for a combination of GCO and serial dilution approaches. The most prominent odor-causing substances in a sample are those with a high Odor Activity Value (the ratio of the odorant concentration in the sample to the odorant threshold in air) (or offodor).

Flavor and Fragrance materials can be analyzed, authenticated, and identified using G C, MS, NMR, IR, HPLC, TLC, and other procedures, either alone or in combination. Examining the benefits and drawbacks of employing various analytical methods to verify F & F materials. Concentrations of sulphur or nitrogen compounds with a strong olfactory influence can be detected by GC utilizing element specific detectors. Extracts of natural materials used in Flavor and Fragrance are frequently composed of dozens of different chemicals. The numerous components of a complicated extract can be more easily identified using GC analysis of off-line 'rough cut' L C separations.

Stable Isotopic techniques

Analysts can utilize the isotopic distribution of natural Flavor and Fragrance molecules as a hallmark to distinguish them from manufactured analogues. The carbon molecules that plants make use of metabolic pathways that can tell the difference between 13C and 12C. Both the carbon dioxide the plant needs as a reactant and the chemicals it generates have different 13C / 12C ratios. Some Flavor and Fragrance materials can be verified as having natural or synthetic origins by stable carbon isotope ratio analysis (SIRA), which analyzes the, 13 C / 12 C ratio. Using stable isotope ratio analysis (SIRA) on hydrogen isotopes like 2 H or D and 1 H can help verify the authenticity of Flavor and Fragrance compounds found in nature. By combining GC with on-line 13 C / 12 C or D/'H SIRA analysis, a complex combination like cinnamon bark oil may be verified down to its individual components.

Radioactive isotopic techniques

Because of the constant bombardment of Earth's atmosphere by the sun's cosmic rays, a small amount of naturally radioactive 14C gets incorporated into the carbon compounds produced by living plants. After a plant is harvested or dies, it can no longer take in any more 14C, and the amount of 14C in the remaining plant material begins to decline at a rate proportional to the half life of 14 C. (5760 years). Flavor and Fragrance compounds extracted from plants have a negligible but detectable amount of radioactivity from natural, 14C, in contrast to the nearly nonexistent amount of 14C in Flavor and Fragrance compounds made from petroleum. Carbon in petroleum is far older than the

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carbon in living things by millions of years and several radioactive half-lives.

Table 1: Pros and Cons of Flavor and Fragrance Authentication Methods

method	pros	cons
GC sample: 0.1g or less high purity needed?: no test cost: ~$100 equip. cost: ~$30,000	Relatively fast and inexpensive. Customizable. Much published reference data. Can use element specific detectors (S, N).	ID of components requires another method, typically MS. Only for volatiles. Requires authentic references.
Chiral GC sample, purity requirements and costs similar to GC	Difficult to circumvent.	Requires authentic references. Columns cost more and are less durable than regular GC columns.
TLC sample: 0.1g or less high purity needed?: no test cost: ~$25 equip. cost: ~$200	Inexpensive and fast. Customizable. Non-destructive. Useful for non-volatiles.	Limited resolution capability. Need authentic references. High resolution methods cost much more.
HPLC sample, purity requirements and costs similar to GC	Fast. Non-destructive. Much published reference data. Useful for non-volatiles.	ID of components requires another method. Requires authentic references.
OR (optical rotation) sample: 1g or more high purity needed?: yes test cost: ~$10 equip. cost: ~$10,000	Fast. Much published reference data. As an HPLC detector costs more but lowers sample size requirements.	Only gives total OR, not a measure of enantiomeric ratios. Only for chiral materials.
Carbon SIRA sample: 0.1g or less high purity needed?: yes test cost: ~$100 equip. cost: ~$200,000	Can authenticate some compounds (vanillin). Can be combined with GC for peak-by-peak analysis.	Does not have application to many F&F materials. Equipment requires careful calibration.
Hydrogen SIRA sample, purity requirements and costs similar to Carbon SIRA	More application than Carbon SIRA. Can be combined with GC for peak-by-peak analysis.	Deuterium F&F analogs are available to adjust the overall ratio of synthetics to pass test.
Carbon-14 sample: 1 to 3 g high purity needed?: yes test cost: ~$200 equip. cost: ~$200,000	Provides definitive results unless sample is diluted with radioactive components. No database needed.	F&F materials synthesized from natural materials (i.e. citral from turpentine) will pass test as 100% natural.
D-NMR (SNIF-NMR) sample: 0.5 to 2 g high purity needed?: yes test cost: ~$1000 - $1500 equip. cost: ~$500,000	Reliable when used with a reference database. Difficult to circumvent.	Expensive. Requires database. Natural F&F from new sources (i.e. not in reference database) may test as non-natural.

Isolation and Interaction Effects

F & F compounds can be high purity (like orange oil from orange peels) or low concentration in a substrate (such as the flavour of bread crust which is only generated upon baking). Since most flavours and scents are active at low levels, most Flavor and Fragrance analyses begin by concentrating them. Many Flavor and Fragrance compounds are labile, reacting and degrading when exposed to heat or pH changes. Low-pH distillation hydrolyzes esters. Plant-based enzymes can react with Flavor and Fragrance. If you want to isolate a plant's natural scent, the enzymes that may breakdown it must be inactivated by moderate heat, methanol, or high salt solutions. Flavor and Fragrance compounds may be isolated by liquid CO2 extraction, SPME, purge and trap, low temperature vacuum distillation, and solvent extraction. When employing C02 recovered from fermentation, liquid CO_2 extraction leaves the extract natural and organic because the solvent has no artificial residues.

Isolation must also include substrate-flavor-fragrance interactions. Low odorant concentrations and excessive water vapour emissions make it difficult to collect natural scents from skin or breath. Washing the skin with ethanol or massaging it with thermally desorbed glass beads might gather skin emanations. Fats, carbs, water, and proteins in meals affect taste stability, release, and perception. Hard candy won't taste like ice cream flavour. Aroma molecule partition coefficients favour an oil phase, limiting the number of molecules released to the air and nose odour receptors. Variable effects of carbohydrates on aroma molecule partition coefficients. Carbohydrates bind certain tastes and release others, like salting-out. Proteins are macromolecules that bind fragrance molecules through hydrogen bonding or van der Waals forces. Protein amines react with aldehydes.

Aromatheraphy

Aromatherapy is the practice of employing aromatic essential oils to promote physical and mental well-being. There has been a lot of effort put into establishing causal relationships between smells and the positive (or negative) physiological responses they elicit in humans, and this work is beginning to bear fruit. Aromathermapy patients who breath vapours containing chemical elements of natural essential oils show changes in EEG activity and detectable alterations in their plasma and cell membranes. In fact, even those with anosmia show changes in EE G activity, proving that the effects are not only psychological.

Odor and taste reception

Consideration of how the human senses of taste and smell detect and discriminate chemical substances is essential even for the most fundamental knowledge of Flavor and Fragrance materials. Salt, sweet, bitter, sour, umami (Japanese for "tastes nice"), odour, and trigeminal receptors all play a part in the complex reaction that is flavour (heat, cooling, pain, temperature, tingling, astringency, and pungency). The crunch of crisp meals and the pop of carbonated beverages both provide auditory contributions to the sensory experience. Human taste receptor cells detect salty and sour chemicals by effects on ion channels, whereas G-protein coupled receptors are involved in the detection of bitter, sweet, and umami compounds. Researchers can create molecules with a desired sensory character from scratch by establishing Structure Activity Relationships (SAR), or they can create chemicals that prevent the perception of certain tastes. Research using SAR techniques improved scientists' grasp of the molecular mechanisms behind Asian peppers' characteristic heat. Newly synthesized isqbutyl undeca-2E, 4E, 8Z-triene amide was discovered to have a strong odour, just as anticipated by SAR learning.

Non-Volatiles

Flavor compounds may be volatile or non-volatile, but aroma compounds must be volatile enough to be breathed by the nose. Most substances with molecular weights under 300 Daltons are considered volatile. A molecular weight of over 300 is not uncommon for taste compounds that do not evaporate. Non-volatiles can be detected using TLC or HPLC, either alone or in conjunction with an

identification method. Citrus oils, like the substituted psoralen byakangelicol, are enriched in non-volatile coumarins, sterols, fatty acids, and psoralens, which may be identified using high-performance liquid chromatography-nuclear magnetic resonance. Because of their ability to function as odour fixatives, non-volatiles can affect how quickly a perfume evaporates off the skin. Non-volatiles can also be used as immutable authentication marks that are tough to forge around.

CONCLUSION

The international market for Natural Fragrance Ingredients is facilitated by the data provided by a thorough examination of exporters, suppliers, and buyers. Customers benefit from the data and research by better planning their purchases, narrowing in on promising vendors/clients, gaining insight into price trends and patterns, and discovering untapped avenues for selling Natural Fragrance Ingredients. The study's goal was to familiarize the reader with the Natural Product Analysis complexity of natural taste and aroma chemistry, analysis, and manufacture. Everyone with a sense of smell or taste plays a vital role in this arena. Every day, we see the introduction of new ingredients, methods, products, and even scents. Researchers are advanced thanks in part to their ability to adapt to the ever-changing landscape of natural flavour and fragrance.

REFERENCES

1. Bernier, U.R., Booth, M.M., Yost, R.A. Analytical Chemistry 1999, 71(1), 1-7
2. Brody, A.L. Food Technology 2002, 56(6), 124-125
3. Buchbauer, G. (2012) in Proceedings of the 12th International Congress of Flavours, Fragrances, and Essential Oils, Woidich, H., Buchbauer, G., Ed. Austrian Association of Flavour Fragrance Industry. Vienna, pp 34-43
4. Frey, C. in Flavors and Fragrances: A World Perspective.; Proceedings of the 10th International Congress of Essential Oils, Fragrances, and Flavors; Lawrence, B.M; Mookherjee, B.D; Willis, B.J. Ed.; Elsevier Science Publishers, Amsterdam, pp 517-524
5. Lucas, C.D., Putnam, J.M., Hallagan, J.B., 1995 Poundage and Technical Effects Update Survey, Flavor and Extract Manufacturers' Association of the United States, Washington, DC 1999, p 90
6. Phlak, L.C. , Park, E.S. J. Agric. Food Chem. 2003, 51, 3731-3736
7. Sloan, A.E., Food Technology 2003, 57(4), 30-49
8. Smith, R.L., Doull, J., Feron, V.J., Goodman, J.I., Munro, I.C., Newberne, P.S., Portoghese, P.S., Waddell, W.J., Wagner, B.M., Adams, T.B., McGowen, M.M. Food Technology 2001, 55(12), 34-55
9. Sommer, H., Bertram, H.J.; Krammer, G., Kindel, G., Kuhnle, T., Reinders, G, Reiss, I., Schmidt, C.O., Schreiber, K., Stumpe, W., Werkhoff, P., Perfumer and Flavorist 2003, 28(1), 18-34
10. Stofberg, J. Perfumer and Flavorist 1983, 8, 53-62
11. Swenig, S; Hener, U.; Mosandl, A., Eur. Food Res. Tech. 2003, 217(5), 444-448
12. Weiss, E.R.; Braddock, R.J.; Goodrich, R.M.; Gregory, J.F. III; Pika, J., J. Food Sci. 2003, 68(6), 2146-2149

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