Module 7 Flavourings for the food industry

1. Definition of a Flavour

Flavour and food flavourings are related terms, although they vary in definition.

Flavour is created by nature and is composed by aromatic chemicals that are biosynthesised during the normal metabolic processes in plants and animals and which may be further modified by subsequent processing. The intrinsic flavour of food represents the complex impact by these aromatic components on the senses of odour and taste.

Flavourings, on the other hand, are man-made. They are prepared from natural and/or synthetic aromatic substances that may or may not be found in nature. The aim is to increase the acceptability of the end-product through the stimulation of the nose and the palate, by modifying a flavour that is already present or masking some undesirable flavour

The Society of Flavour Chemists (1969) formulated following definition of Flavour: ‘‘A flavour is a substance which may be a single chemical entity, or a blend of chemicals of natural or synthetic origin, whose primary purpose is to provide all or part of the particular effect to any food or other product taken in the mouth.’’

The International Organization of the Flavour Industry (IOFI) defined flavours from the industry's point of view: ‘‘Concentrated preparation, with or without solvents or carriers, used to impart flavour, with the exception of only salty, sweet, or acid tastes. It is not intended to be consumed as such.’’

According to the Council of Europe: ‘‘Flavouring is a substance which has predominantly odor-producing properties and which possibly affects the taste.’’

2. Functions of Flavours

The role of a flavour is simply to impart sensory pleasure to a good, beverage, tobacco, or pharmaceutical, and in doing so it serves a diverse function. It is important to understand the function expected of the flavour so that the type best suited for this function can be delivered. As differentiated in Table flavour has three major categories of function: Economic, Physiological, and Psychological. Many flavour applications perform functions in all three categories, although each category will have a different emphasis. For example, some applications are mainly for pleasure (psychological functions) as exemplified by a hard-boiled candy as opposed to a flavoured yogurt (for breakfast) where the three functions—economic, physiological, and psychological—are applied in differing degrees.

Table: 2.1 Functional Uses of Flavours

Economic	Physiological	Psychological
Simulate	Metabolic response	Nostalgia
Extend	Intestinal absorption	Association
Flavour the unflavoured	Appetite and consumption	Intellect/belief, cognitive factors
Modify (cover taste)		Trend
Compensate for flavour losses		Flavour the flavoured

Improve shelf-life		

2.1 Economic Functions

Some healthful, nutritional food preparations might have undesirable tastes (e.g., soya and vitamins). Flavours that can modify their taste and make these nutritional, economical food preparations more palatable would be desirable. Another example of this application is the use of flavour to compensate for flavour losses in food processing or to extend freshness during storage.One important function conceptualized by Givaudan Roure is to ‘‘flavour the unflavoured’’ which is used to bring variety and palatability to a bland food such as rice or cereal.

2.2 Physiological Function

Various studies on taste and fat digestion provide some indication that taste can alter the metabolic response to a fatty meal. There is also research on taste and intestinal absorption of glucose that proposes oral stimulation affecting intestinal absorption. However research in this regard is still in infancy stage.

2.3 Psychological Functions

Although the main role of a flavour is to provide sensory pleasure, psychological analysis of this pleasure can greatly assist in proper flavour selection. Examples of today’s trendy flavours are the fantasy types that do not necessarily represent a commonly known food, but rather a novel combination, thus creating a new identity. These are exemplified by the various fruit punches, candies, toffees, etc. The concept of ‘‘flavour the flavoured’’ is also useful to add variety and increase sensory pleasure to foods that normally need no further flavouring. The addition of flavours to tea and coffee is an example of this concept.

3. History

The nature of today’s flavour industry is in marked contrast to that of the spice and essential oil business of the Middle Ages. Simulated Flavours became available in the 19th century, prior to 1800 there were no simulated flavours. It is interesting to note that flavours produced by the industry in the late 19th century were about 90% natural, derived mainly from spices and essential oils. In the 1950s, flavours became about 90% artificial, due to the availability of synthetic chemicals. In the 1980s and 1990s natural flavours comprise roughly 70% of the mix. Few of the important events in the History of development in Flavour industry is delineated below.

Year	Events
16^{th} Century AD	During the early days of history, people used spices mainly to enhance or modify the flavour of their food. Although some of the herbs and spices were grown in many parts of the world, the most important spices came from the east, especially from India, Ceylon, and the spice islands (Sumatra, Java, Bali, etc.). In the second half of the 16th century essential oils began to be widely produced and used predominantly by the pharmacists, which became a factor in the flavour industry only during 19^{th} century.
1608	Succinic acid and benzoic acid were isolated.

1661	Pyroligeneous acid was isolated by dry distillation of wood.
1769–1785	Swedish chemist Carl Wilhelm Scheele was the first to apply solvent extraction of plant and animal products to investigate chemical components. Tartaric, citric, malic, gallic, lactic, and uric acids were isolated from natural matters.
1772–1777	Lavoisier (France) was the first to shed some light on the chemical nature of these substance (identification of oxygen and ‘‘azote’’).
1807	Berzelius (Stockholm) was the first to refer to the earlier studies as ‘‘organic chemistry’’ and was the father of the ‘‘vital force.’’ Wohler (Germany) was the father of synthetic organic chemistry and the first scientist to refute the hypothesis of the ‘‘vital force.’’ He succeeded in preparing synthetic urea.
1850 to early 1900	Most flavours consisted of a single chemical. Sophisticated flavours at that time constituted a mixture of three or four ingredients, selected from the 50 available chemicals. Over 90% of the raw materials used for flavours were of natural origin.
1930s and 1940s	The flavour industry flourished with artificial flavours
1950s	Development of new analytical tools like the gas chromatograph, the mass spectrometer, nuclear magnetic resonance, etc.
1960s and 1970s	Following the advent of these new analytical tools, a number of new aroma chemicals were identified and became available.

4. Classification of Flavouring substances

Depending on the source materials and accepted techniques Flavours can be Broadly classified into three categories: (1) Natural Flavouring substances and (3) Artificial / Synthetic flavouring substances. The raw materials used for production of synthetic and natural flavours are listed in Table 1. Classification of Natural Flavours and synthetic flavours are presented in table 2 and table 3 respectively.

4.1 Natural flavours

The flavouring substances, which are naturally present in plant and animal source materials, must be isolated for example via extraction or distillation - processes where specific substances are separated from a natural mixture. Different processes applied for extraction of natural flavours are: 1) Extraction process as for example in coffee preparation wherein hot water is used for extraction of coffee flavour from coffee powder and vanilla extract from vanilla beans where alcohol or supercritical carbondioxide is used for extraction. 2) Distillation process wherein the plant or animal source material are brought to a certain, pre-determined boiling point and the steam is collected by cooling, as for example to produce natural citral from lemon grass oil. 3) Biotechnological production process which is used in the case of source materials not being available in quantities necessary to produce a flavouring substance or if the production is too complex and expensive.

4.2 Artificial / Synthetic flavouring substances

There is distinguished difference between nature-identical and artificial flavouring substances, both being produced by chemical methods. However, nature-identical flavouring substances have the same chemical formula as their natural model. This is not the case for artificial flavouring substances.

At present there is no classification between nature-identical and artificial flavouring with the application of the new EC Flavouring Regulation on 20th January 2011. Under the new Regulation both flavouring substances groups are subsumed under the category of "flavouring substances" with no further distinction being made between them.

Nature-identical flavouring substances are isolated from raw materials by chemical methods or are produced synthetically. For example, vanillin, the main component of vanilla beans, can be produced as a natural or a nature-identical flavouring substance. Nature-identical means that nature-identical flavouring substances are "born" in a laboratory but that their chemical structures are identical to the substances present in natural products. A substance can only be named as nature-identical if it naturally occurs in plant or animal raw materials. For example, the molecular structure and the smell or flavour of natural citral which can be distilled from lemon grass oil, and of nature-identical citral which is chemically synthesized, do not differ. Only the production methods are different, and the substances are obtained from different source materials.

By contrast artificial flavouring substances have no equivalent in nature. A well-known artificial flavouring substance is ethyl vanillin which smells and tastes like vanillin yet is roughly three times more taste-intensive.

4.3 Other flavouring categories

4.3.1 **Flavouring preparations**

Flavouring preparations are not chemically defined substances but complex mixtures whose composition is defined by natural raw materials. Well known examples are vegetable and fruit extracts, spice and herb extracts and yeast extract. As is the case with natural flavouring substances, flavouring preparations are obtained from plant, animal or microbiological source materials by means of physical or biotechnological production processes. Flavouring preparations are often the main component of citrus, spice and mint flavourings, reflecting their characteristic smell and taste.

This category also includes essential oils, such as clove and eucalyptus oil.

4.3.2 **Thermal process flavourings**

Thermal process flavourings are industrially produced by the controlled heating of several components (e.g. by a Maillard reaction). During the process, intense flavours develop, as is the case when roasting meat or baking bread. The flavouring itself only develops as a result of the thermal process and the essential basic materials for their development include amino acids and also reducing sugars, such as dextrose (glucose).

4.3.3 **Smoke Flavourings**

Smoking is one of the most ancient procedures to season and preserve foods. Smoke flavourings are not only used to preserve but to confer a special smoke flavour in foods such as fish and meat products, steak, sauces and chips.

Freshly produced smoke is obtained by means of controlled burning of hardwood at temperatures of up to 600°C. This happens mostly in the absence of air, and in many cases charcoal develops as a by-product. The smoke generated is condensed and for practical reasons, such smoke primary products can be mixed with solvents such as cooking oil or carriers such as table salt.

Table: 4.1 Source of raw materials used in flavouring compounds

Synthetic	**Natural**	
	Botanical	**Animal**
Benzaldehyde	Fruit and vegetable juice, extract and distillate	Plasma drippings
Cinnamic Alcohol	Herbs	Seafood byproducts, enzyme-modified cheese, meat extract
	Spices	
	Nuts	

Table: 4.2 Classification of Nature's Flavours

Source	Primary Origin	Secondary Origin	
		Biological	Thermal
Botanical	Fruits, vegetables, spices, flowers, nuts	Wine, beer, bread	Coffee, cocoa, caramel
Animal	Fish, beef, chicken, milk	Fermented sausage, cheese	Roast beef, boiled chicken, grilled cheese

Table 4.3: Organic Synthetic Chemicals Used in Flavours

Group	**Subgroup**	**Example of chemicals**	**FEMA No.**	**Natural Occurance**	**Organoleptic Characteristics**
Aromatic-Benzenoid	Phenols	Eugenol	2467	Clove oil, banana, cinnamon, cocoa, coffee	Clove-like, spicy
	Ethers	Anethole	2086	Anise, fennel, basil, mint, cheese, tea	Anise odour, sweet herbaceous
	Acetals	Acetal	2002	Apple, grape, bread, whisky, rum	Fruity, green
	Carbonyls	Acetanisole	2005	Anise seed, tomato, tea	Floral, bitter
	Carboxylic acids	-	-	-	-
	Esters	Methyl	2745	Apple, cherry, tomato,	Characteristic,

		Salicylate		wine, winter green oil	wintergreen
	Lactones	Dihydrocoumain	2381	Sweet clover	Spicy, vanilla
	Sulfur compounds	5-methyl-2-thiophene-carboxaldehyde	3209	Roasted peanuts	Strong, nutty, meaty
Aromatic-Heterocyclic ring	Furans	Furfural Mercaptan	2493	Coffee, beef	Strong, unpleasant
	Pyrans	Maltol	2656	Roasted malt, chicory, strawberry, bread	Coffee-like, sweet, fruity, jam-like
	Thiophenes	-	-	-	-
	Pyrazines	2,3,5-Trimethyl pyrazine	3244	Baked goods, coffee, cocoa, peanuts	Sweet, roasted peanut
	Imidazoles	-	-	-	-
	Pyridines	Pyridine	2966	Wood oil, coffee, tobacco	Penetrating, fishy odour, burnt
	Pyrroles	2-acetyl pyrrol	3202	Bread, cheese, tobacco, tea	Strong, roasted
	Oxazoles	-	-	-	-
	Thiazoles	2,3,5-Trimethyl thiazole	3325	Potatoes, beef, coffee	Chocolate, nutty, coffee
Aliphatic - Cyclic	Lactones	γ-Decalactone	2360	Peach, apricot, butter, cheese, meat	Pleasant, fruity, peach-like, creamy
Aliphatic - Acyclic	Hydrocarbons	d-limonene	2633	Lemon, orange, mandarin, peppermint	Weak orange or lemon
	Alcohols	Cis-3-hexenol	2563	Apple, orange, raspberry, grapefruit	Intense, green odour, leafy
	Carbonyls a. ketones b. aldehydes	a. Octanal b. Acetaldehyde	2797 2003	Orange, mandarin, grapefruit, rose, beef Fruits, tobacco, orange, nuts	Fatty, orange Pungent and penetrating
	Carboxylic acids	Butyric acid	2321	Dairy products, bread, strawberry, beef	Rancid, sour milk
	Esters	Ethyl butyrate	2427	Strawberry, olive oil, apple, cheese	Fruity, powerful
	Isoprenoids	Citronellal	2307	Citronella, lemon, mandarin, grape	Floral, citronella, rose-like
	Sulfur compounds	Methyl sulphide Allyl disulphide Methyl mercaptan	2746 2028 2716	Dairy products, meat peppermint Garlic, meat, onion Meat, cheese, bread	Unpleasant, cabbage-like Characteristic garlic, pungent Objectionable, rotting cabbage
	Nitrogen compounds	Piperidine	2908	Black pepper, tobacco, bread, meat, fish	Heavy, sweet, animal like

5. Process of Flavour Creation

The oldest and simplest method for flavour creation is the artistic approach. The second approach is to combine art with scientific know-how. The third approach is to follow nature's footsteps and develop flavours biosynthetically.

5.1 The Artistic Approach

In this approach, the artistic powers of the flavour chemist are at work. These several components comprise. The sensory characteristics of flavour components like synthetic organic chemicals, natural essential oils, botanical extracts, juices, spices, nuts, herbs, and concentrates of animal origin, leave various impressions. Each flavour chemist will have the characteristics of these components and their corresponding food-nuance associations stored in memory, dependent on his or her personal ability and training.

This approach can be called an iterative method, or a trial by error approach. The flavourist produces a trial formulation, evaluates the trial by taste, and then makes revisions based upon their evaluation. This is the traditional type of methodology and has been used by flavourists for many years.

5.2 The Scientific Approach

The artistic approach is used along with the scientific knowledge. The utilization of chromatography, along with various other analytical techniques, has the flavour chemist gain a better understanding of nature's process in producing flavours. This knowledge is used in combination with the artistic skills of the flavour chemist to create unique flavours.

5.3 The Biosynthetic Approach

In this approach, the biochemist attempts to duplicate nature's biogenetic pathways. Although science has not yet unlocked many of nature's secrets in developing its flavours, some of the known enzymatic and fermentation reactions are crudely exploited to produce building blocks. Enzymatically modified cheeses, fermented fruits and wine, and cooked and roasted foods are just a few examples. Due to the increased demand for natural flavours, research in this area is dramatically increasing.

The primary areas of biotechnology that are being utilized and explored for use in the flavour business are:

i. The product of natural flavour ingredients
ii. The production of part or complete flavours
iii. Increased yields of essential oils, oleoresin, and flavour components by the use of enzymes in the processing of natural materials
iv. Plant cloning for maximum yields of secondary metabolites
v. Specific chemical steps to produce economies in the production of expensive flavour chemicals or to support natural claims (e.g., production of natural benzaldehyde from other natural chemicals)
vi. Modified traditional fermentation systems to produce flavour enhanced bases for direct use or further concentration
vii. Secondary metabolites from in vitro tissue culture of vegetable cells

Table:5.1 Examples of Biosynthetic Production of Chemicals

Sr. No.	Major product(s) produced in nature	Examples of occurrence	Microorganism applied*	Major portion of substrate
1	Methyl ketones	Cheese	*Penicillium*	Fatty acids

			Roqueforti	
2	Lactones	Peaches, coconut	*Pityrosporum* species	Lipids
3	Butyric acid	Butter	*Clostridium Butyricum*	Dextrose
4	Carveol, carvone, dihydrocarvone, perillyl alcohol	Spearmint and other essential oils	*Pseudomonas* species	Limonene
5	d-Verbenone, d-*cis*-Verbenol	-	*Aspergillus Niger*	α-Pinene
6	Cheese like flavour	Cheese	*Streptococcus* species *Lactobacillus* species	Reconstituted milk
7	Bread like flavour	Bread	*Saccharomyces Cerevisiae*	Sugar and milk

* Exclusively food microorganisms are applied.

5.4 Thermally Produced Flavours

In this process, the chemist follows the natural route of forming the ‘‘secondary origin’’ flavours mentioned in Table 1. Ingredients used in their preparation consist of one or more of the following:

1. A protein nitrogen source, for example, meat, poultry, dairy products, seafood, and their hydrolysis products
2. A carbohydrate source, for example, vegetable, fruit, sugars, and their hydrolysis products
3. A fat or fatty source
4. Herbs, spices, water, selected vitamins, acid, emulsifiers, and nucleotides
5. Flavouring preparations and flavour adjuncts to be added after processing

The prepared mixture is then processed under controlled conditions. The temperature should not exceed 180°C for the specified time. The general concept of producing flavours thermally is to utilize foodstuffs or constituents of foodstuffs and apply processes comparable to traditional kitchen treatments.

5.5 Recent Flavour Creation Technologies

Flavour companies are using computer technology to assist the flavourist in their creative task. Many companies have introduced systems where a flavourist has access to a database of thousands of different flavour preparations. By doing selective searches through this database, the flavourist can retrieve a starting formulation which meets specific parameters (e.g., liquid, natural, kosher, and heat stable). From there, the flavourist can tailor a new formulation that meets a specific customer’s needs. By the use of this type of technology, the time to develop a new flavour has been reduced significantly. There are also equipments developed, which allows flavourist to evaluate almost instantaneously the aroma of blends they make using computer technology even to the extent of including any aroma of a food product—for example, yogurt. Other equipment is used to accurately measure threshold levels either of individual components or of flavours in finished food products. By using this type of equipment, the flavourist, supported by sensory specialists, can evaluate the different release rates of a flavour in different bases or products and then can adjust formulations so that the same flavour perception can be achieved in different applications.

6. General Rules for Flavour Creation

In spite of the increasing number of technological processes and tools, artistry is still the most important factor in the process of flavour creation. Modern flavour chemists utilize all the scientific resources available to them to create the proper balance between art and science to achieve excellence. Attempts to use science only, such as using analytical tools to recreate flavours from data produced, have proven to be fruitless. Reasons for failure of such an approach can be summarized as follows:

i. Only a few of the hundreds of chemicals identified in foods have sensory significance.
ii. Availability and cost of the total chemicals identified will prove prohibitively costly.
iii. The methodology to obtain qualitative and quantitative identification of trace chemicals is not very accurate.
iv. Synthetic chemicals, utilized to duplicate nature, contain trace impurities that affect the final taste of the compound.

Therefore, technical resources are tools that should be employed to service the flavour chemist.

Important factors influencing flavour creation are:

a. **Flavour Profile of the Target**: The flavour target could be any flavour, aroma fruit such as a mango to roast beef. Drawing the preliminary flavour profile of this target is an important step in the process of the flavour development and constitutes the foundation upon which the flavour will be created.
b. **Flavour Descriptive Language**: To reduce communication gap between industry, customers and also amongst flavour chemists for description of a particular flavour, it is imperative to use a standard descriptive language among flavour chemists and food scientists.
c. **Sensory Evaluation**: Application of proper sensory techniques, and large panels will make the difference in the fine tuning process. Reviewing the flavour profile by utilizing focus groups will bring the right balance of art and science. Consumers should be the ultimate judges of the quality of a flavour.
d. **Reproducibility**: Since flavours are complex mixtures of various components, the flavour chemists' task is to ensure the compatibility of such mixtures and also it is important that any laboratory process should be reproducible in production.

7. Analytical Techniques for determining Flavour components

The process of determining the flavour components in a food can be divided into three general phases.

1. **Isolation of the volatile flavour components from the bulk of the nonvolatile matrix**
   Once the sample has been reduced to the proper physical form, the volatile flavour components are usually isolated by either distillation or extraction, or a combination of the two. Since most liquid samples are in an aqueous medium, a simple extraction with an organic solvent (either polar solvents such as methylene chloride or nonpolar solvents such as ether or pentane) in a separatory funnel are used. There are also solvents that can be used in special cases, such as isopentane, which can extract the volatile components from a matrix high in ethanol or propylene glycol. soxhlet extraction apparatus is used for the extraction of solid samples, such as ground nuts or seeds. since this method collects the extracted volatiles in boiling solvent, heat-sensitive compounds may be lost or produce artifacts. Where significant heat-sensitive materials are present, an extraction in which solvent is continuously recirculated through the sample by means of a pump at ambient temperature is more suitable.

2. **Separation of the isolated components into individual or small groups of components**
   Column and thin-layer chromatography are generally used for rough separations into groups of components, while gas chromatography (GC) and high-performance liquid chromatography (HPLC) are of greater value in determining individual components.

3. **Identification of the flavour components**
   There are a wide variety of tools to identify unknown components. If the general class of the flavour components is known and compared to an accumulated library of standards, retention time data can be used for identification. Tables of retention indices such as the Kovats index have been published. Kovats indices provide the retention times of individual components compared with those of a homologous series of alkanes or esters. SNIFF analysis may also be used. In this method, an unknown sample is injected into the gas chromatograph and is separated into the various components. As the components are eluted, a portion of each is sent to the detector and a separate portion is also sent to a sniffing port where the flavourist evaluates the odor of the component as it is released from the gas chromatograph and identifies the component. Mass spectrometry (MS) is also a widely used tool to identify unknown components. The mass spectrometer is attached to a gas chromatograph which separates the unknown sample into its components. With the progress in computers GC-MS systems are nowadays available at reasonable costs.

8. Applications of Flavours

Flavours are applied to various products in the food, beverage, tobacco, pharmaceutical, and oral hygiene areas. Lately, some applications have extended to other segments such as the toy industry. Flavoured products fall into two categories:
1. *Flavour-dependent*: These are foods and beverages that cannot exist without the application of flavours. Examples are hard-boiled candy, chewing gum, carbonated and nonjuice drinks, gelatin desserts, and powdered artificial beverages.
2. *Flavour-independent*: These are products that can be marketed without flavours (e.g. crackers, cereals, and nuts) or for which flavours are legally prohibited (e.g. milk, orange juice, and butter wherein flavour reinforcement is not permitted, unless a new identity is given to the food)

8.1 Direct and Indirect Flavouring

It is interesting to note that almost every food can be flavoured provided that consumers are not misled or deceived. The food industry achieves this, as in the following examples:
1. *New identity*: A food such as milk, butter, or juice can be flavoured provided that it is name to convey to consumers its new identity and avoid consumer deception. Examples are blends of butter and margarine.
2. *Indirect flavouring*: Indirect flavourings are preparations that might be added by consumers to their home-cooked meals e.g. Salad dressings.

8.2 Flavour Selection

It is important for flavour users to understand the complexity of flavour selection. It will be helpful to begin by separating flavours from all other additives and placing them in a class by themselves. The main reason for the said purpose is *Specificity*. Flavours are very specific to certain applications. For example, the same orange flavour (same identification number and supplier) might taste excellent in some applications but be much less acceptable in others. Flavours in many instances are tailored to suit a complex food system as well as the processing conditions applied.

9. Flavour Forms

Flavour strength and potency vary considerably. Some flavours are diluted with solvents and carriers, whereas others are compounds of aromatic chemicals without a solvent. Various flavour forms are delineated in table

Table: 9.1 Forms of Flavours available in Market

Type	Forms	Solvents and carriers
Liquid	Water-, alcohol-, or oil-soluble	Alcohol, propylene glycol, triacetin, benzyl alcohol, glycerin, syrup, water, vegetable oil
Powder	Spray-dried, absorbates, or powder mixes	Gum acacia, starch hydrolysates, selective hydrocolloids, simple carbohydrates
Pastes and emulsions	Emulsion of the oil-in-water type	Same ingredients as for powder and liquid

10. Flavour Regulations

The purpose of food laws is to assure safety for the consumer and prevent deception. Labeling regulations require that information be provided on the kind of food, its processing, and the additives contained in it. These principles also apply to flavours. The vast number of flavouring raw materials makes this a difficult task for legislators, resulting in various countries taking different approaches. The purpose of flavouring a food is to add sensory value (pleasure) to that food without altering its identity. Most food regulations are formulated to put a stop to practices where flavour might be used to give false values. The addition of a characterizing flavour is usually not permitted to compensate for the lack of natural flavour due to poor or improper processing. For example, butter or cheese flavours are not permitted to flavour natural butter or cheese, respectively.

10.1 Flavour safety

Flavourings are a part of food, and they must be safe for human consumption. Only regulated ingredients that are recognized to be safe are permitted. Types of systems regulating addition of flavour components in foods are:

(i) Positive List System: A positive list is composed of flavouring raw materials that are believed to be innocuous and safe for use in food. Positive lists are used mostly to regulate the use of food additives such as preservatives, colorants, and antioxidants.

(ii) Negative list System: A negative list records materials that shall not be used in flavourings because they are known to be harmful and also lists substances for which an upper consumption limit has been fixed.

(iii) Mixed System: The mixed system was introduced in some European countries to combine the advantages of the positive and negative list systems. The advantage of the mixed system is the clear listing of forbidden substances, providing adequate consumer protection; it can be enforced in practice without undue cost.

The Flavour and Extract Manufacturers Association (FEMA) of the United States was founded in 1909 by several flavour firms in response to the passage of the Pure Food and Drug Act of 1906, through its "generally recognized as safe" (GRAS) assessment of flavouring substances. FEMA is also a founding member of the International Organization of the Flavour Industry (IOFI), which is an association of regional and national associations of the flavour industry, headquartered in Switzerland.

10.2 Labeling

Flavours are declared in finished food products according to national food labeling regulations. The labeling of foods in relation to added flavours is regulated in many countries. The purpose is to label the flavours in conformity with their true nature so that consumers will be properly advised as to the type of flavours used. Although regulations differ greatly from one country to another, the chief objective is to differentiate among the main types of flavours:
Natural flavours
Nature-identical flavours (where applicable)
Artificial flavours
Mixtures of natural flavours and nature-identical or artificial flavours

This is a simplification of terminology. What is considered natural or artificial in one country is not necessarily perceived as such in another.

11. Conclusion

Consumer acceptance is the sole basis for acceptability of any product in the market. A natural product, when sold as such retains its characteristic flavor and other sensorial attributes. However, due to limitation of shelf-life, processing of foods has become indispensible. Also there is a great demand for ready to eat / ready to serve food products in the market. Inspite of minimal processing for extension of shelf-life as well as for product modification, a definite loss / change in flavour in foods is observed. This has established flavour as an important additive in food products and progress of flavour industry has taken place in wide scale. Consumer safety being the major concern, natural flavours are much in demand but are much expensive as compared to simulated synthetic flavours. Cost effective manufacturing techniques for natural flavours as well as safety analysis of available synthetic flavours are need of the present era. The demand for flavours is bound to increase in future with development of many functional foods requiring flavour modification and also widening of applicability of flavours as for example in papers, toys, etc.