

## **Paper No.: 13**

### **Paper Title: FOOD ADDITIVES**

#### **Module – 01: Introduction to food additives**

##### **1. Introduction**

Mankind has been adding substances to foods for thousands of years to preserve them, improve their flavour and appearance, and for manufacturing convenience foods. Historians tell us that colourings were added to foods as early as 1500 BC. Theophrastus, a Greek philosopher, reported the use of artificial flavourings in foods in the 3rd century BC. Pliny the Elder remarked on the use of animal fodder and chalk in making bread in the 1st century AD. In the 2nd century AD the respected physician, Galen, warned against the adulteration of herbs and spices. Sodium chloride or common salt has been added to foods as a preservative for thousands of years. Spices like nutmeg and cinnamon, used to flavour foods, have been sought after and traded throughout history. The trade routes between Asia, the Middle East and Europe flourished as the demand for these additives grew. In Rome wealthy citizens were kidnapped for ransom, not of gold or jewels, but exotic spices. The ancient Greeks burned sulphur over wine casks before sealing to produce the preservative sulphur dioxide which is still used today.

Making convenience foods both varied as well as nutritious and safe, is now being done using modern technology. This technology includes food additives that have been proven both useful as well as safe through long use and stringent testing. Food additives are substances added to foods to preserve flavor or enhance its taste and appearance. Since prehistoric times, chemicals have been added to foods to perform special functions for example, preserving food by pickling (with vinegar), salting, as with bacon, preserving sweets or using sulfur dioxide as in some wines. Although basic foods contain no additives, as foods are processed for conversion into a variety of products, an increasing number of additives are generally used. Technological advances in food processing have increased the variety and use of these additives. Today, more than 2500 different additives are intentionally added to foods to produce a desired effect. The use of these additives is a well-accepted practice but is not without controversy.

##### **2. Definition of Food additive:**

Food additives are defined in various ways.

###### **2.1 General:**

Food additives may be defined as chemical substances which are deliberately added to foods, in known and regulated quantities, for the purpose of assisting in the processing of foods, preservation of foods or in improving the flavor and texture or appearance of foods. Food additives are in general not a primary (major) constituent of food and are usually used at a very small quantity.

## 2.2 Food Additive as per National Academy of Science:

Food additives are defined as those chemicals which are incorporated in the food stuffs, either directly or indirectly during processing.”

## 2.3 Food Additive as per Food and Agricultural Organization / World Health Organization:

“Food additives have been defined as non-nutritive substances which are added either intentionally to food, generally in small quantities to improve their appearance, flavor, texture or other secondary properties or find their way otherwise, into food during handling, processing or distribution.” In more recent wordings the term *improvement* is not included, and the remaining presence of the compound, or reaction products from that compound, are included in the definition.

\* Many chemical compounds are extracted from foods and added to other foods

- In this case they are considered as additives

For example

- Meat extract from meat
- Cod liver oil from fish
- Juice from fruits
- Starch from grains

## 2.4 Food Additive as per Codex Alimentarius Commission (1979):

“ Food additives means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing ,transport or handling such food results or may be reasonably expected to result (directly or indirectly) in it or its byproducts becoming a component or otherwise affecting the characteristics of such foods.”

The term does not include contaminants, insect fragments, hairs and other extraneous material added to food for maintaining or improving nutritional availabilities.

## 2.5 Food Additive as per International Dairy Federation:

“Food additives are the chemical substances that might be added to milk and dairy products for any purpose.”

## 3. Types of Food Additives

Several additives commonly serve more than one function in foods. Based on the functions, additives can be divided into six major categories: preservatives, nutritional additives, flavoring agents, coloring agents, texturizing agents, and miscellaneous additives.

### **3.1 Preservatives**

There are basically three types of preservatives used in foods: antimicrobials, antioxidants, and antibrowning agents. Antimicrobials play a major role in extending the shelf-life of numerous snack and convenience foods and have come into even greater use in recent years as microbial food safety concerns have increased. The antioxidants are used to prevent lipid and/or vitamin oxidation in food products. They are used primarily to prevent autoxidation and subsequent development of rancidity and off-flavor. Antibrowning agents are chemicals used to prevent both enzymatic and nonenzymatic browning in food products, especially dried fruits or vegetables.

### **3.2 Nutritional additives**

Nutritional additives have increased in use in recent years as consumers have become more concerned about and interested in nutrition. Primary nutritional additives includes vitamins and minerals, while other nutritional additives are the food additives used for special dietary purposes as for e.g. dietary fibers, fat replacers, etc.

### **3.3 Flavouring agent**

Flavoring agents comprise the greatest number of additives used in foods. There are three major types of flavoring additives: sweeteners (sucrose, fructose, glucose, lactose), natural and synthetic flavors and flavor enhancers (monosodium glutamate and various nucleotides).

### **3.4 Colouring agents**

Most coloring agents are used to improve the overall attractiveness of the food. A number of natural and synthetic additives are used to color foods.

### **3.5 Texturizing agents**

Although flavoring agents comprise the greatest number of chemicals, texturizing agents are used in the greatest total quantity. These agents are used to add to or modify the overall texture or mouthfeel of food products. Emulsifiers and stabilizers are the primary additives in this category, while Phosphates and dough conditioners are other chemicals that play a major role in modifying food texture. Phosphates are some of the most widely used and serve a number of functions in foods.

### **3.6 Miscellaneous additives**

There are numerous other chemicals used in food products for specific yet limited purposes. Included are various processing aids such as chelating agents, enzymes, and anti-foaming agents; surface finishing agents; catalysts; and various solvents, lubricants and propellants.

## **4.0 Natural and Synthetic Food additives**

Artificial or Synthetic additives are synthetic substances that are added to food. Synthetic substances are not found in the natural environment, so they must be manufactured. They are commonly used to preserve food or enhance its flavor. Artificial additives are often contrasted with natural additives, which typically are made from chemicals that are found naturally. The use of artificial additives is widespread in industrialized countries, but there are growing movements

that advocate all-natural or organic foods. Natural additives are naturally occurring substances and are usually considered harmless. They include additives extracted from natural source of origin viz. salt, sugar, vinegar, alcohol, etc. There is a continuing demand, from the consumer's side, for natural additives. No additive, however, is completely free of impurities. Products of chemical synthesis should be purified, eliminating starting materials and compounds resulting from side reactions. It must be stated that enzyme-catalyzed synthesis or modification more and more frequently replaces purely chemical synthesis of modification. "Natural" compounds should be purified as well in order to remove accompanying substances that have no significance in the final product. Generally speaking, purification is more difficult and more complicated for natural additives, as it is also much more problematic to characterize the raw material, which may contain a great many ill-defined compounds whose toxicity is largely unknown. However, official legislation does not discriminate between safe natural and safe artificial food additives. The main difference can be stated by safety evaluation between these two categories.

The controversy with artificial additives dates back to the early years of the twentieth century. Certain artificial additives have been linked in research studies to cancer, digestive issues, and behavioral effects. A famous example is the artificial sweetener Saccharin. Saccharin was investigated by the United States Food and Drug Administration beginning in 1907 when the additive was suspected to be dangerous to public health. Laboratory rats fed high doses of saccharin were shown to develop instances of bladder cancer. Saccharin is widely used today, however, because this danger was shown to apply only to rats and not to humans.

### **5.0 Coding Systems**

In Europe and other parts of the world, the E system, developed by the European Union (formally the European Economic Community), provides a listing of several commonly used additives. The list, which is updated on a regular basis, includes those additives that are generally recognized as safe (GRAS) within the member states and allows foods to move from country to country within the European Union. Nutrients are not included in the E system. The Codex Alimentarius Commission Committee on Food Additives and Contaminants has developed an International Numbering System (INS) for food additives based on the E system (Codex Alimentarius Commission, 2001). The INS system is broader than the E system and is intended as an identification system for food additives approved for use in one or more countries. It does not imply toxicological approval by Codex, and the list extends beyond the additives currently cleared by the Joint FAO/WHO Expert Committee on Food Additives (Codex Alimentarius Commission, 2001). The INS numbers are largely the same numbers used in the E system without the E as for example, acetic acid is written as E260 on products sold in Europe, but is simply known as additive 260 in some countries. The INS system also includes a listing of the technical function for each additive based on 23 functional classes.

## **6. Functions of Food Additives**

## **6.1 Beneficial Functions**

Food additives serve useful functions in the interest of processor or manufacturer and consumer of the food. The major functions of food additives can be delineated as below:

- (1) To enhance the shelf life of food.
- (2) To enhance the consumers acceptability of the food.
- (3) To reduce wastage and improve yield of the product.
- (4) To facilitate preparation of food.
- (5) To improve color and appearance of food.
- (6) To improve body and texture of food.
- (7) To improve flavor (aroma and taste) of food.
- (8) To improve and maintain the nutritive value of food.

## **6.2 Functions used for unlawful intentions**

Food additives are also sometimes used for the evil intentions such as:

- (1) To conceal (hide) damage, spoilage, etc.
- (2) To adulterate food with cheaper material.
- (3) To cover up the use of faulty ingredients.
- (4) To disguise faulty process of manufacture.
- (5) To replace lengthy and cumbersome process.
- (6) To achieve desired effect in short time.
- (7) To hide the adulteration of the food.

## **7. Benefits of Food Additives**

Considering the above listed functions of additives, there are obviously many recognized benefits to be derived. Some of the major benefits are a safer and more nutritious food supply, a greater choice of food products, and a lower-priced food supply.

### **7.1 Safer and More Nutritious Foods**



There is no question that the preservative and nutritional additives used in foods increase the safety and overall value of many food products. The use of several antimicrobials is known to prevent food poisoning from various bacteria and molds. Antioxidants, used to prevent the development of off-flavors, also prevent the formation of potentially toxic autoxidation products and maintain the nutritional value of vitamins and lipids. The use of various nutritional additives such as vitamins is also of proven value in preventing nutritional deficiencies.

## **7.2 Greater Choice of Foods**

Most major supermarkets today carry more than 20,000 food items, providing the consumer a wide choice of food products. The availability of additives has allowed the production of numerous out-of-season foods and a variety of new food products. Additives have increased the development of convenience foods, snack foods, low-calorie and health promoting (functional) foods, exotic foods, and a variety of food substitutes.

## **7.3 Lower-Priced Foods**

For some processed foods, total removal of additives would result in higher prices. For example, if additives were removed from margarine, consumers would have no alternative but to purchase a higher-priced spread such as butter, which usually contains few or no additives; if additives were removed from bread, franks, wieners, and processed cheese, new processing procedures, increased refrigeration, and improved packaging would be required, at a higher cost, to keep the same type of products available.

## **8. Considerations required in use of Food Additives**

Before the use of any proposed additives following aspects are required to be taken care.

### **8.1 General principles for the use of additives:**

- (1) It must be ascertained that the real need exists for the use.
- (2) It does not cause any adverse physiological and harmful effects even upon regular consumption for a long period – must be safe – harmless.

\* It is advisable to take into account Average Daily Intake or equivalent assessment established for the food additive.

- (3) It should not reduce the nutritive value of food.
- (4) It should confirm the agreed specifications.
- (5) Where possible legislation should define permissible maximum quantities of a given additive.
- (6) Even when an additive is considered harmless, it seems advisable (desirable) to use as little as possible of its consistent effect.

(7) All food additives should be kept under continuous observation and should be re-evaluated wherever necessary, in the light of changing conditions of use and new scientific information.

(8) Addition of nutrients to food should not be left to the free initiative of the industry, but should in general be prohibited and only in special cases should a dispensation of prohibition be given.

## **9. Ascertaining limits for addition of Food additives**

Any food additive should be used at the minimum level necessary to produce desired effect. The limit of addition should be established on the basis of:

(1) The estimated level of consumption of the food for which the additive proposed.

(2) Minimum levels which in animal studies produce deviations from the normal physiological behavior.

(3) An adequate margin of safety to reduce risk to a minimum for any hazard to health in all groups of consumers.

## **10. Regulations for use and Labeling of Food additives**

### **10.1 Regulations**

The use of food additives originated in ancient times but did not engender controversy until the early 1800s, when intentional food adulteration became appallingly common in some countries. Problems with intentional food adulteration continued until about 1920, when regulatory pressures and effective methods of food analysis reduced the frequency and seriousness of food adulteration to acceptable levels in the United States. Since 1920 the use of legally sanctioned food additives has become common.

Regulatory bodies like CODEX Alimentarius Standards (International), Food Safety Standards Act (India) regulates addition of Food additives in Foods by limiting maximum permissible quantity of the ingredient or for some ingredients the limit is not given and it is stated to be added 'as per GMP' as for e.g. use of Lecithin in Sweetened Condensed milk is as per GMP according to CODEX standards.

Good Manufacturing Practices (GMP) for food additives are described in Section 3.3 of the Preamble of the Codex General Standard for Food Additives as follows:

"All food additives subject to the provisions of this Standard shall be used under conditions of good manufacturing practice, which include the following:

- The quantity of the additive added to food shall be limited to the lowest possible level necessary to accomplish its desired effect;
- The quantity of the additive that becomes a component of food as a result of its use in the manufacturing, processing or packaging of a food and which is not intended to accomplish any physical, or other technical effect in the food itself, is reduced to the extent reasonably possible; and,
- The additive is prepared and handled in the same way as a food ingredient."

## 10.2 Labeling

According to CODEX general standards **Label** includes any tag, brand, mark, pictorial or other descriptive matter, written, painted, stencilled, marked, embossed or impressed on, or attached to, a container. **Labeling** includes the label and any written, printed or graphic matter relating to, and accompanying the food additives. The term does not include bills, invoices and similar material which may accompany the food additives.

According to Food Safety Standards Act, labeling is mandatory for food additives falling in the respective classes and appearing in lists of food additives permitted for use in foods generally, their respective class titles shall be used together with the specific names or recognized international numerical identifications. For externally added flavours, flavouring substances or colour, declaration must be made on the package as it is containing these additives specifying the type either natural, nature identical or synthetic.

## 11. Conclusion

A food undoubtedly will be considered the best without any additives. However, with advent of modern technology and need of the hour for low calorie, functional foods; food additives are inevitable ingredient for production of such foods. There are a number of benefits of use of food additives in various food products but potential health hazard of consuming excess of chemical additives are a matter of great concern. There is need for production of safer food ingredients and upgraded analytical techniques are required to ascertain excess quantity of food ingredients used for unlawful intentions.