

Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Week – 01

Lecture – 02

Hello friends. Welcome to the NPTEL online certification course on Modern Food Packaging Technologies Regulatory Aspects and Global Trends. Now lecture 2 we will proceed which deals with the introduction to food packaging. In this we will be discussing about what is food and what is the shelf life of the food, how the food is spoiled and then what are the packaging requirements and how this packaging has been improved. And in this we will be seeing the history, definition, then packaging functions and requirement, printing of packaging, then labeling and then codes.

Let us see what is food. Food is any substance consumed to provide nutritional support to the body. It is a vital component of our daily lives and its primary purpose is to provide the necessary nutrients and energy for the body to function and thrive. Food comes in various forms and can be categorized into different groups including fruits, vegetables, grains, meats, dairy products and fats.

These groups collectively provide the essential nutrients needed for health and well being. Let us see the importance of food which is summarized below. The nutrient supply. The food is the primary source of essential nutrients that the body requires for growth, maintenance and repair. These nutrients include carbohydrates, proteins, fats, vitamins and minerals.

Each nutrient plays a specific role in maintaining overall health. The food is also served as energy source. Food provides the body with the energy required for all physiological processes and physical activities. The calories from food accelerates bodily functions from basic metabolic processes to exercise and movement. Growth and development.

The adequate nutrition during childhood and adolescence is crucial for proper growth, for proper growth and development. Nutrients like proteins, vitamins and minerals support the development of tissues, bones and organs. Disease prevention. It also helps in prevention of diseases. Proper nutrition through a balanced diet can help prevent various health conditions.

For example, a diet rich in fruits and vegetables can reduce the risk of chronic diseases like heart disease and certain types of cancer. The brain functions. It also governs the

brain functions. Nutrition is closely linked to cognitive function. Consuming the right nutrients such as omega 3 fatty acids and antioxidants can support brain health, memory and concentration.

It also supports the immune system. The nutrient rich foods strengthen the immune system helping the body defend against infections and illness. Healthy weight management. A balanced diet promotes healthy weight management consuming the right amount of calories and nutrients helps prevent obesity and related health issues. Digestive health. The dietary fiber and probiotics in food aid in digestion and maintain a healthy gut. A well-known functioning digestive system is vital for overall well-being. Social and cultural significance. The food plays a central role in social interactions, cultural traditions and family gatherings. Sharing meals fosters relationships and strengthen bonds within communities.

The most important thing is economic and agricultural impact. Food production and agriculture are major contributors to the global economy. Food production provides employment and supports livelihoods for millions of people worldwide. Therefore, food is not only essential for survival, but also promoting health, preventing diseases, supporting growth and enhancing overall well-being. Making informed and balanced dietary choices is key to reaping the benefits of food and maintaining a healthy and active lifestyle.

Now shelf life of food. The quality of most foods and beverages decrease with storage or holding time. The shelf life of product is best determined as a part of the product development cycle. The institute of food technologies defined of United States has defined shelf life as the period between the manufacture and the retail purchase of a food product during which time the product is in state of satisfactory, quality in terms of nutritional value, taste, texture and appearance. The institute of food science and technology in the United Kingdom has defined shelf life as the period of time during which the food product will remain safe.

Be certain to retain desired sensory, chemical, physical, microbiological and functional characteristics and comply with any level declaration of nutritional data when stored under the recommended conditions. The date of minimum durability is defined as the date until which the food retains its specific properties when properly stored. It must be indicated by words based before followed by a date or a reference to where the date is given on the labelling. Depending on how long the food can keep the date can be expressed by the day and the month and the month and the year or the year alone. Now the what are the different factors which affect the shelf life of the product.

So, one is the product characteristics which includes the formation and processing parameters that is intrinsic factors and intrinsic factors are the properties resulting from the makeup of the final product and include the following that water activity, pH/acidity, natural micro flora and surviving microbiological counts, availability of oxygen, oxidation reduction potential that is EH, then natural biochemistry and chemistry of the product, added new preservatives. For example, salt, spices, antioxidants etc. Now the second environmental factors environment to which the product is exposed during distribution and storage that is the extrinsic factor. Extrinsic factors are a result of environment that the product encounters during life and include the following. The first is temperature.

The temperature is a key factor in determining the rates of deteriorative reactions and in certain situations the packaging material can affect the temperature of the food. For packages that are stored in refrigerated displaced cabinets most of the cooling takes place by conduction and convection. Simultaneously there is a heat input by radiation from the fluorescent lamps used for lighting. Under these conditions aluminum foil offers real advantage because it is high reflectivity and high conductivity. The another important factor is relative humidity.

The relative humidity of the ambient environment is important and can influence the water activity of the food unless the package provides an excellent barrier of water vapor. Many flexible plastic packaging materials provide good moisture barrier, but none is completely impermeable. The another important factor gas atmosphere. The presence of concentration of gases in the environment surrounding the food have a considerable influence on the growth of microorganisms and the atmosphere inside the package is often modified. The simplest way of modifying the atmosphere is vacuum packaging that is removal of air that that is oxygen from the package prior to sealing.

It can have a beneficial effect by preventing the growth of aerobic microorganisms, flushing the inside of the package with a gas such as carbon dioxide or nitrogen before sealing is basis of modified atmospheric packaging that is MAP popularly known as. For example, increased concentration of gases such as carbon dioxide are used to retard microbial growth and thus extend the shelf life of foods. MAP is increasing in importance especially with the packaging of fresh fruits and vegetables, fresh foods and bakery products etc. Another important point is light. The many derivative changes in the environmental quality of foods are initiated or accelerated by light.

The intensity of light and the length of exposure are significant factors in the production of discoloration and flavor defects in packaged foods. Among the most commonly studied foods has been fluid milk. The extent of flavor development being related to the

exposure interval strength of light and amount of milk surface exposed. The another important factor which governs the shelf life of the product is the enzyme reactions. In food packaging technology knowledge of enzyme action is essential to a fuller understanding of the implication of different forms of packaging.

The importance of enzymes to the food processor is often determined by the conditions prevailing within and outside the food. Control of these conditions is necessary to control enzymatic activity during food processing and storage. The major factors useful in controlling enzymatic activity are temperature, water activity, pH, chemicals that can inhibit enzyme action that is additives, alteration of substrates, alteration of products and processing control. Three of these factors are particularly relevant in a packaging context. The first is temperature that is the ability of a package to maintain a product temperature and thus relate retard enzyme action will often increase product shelf life.

The second important factor is water activity because the rate of enzyme activity is dependent on the amount of water available. Low levels of water can severely restrict enzymic activities and even alter the pattern of activity. Finally the alteration of substrate in particular the ingress of oxygen into the package is important in many oxygen dependent reactions that are catalyzed by enzymes for example, enzymic browning due to oxidation of phenols in fruits and vegetables. The chemical reactions that also governs the shelf life of the product many of the chemical reactions that occur in foods can lead to deterioration in food quality both nutritionally and sincerely or the impairment of food safety. Such reactions classes can involve different reactants or substrates depending on the specific food and the particular conditions for processing or storage.

The rates of these chemical reactions are dependent on a variety of factors amenable to control by packaging including light, oxygen concentration, temperature and water activity. Therefore, the package can in certain circumstances play a major role in controlling these factors and thus indirectly the rate of deteriorative chemical reactions. The two major chemical changes that occur during the processing and storage of foods can lead to deterioration in sensory qualities are lipid oxidation and non-enzymatic browning. The lipid oxidation that is auto oxidation is a reaction of molecular oxygen by a free radical mechanism with hydrocarbons and other compounds. The crucial role that auto oxidation plays in the development of undesirable flavors and aromas in food is well documented and auto oxidation is a major cause of food deterioration.

Non enzymatic browning the non-enzymatic browning is one of the major deteriorative chemical reactions that occur during storage of dried and concentrated foods. The non enzymatic browning or Maillard reaction can be divided into following three stages one

the early Maillard reactions involving a simple condensation between an aldehyde usually a reducing sugar and an amine usually a protein or amino acid without browning. The second stage is advanced Maillard reaction that lead to the formation of volatile or soluble substances and finally, the third Maillard reaction leading to insoluble brown polymers. The changes in color in given food is influenced by many factors including cultural, geographical and sociological aspects of the population. Flavor changes in fruits and vegetables, enzymically generated compounds derived from long chain fatty acids play an extremely important role in the formation of characteristics flavors.

In addition these types of reactions can lead to important of flavors. The nutritional changes the four major factors that influence nutrient degradation can be controlled to varying extents by packaging or lights, oxygen concentration, temperature and water activity. The another factor which governs the shelf life is physical changes. The physical properties of foods can be defined as those properties that lend themselves to description and quantification by physical rather than chemical means and include geometrical, thermal, optical, mechanical, rheological, electrical and hydrodynamic properties. Although many of these physical properties are important and must be considered in the design and operation of a successful packaging system.

In the present context the focus is on undesirable physical changes in packaged foods. Now the microbiological changes the microorganisms can make both desirable and undesirable changes to the quality of foods depending on whether they are introduced as an essential part of the food preservation process or arise in advantageously and subsequently grow to produce food spoilage. Water activity can influence each of the four main growth cycle phases by its effect on the germination time, length of the lag phase and the growth rate phase, the size of the stationary population and the subsequent death rate. These factors can combine a complex way to encourage or discourage microbial growth.

Dear friends let us stop here for the time being and the next lecture we will start with the spoilage of food. Thank you.