Paper No.: 12
Paper Title: FOOD PACKAGING TECHNOLOGY
Module – 20: Packaging of Flesh Foods and Eggs

1. Introduction:

Packaging of flesh foods and egg products is done to protect them against contamination by dust, microbes, toxic substances or the factors which influence taste, flavour and loss of moisture. Packaging should support to prevent spoilage, weight loss and enhanced consumer acceptance of the product. Factors, which impact shelf life of muscle foods, may include both endogenous and exogenous factors in addition to sources of secondary contamination. The endogenous factors are pH, acidity and water activity, or moisture content, whereas the major exogenous factors are presence of atmospheric oxygen, microorganisms, storage temperature, exposure to sunlight and evaporation or desiccation. Secondary contamination of muscle foods during slaughtering, carcass dressing, cutting and processing is unavoidable. Bacterial growth during storage cannot be altogether prevented by only use of packaging. However, secondary contamination of these foods from sources such as contact with dust, dirt and unclean hands and equipment can be surely avoided to minimize or delay product deterioration.

Nature has given the egg a natural package i.e the shell. Despite its relative strength, it is an extremely fragile product and even with the best handling methods, serious losses can result from shell damage. Thus, it requires that eggs be protected by the adoption of specialized packaging and handling procedures. Eggs also need to breathe, hence packaging material used must be permeable to oxygen. The material used must be clean and odourless to prevent probable contamination and tainting. Egg packaging materials can be reused, but care must be taken to possible damage, odours and cleanliness. The packaging must withstand handling, storage and transport methods of the most diverse kind and protect the eggs against temperatures that cause deterioration and humidity. Consumers like to see what they are buying, especially if it a fresh produce. An egg package should be designed so that the customers not only know the product as such, but can also see the eggs they are buying.

2. Packaging of Muscle Foods

Packaging materials for muscle foods could be either mono films or a laminate of two or more films. These materials may differ in oxygen permeability, water vapour permeability, resistance to temperatures and mechanical strength. A high oxygen barrier is important in the application of films for packaging of meat and meat products. Films made of poly vinyl

chloride (PVC), polyethylene (PE) or polypropylene (PP) have a relatively high oxygen permeability, whereas films of polyvinylidenechloride (PVDC), polyester (PET), polyamide (PA) or nylon and cellulose films are less or non-permeable to oxygen. Materials of the former group are used as laminates with materials of the latter group to meet special requirements like mechanical strength, heat sealing or to make packages impermeable to oxygen and water vapour depending on the product requirements. Types and characteristics of packaging films used for muscle foods is listed below.

Sr. No	Type of Packaging Film	Characteristics
1	Cellulose acetate	Oxygen and carbon di oxide permeable, oil resistant, not heat sealable, used for fresh sausages like products
2	Metallized films	Light and gas resistant, printable, tough, easily laminated into retort pouches
3	Polyamide	Temperature resistant, very impermeable to oxygen and water vapour, easily printable, tough
4	Polyester	Oxygen permeability, easily sealed, moderate strength, poor grease resistant and heat resistant
5	Polyethylene-HDPE, LLDPE	Stronger than PE, more heat resistant, more grease resistant
6	Polypropylene	Readily processed, clear, oxygen permeable, not resistant to flex
7	Polyurethane	Very clear, heat stable and used as vacuum and shrink films
8	Polyvinylidene Chloride	Easily formed, easily sealed, strong, easily coated and printed
9	Polyvinylidene chloride with PP-Saran	Extremely low water vapour permeable, resistant to chemicals, heat abrasion, tearing, oil and grease. Frequently used as a coating on other films
10	LDPE derived ionomers	High strength, oil resistant, used for vacuum packages

3. Packaging of Meat

Carcass and joints remain wrapped during transport from slaughterhouse and wholesale market to retail processor and outlets. Usually, they are covered with soft cotton. Vacuum packaging is widely used for hot boned wholesale meat. Nowadays instead of whole carcass, the meat is cut into 'prime cuts' which are intermediate products between quarters and retail cuts. Prime and subprime cuts can be vacuum packed in specialized barrier bags like Saran. However, unwrapped meat is to be stored under refrigerated conditions. Careful control of temperature fluctuations is must to avoid loss of surface moisture, in such conditions meat is stored in a thin high-density polyethylene (HDPE) film, which prevents leakage and moistening of other items. In supermarkets, packaged meat is an important item and maintenance of red colour and bloom of the meat is essential. So packaging film used for this

purpose must have higher permeability to oxygen and good appearance, sealibility and low water vapour transmission rate, to control loss of weight of meat.

3.1 Vacuum Packaging of Meat Products

Vacuum packaging of meat is meant to retard or completely stop the oxidative reactions. The complete removal of oxygen from the packaging environment significantly inhibits the growth of microorganisms. But, vacuum packaging of meat frequently causes discolouration as meat becomes darker and purplish. On opening the package, oxygen availability at the surface of meat returns its original red colour. Small quantity of oxygen always remains inside the packaging bag as entrapped air will always be there in foods. Oxidation of meat therefore be reduced by using materials of low oxygen permeability.

Slime production by *Pseudomonas sp.* at refrigerated temperatures spoil fresh meat. High bacterial population may also result in putrid flavour. Lactic acid bacteria grows rapidly in vacuum packaged meat. These growths limit the shelf life of meat stored at refrigerated temperatures, due to development of sourness. Puncturing favour spoilage of vacuum packaged meat. Hence, packaging materials used in vacuum packaging of meat must have high barrier for gas and water vapour along with perfect seal and excellent mechanical strength. LDPE derived ionomers have high strength and oil resistance and are frequently used in vacuum packaging of fresh meat. Beef having pH more than 5.8 is not suitable for vacuum packaging, due to chances of the growth of H_2S producing bacteria and H_2S reacts with myoglobin and forms a green coloured compound 'Sulphmyoglobin'. Higher fat containing products like pork and lamb are not vacuum packaged, as not much known about their microbiology and shelf life. Lamb is expected to have shorter shelf life than beef as it has higher pH than beef, while pork will have a short shelf life as it is deeply contaminated with bacteria.

4. Packaging of Poultry Products

4.1 Packaging of Poultry Meat

Poultry birds are defeathered and disembowelled after slaughter and then the meat is quickly cooled. Carcasses are then hung for a short duration before being weighed and graded for packaging. Poultry meat is also susceptible to microbial spoilage, particularly to *Salmonella* and *campylobacter*. Packaging should ensure that moisture evaporation and discolouration through oxidation are minimized besides subsequent loss of flavour. Packaging considerations are alike to those used for meats, only difference being the shapes and sizes. Shrink wrapping polystyrene foam trays with PVDC films or shrink wrapped low density

polyethylene (LDPE) are mostly used. Poultry meat can also be packaged in laminates such as LDPE/Vinyl acetate copolymer (EVA).

4.2 Packaging of Eggs

Many factors must be taken into consideration during packaging of eggs. It is important to obtain information regarding the necessary requirements for a particular market, such as: quality maintenance, storage facilities, type of transport, distance to be travelled, climatic conditions, time involved and costs.

There are many different types of egg packages, which vary both in design and packaging material used. Packing eggs with clean and odourless rice husks, wheat chaff or chopped straw in a firm walled basket or crate decreases the risk of shell damage. It is also be possible to pack eggs in a simple basket without cushioning material such as straw. Thus, damage to the eggs may occur more easily. This kind of packaging may be fit for short distance transport.

A very common form of packaging is the filler tray. The fillers are placed in boxes or cases after filling. Filler trays are made of wood pulp moulded to pack the eggs. They are formed so that they can be stacked one on top of the other and can be placed in boxes for transport. Filler trays also offer a convenient method for counting the eggs in each box, without having to count every single egg. Usually the standard egg tray carries 36 eggs. Therefore, if a box holds five trays, for example, the box has a total of 180 eggs (36 x 5 = 180).

The cases may be made of sawn wood, but, they are more commonly made of cardboard. A special care must be taken in stacking while using cardboard cases, so that excessive weight is not placed on a case at the bottom of a stack. Fillers can also be made of plastic. The advantage of using plastic fillers is that they are reusable and washable. The fillers can be covered with plastic films and be used as packages for final sale to the buyer. More importantly, plastic transparent fillers facilitate the inspection of eggs without handling or touching the eggs.

Eggs can also be packed in packages that are specific for retail sale. Each package can hold two to twelve eggs. These cases can be made of paperboard or moulded wood pulp or plastic.

It is possible to pack eggs in small paperboard cases and cover them with plastic film. The advantages of using polystyrene egg cases are superior cushioning and protection against odours and moisture, resistance to mould growth. Small cases are good for retailers and customers. They are easy to handle by the retailers and customers can inspect the eggs.

5. Packaging of Frozen Flesh Foods

Freezing of flesh food is done to extend the storage life beyond which obtained by chilling. The physical and chemical changes in meat still take place. Fat when exposed to oxygen and light may lead to rancidity whereas the myoglobin in the lean tissue may fade. Freeze burn is also the common defect in frozen meat due to dehydration of the meat surface. The development of PVDC copolymer film has facilitated to overcome such problems to a great extent. These materials have both moisture dehydration or absorption and have good oxygen barrier properties, which prevent rancidity. Several other materials suitable for frozen storage of flesh foods are a range of laminated deep frozen grades of PE and other films.

6. Modified Atmosphere Packaging (MAP) of Fresh Flesh Foods

Modified atmosphere packaging of meats is done by using CO_2 alone or in combination with O_2. Oxygen concentration could be between 60-80 % to retard formation of metmyoglobin. Higher CO_2 concentration of about 40-60% results in better preservation, but, it may lead to discolouration due to denaturation of meat proteins. This superiority of CO_2 atmosphere over vacuum packaging is credited to more inhibition of pathogenic psychrotrophs. In modified atmosphere packaging, the headspace CO_2 pressure change depends upon the initial packaging/product and storage conditions like head space-to-meat ratio, surface area of package, meat volume and initial gas composition. As CO_2 can be absorbed by fresh meat, package shrinkage is one of the important problem to be overcome.

MAP of poultry meat results in shelf life 2 to 3 times more than air packed meats when stored at same refrigerated temperatures. The modified atmosphere with 70 % CO_2 and 30% nitrogen gives better shelf life than 30% CO_2 and 70 % nitrogen. The temperature of storage having higher inhibitory effects on the growth of *enterobacteriaceae* and on production of spoilage metabolites like free fatty acids and extract release volume is generally in the range of 2-4°C.

The shelf life of MAP fish is increases many times as compared to fish stored under atmospheric conditions. CO_2 is considered effective medium for MAP of fish. MAP inhibits bacterial growth, prevents increase in the pH, trimethylamine level and total volatile bases, along with delayed changes in protein functionality. Gas mixtures with highest initial CO_2 concentration are very effective in extending the shelf life, however, sometimes it leads to reduced water holding capacity. MAP has also been used successfully for a variety of processed meat products like sausages, patties, nuggets etc. Depending upon product

characteristics, the combination of gases tried could be mixture of CO_2, nitrogen and oxygen or only CO_2 flushing.

6.1 Safety of MAP Muscle Foods

Though MAP results in extended shelf life of all muscle foods, USFDA of has shown concern with regard to safety aspects of its use. Low oxygen and high CO_2 level in modified atmosphere may encourage longer log/lag phase of aerobic spoilage organisms. Also, it may favour growth of anaerobic pathogens. Psychrotrophic non-proteolytic strains of *Clostridium botulinum* and *Listeria monocytogenes* and many others could grow in many meat products stored under modified atmosphere at room temperature.

7. Conclusion

Packaging of foods is one of the integral techniques used for extending the shelf life. With consumers becoming more and more conscious of quality, hygiene and convenience there is need for adopting packages, which maintains product quality, safety and improve consumer appeal. Vacuum packaging and modified atmosphere packaging have been successfully exploited in meat industry. Vacuum packaging delays the growth of aerobic spoilage microorganisms and retard oxidation of lipids in fresh meats.

However, deformation of cuts by tightening of packaging film and temporary discoloration have adversely affected its widespread use. MAP greatly extends not only the shelf life of muscle foods but also maintains colour, texture and flavour of the product. In spite of this, pathogens may grow if there are extreme temperature abuse and the spoilage organisms are low in the MAP foods which would otherwise compete with the pathogens. It is therefore that more hurdles must have to be incorporated to ensure product safety. Active packaging concepts will probably dominate the future trends in flesh food packaging. Research efforts in this area have been very active and already some packages based on this principle are available in the market, like packaging material which release microbial inhibitors containing metal ions and salts of propionic acid, have been tested successfully in the laboratory. Specially fabricated films to absorb flavour and odours, or, on the contrary to release them into the package are being reported and could soon be seen in the market place.

References

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