Paper No.: 12
Paper Title: FOOD PACKAGING TECHNOLOGY
Module – 16: Packaging of Snack Foods

1. INTRODUCTION:

Snack is a slight or casual or hurried meal, a small portion of food or drink, or a very light meal. Until the 1970s, commercial snack foods could be said to be potato chips or crisps, nuts, cookies and confectionery. Snack foods now include a very wide range of products.

The snack food industry today relies more and more on extrusion cooking processes. A major distinction can be made between direct expanded snack foods and the expanded pellet forms. The direct expanded snacks are usually very light structures which develop from the cooker/extruder and require only adjustment to moisture content before enrobing and flavouring, whereas the expanded pellets are typically compact and dense and require specialized drying before expanding. This is accomplished by means of a number of techniques including frying in oil, rotating in sand or salt roasters, microwave heating or fluid bed toasters.

2. FRIED SNACK FOODS

2.1 Characteristics of fried Snack foods

Fried snack foods consist of many ingredients. Although the most popular are based on potatoes and nuts, large quantities are also made from cereal ingredients, the most widely used cereal being corn. Common to all these snacks is fat/oil which is used as a processing agent to dehydrate the product or puff it and develop characteristic flavours. As a consequence, the shelf life of many fried snack foods is closely related to the rancidity of the fat/oil.

The manufacture of potato chips is quite simple. After washing, peeling and trimming, potatoes are sliced thinly, washed to remove adhering starch granules, blanched and dried before passing on a conveyor through hot oil in which they are rapidly dehydrated by frying and cooked. Excess oil is drained or centrifuged off and the chips are cooled, salted, flavoured and packaged. During the processing of potatoes to chips, the moisture content of the potato is reduced from about 79% to 5%, and of the final 95% of dry matter in chips, 35% to 40% is amounts to be fat/oil.

2.2 Deterioration in Fried Snacks

There are two major modes of deterioration of fried snack foods: Development of fat rancidity and loss of crispness. The susceptibility of fried snack foods to oxidative rancidity depends on the type of fat used and the number of unsaturated bonds in the fatty acid moiety. Analysis of volatile compounds in fresh and aged potato chips and unused fresh and aged frying oils showed that oxidation of oils was mainly responsible for volatile compound changes in potato chips during storage. To minimize the development of such rancidity, the product must be protected from oxygen, light and trace quantities of metal ions. The addition of phenolic-type antioxidants such as butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT) and tertiary butyl hydroquinine (TBHQ) is also very helpful but is not always permitted by legislation.

Since the bulk density of chips is typically 0.056 g/ml, they have a very large headspace volume per unit weight of product. If the product is packaged at atmospheric oxygen concentration, then the headspace oxygen is sufficient to cause oxygen uptake in excess of 3 ml O_2 per g at standard temperature and pressure. Therefore, inert gas packaging would result in a very significant increase in the storage life of potato chips, provided that the headspace oxygen concentrations attained were below 1% and the package permeability to oxygen was very low. It was recommended that the package should be designed to avoid light penetration also.

Crispness is a salient textural characteristic for fried snack foods, and its loss due to absorption of moisture is a major cause of snack food rejection by consumers. Water affects the texture of snack foods by plasticizing and softening the starch / protein matrix which alters the mechanical strength of the product. The critical a_w for potato chips has been reported to be 0.40. A more extensive study using sensory panels found that potato chips became unacceptable organoleptically at 0.51 a_w

2.3 Packaging of Fried Snacks

From the modes of deterioration discussed above, it is clear that a satisfactory package for fried snack foods would need to provide a good barrier to oxygen, light and moisture. Fried snacks foods are typically packaged in multi-layer structures, although spiralwound, paperboard cans lined with aluminium foil or a barrier polymer and sealed under vacuum with an LDPE / foil end are used for some specialty products. In addition, the use of metal cans for fried nuts is popular for premium products, the container usually being gas flushed with nitrogen immediately prior to seaming. Limited information is available on the effects of packaging materials on the stability of snack foods during ambient storage. Since these products are frequently displayed for sale under fluorescent lights, flexible packages are either pigmented or placed inside paperboard cartons. The use of metallized films has become widespread in recent years, and although they are reasonably efficient light barriers, they do permit some light to penetrate into the package.

Potato chips packaged in pouches constructed of HDPE, LDPE, LDPE-coated RCF or PVC / PVDC copolymer coated RCF were reported to have a shelf life of about 15 days at 27°C and 65% relative humidity. None of these films offered protection from light and the conditions of lighting were not reported. Potato chips packaged in PVC/PVDC copolymer-coated PP were reported as being more sensitive to water vapour than to oxygen, when stored at 55 to 65% RH became unsalable after 8 to10 weeks. Potato chips packaged in PP / aluminium foil pouches required about 27 weeks to become unsalable due to developed rancid flavours.

The storage life of shelled, roasted and salted peanuts was reported as 3 weeks at room temperature but it can be extended by packaging in inert gas or vacuum or by lowering the storage temperature. It was important to prevent moisture condensation on the peanuts, since it has been shown that deposition of a monomolecular layer of moisture on the product increases the rate of deterioration two to three fold.

An economical method for packaging peanuts for long term storage utilized the CO_2 adsorption properties of it and involved placing them in plastic pouches impervious to air and CO_2, then flushing with CO_2 and then heat sealing. CO_2 is adsorbed into the pores of the peanuts resulting in the formation of a vacuum inside the pouches. Both shelled, raw peanuts and shelled, roasted and blanched peanuts were protected from any significant deterioration of flavour and other quality factors for 12 months and roasted salted-in-the-shell peanuts were protected for 4 months.

The formation of a tight collapsed package a few weeks after vacuum-packaging peanuts has been reported. It was attributed to the conversion of oxygen to peroxides and depended on the initial residual oxygen level and gas volume. Initial residual oxygen levels in commercially vacuum-packaged peanuts were reported to be around 5% of the remaining air because the extent of the vacuum achieved is limited to 75% due to film deformation and line speeds. However, the adsorption of CO_2 by cereals, grains and nuts is well documented and led to the development of a technique for cereal skin packaging known as CEM (CO_2 Exchange Method). In this method, cereals are packaged in CO_2 in a plastic bag of low gas permeability and the bag is sealed. The package volume gradually decreases as CO_2 gas is absorbed by the cereals and finally a skin package is obtained as we have seen in the case of peanuts above.

3 EXTRUDED AND PUFFED SNACKS

3.1 Characteristics of Extruded and Puffed Snacks

Extrusion has given means of manufacturing new and novel products and has revolutionized many conventional snack processes. The most popular and successful extruders used in the production of snack foods have been single-screw extruders, although in recent years twin-screw extruders have begun to be used. The extruder should exercise number of functions in a short time under controlled, continuous operating conditions. These functions may include heating, cooling, conveying, feeding, compressing, reacting, mixing, melting, cooking, texturing and shaping.

The majority of extruded snacks on the market falls in the category of expanded snacks. They are usually light with a low bulk density and are seasoned with a range of flavours, oils and salt. A typical manufacturing process would consist of blending of the ingredients with water prior to being fed into the extruder. As the mix passes through the extruder it is compressed, the work performed on the mix during extrusion being transformed into heat. The combination of pressure and heat causes the mix to become very viscous and as it passes through the extruder heads, the superheated moisture instantaneously vaporizes, resulting in puffing of the product.

Sometimes the product is subsequently fried in oil to remove moisture and develop a desirable flavour. It is then cooled and coated with flavours. It is achieved either by first spraying the product with vegetable oil and then dusting with a variety of dry flavours and / or seasonings, or alternatively the oils, flavours and seasonings may be mixed together and applied to the extruded product as it is tumbled in a flavour application equipment. Puffed snack foods such as popcorn were originally made by placing grains of corn onto very hot plates. This caused the moisture in the grains to suddenly expand into steam and so cause the grain to be puffed and simultaneously get cooked. This method was refined by heating the grain in a quick-release and hermetically sealed cylinder where the sudden release of pressure caused the grain to puff or expand. A similar principle is used in extrusion. Recent developments have improved the efficiency of the process and many cereals can now be puffed up to 4 to 8 times their original size; these expanded original texture grains are used in many snack products.

3.2 Deterioration in Puffed Snacks

The major cause of deterioration of extruded and puffed snacks is loss of crispness. The critical a_w for puffed corn curl has been reported as 0.36 which corresponds to a moisture content of 4.2 g water per 100 g solids. The initial a_w of this product was 0.082 with a corresponding moisture content of 1.83 g water per 100 g solids. For popcorn, initial and critical a_w's were 0.062 and 0.49, with corresponding moisture contents of 1.70 and 6.1 g water per 100 g solids. The critical a_w for extruded rice snacks has been reported to be 0.43 which corresponds to 6.5% moisture content. The development of stale and / or oxidized and rancid flavours and odours can also be a problem limiting the shelf life of certain extruded and puffed snacks.

3.3 Packaging of Puffed Snacks

Many extruded and puffed snack foods are packaged in identical material to that discussed above for fried snack foods. However, since the major mode of deterioration is loss of crispness, a package which provides a good barrier to water vapour is the primary requirement. Some extruded and puffed snacks are comparatively less sensitive to oxygen than fried snack foods and the oxygen barrier requirements of the packages are consequently less stringent.

4. FRUIT AND CEREAL BASED SNACKS

4.1 Characteristics of Fruit and Cereal Based Snacks

Large quantities of variety of dried fruits, usually with added nuts and honey, sugar or syrup are used in the manufacture of this type of snack foods. Their composition is extremely variable, leading to development of bars with wide variety of flavours and textures. Generally, these products are in the intermediate moisture category and have a_w's in the range of 0.20 to 0.40.This is because of their relatively high sugar content (about 25 to 30%) mainly in the form of glucose, sucrose and fructose from many ingredients like corn syrup, glucose syrup, sweetened condensed and/or evaporated skimmed milk and invert sugar syrup.

This category also includes snacks based on flaked cereals such as oat flakes or wheat flakes, or puffed cereals like rice, which are also added with dried fruits and nuts to produce variations in flavour and texture. Many of these snacks have a chewy texture and a_w which places them in the intermediate moisture range. The fat content of these chewy bars can be as high as 24%.

4.2 Packaging of Fruit and Cereal Based Snacks

Packaging materials for fruit-based snacks must provide a barrier to water vapour entry to avoid the development of stickiness as a result of moisture uptake by the sugar in the product. The a_w to maintain chewiness has been given as less than 0.50, although no specific product was mentioned. In very dry atmospheres moisture loss could be a problem. Before the packaging requirements can be specified with any degree of precision, the moisture sorption isotherm for this type of product would be required. No published isotherms have yet appeared in the literature, although a generalized one for a ready-to-eat cereal has been published.

5. Conclusion

The major cause of reducing shelf life of snack foods is oxidation of fat or moisture ingress or absorption by the snack food. Which causes either unwanted flavours or undesirable texture to the snack, causing the rejection of such type of food products. The shelf life of such products can be improved by use of packaging materials having light and moisture barrier properties. Now a days so many laminates available, which includes may layers of different packaging materials, from which desired properties for a specific snack food can be included in one package.

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