

## **Module III Shelf Life Testing of Foods**

### **Chapter 6 : Savory Snack Foods (Potato Chips), Ready to Eat Cereals, and Cakes**

**Objectives:** By the end of this module, you will have learnt

- a) What environmental factors must be carefully controlled to extend shelf life of snack foods?
- b) What is the role of packaging in extending shelf life of foods?
- c) What types of chemical tests should be performed to study degradation of foods with high fat content?

Savory snacks are manufactured using a wide range of processing methods. The most common products are baked, deep fat fried, roasted, or extrusion-cooked. These products are mostly prepared from starchy raw materials such as cereals (e.g. corn, rice, and wheat), lentils, potatoes, cassava, and nuts. With the removal of most of the water during the heating process, these products have low water activity and therefore an extended shelf life. When, oil is used in the process, such as in the case of deep fat frying, the presence of oil is the limiting cause of product's shelf life. In this module we will consider three products, two with high oil content, namely potato chips and cakes, and another with low fat content namely ready-to-eat cereals often consumed as breakfast food.

#### **6.1 Potato Chips**

Potato chips are thin (2 mm) potato strips that are fried to final moisture content of 3% or less (a water activity of around 0.2). Typical oil content of deep fat fried potato chips is 30-40%. The key modes of deterioration during storage are textural changes due to moisture uptake, and rancidity due to oxidation. In a sensory study, a moisture content of 3.6% was found to be sufficient to reject the chips based on poor texture.

Since water and oxygen are detrimental to the shelf life of potato chips, proper packaging plays an important role in reducing product deterioration. Furthermore, packaging helps to protect the product from ambient light which is another source of light-induced degradation reactions. Typical shelf life of potato chips packaged in cellophane coated with moisture barriers is around 4-6 weeks at 20°C. For longer shelf life, laminated packaging materials that exclude oxygen and

moisture are required. Composite cans, with aluminum foil, are used for prefabricated potato chips giving a shelf life of over a year, although the costs of this type of packaging are high.

Typical chemical tests used for shelf life determination of potato chips involve extraction of oil from the potato chips and determining:

peroxide value (PV)

free fatty acid (FFA) value

It should be noted that changes in peroxide value may not provide good correlation to the shelf life because PV is a measure of the primary oxidation products. These primary products oxidize rapidly into secondary and tertiary products.

Rancidity is accelerated under light. Under light, butyric acid increases as chips become more rancid. Opaque packaging material is therefore preferred. Blue light accelerates rancidity, while red, white, and yellow do not. Therefore, blue colored packaging material should be avoided.

Moisture uptake of the potato chips is another important indicator of the textural quality of the chips resulting in decreased crispness. Therefore a packaging material of low water vapor transmission rate is necessary to minimize textural changes.

### **Shelf life Measurement**

A method proposed by the British Cellophane Limited, BCL(1985) for potato chips involves storing packages containing potato chips at a range of temperature and relative humidity combinations. For comparison with control, packages of chips are stored under frozen conditions where no changes are expected to take place.

The shelf life evaluation is done using sensory analysis. Stored chips are evaluated by sensory panels (of 8-10 judges) on weekly intervals until the product is considered to be unacceptable. The judges assign a score for the flavor and texture of the chip comparing it with the control samples. The score sheet suggested by BCL is as follows:

Sensory observation	Score
Equal to control	10
Slight difference but still acceptable	9
More distinct difference but still acceptable	8
Beginning to lose acceptability	7
More distinct loss of acceptability	6
Very distinct loss of acceptability	5
Unacceptable	4 or less

The plot in Figure 1 shows flavor assessment of chips exposed to fluorescent light.

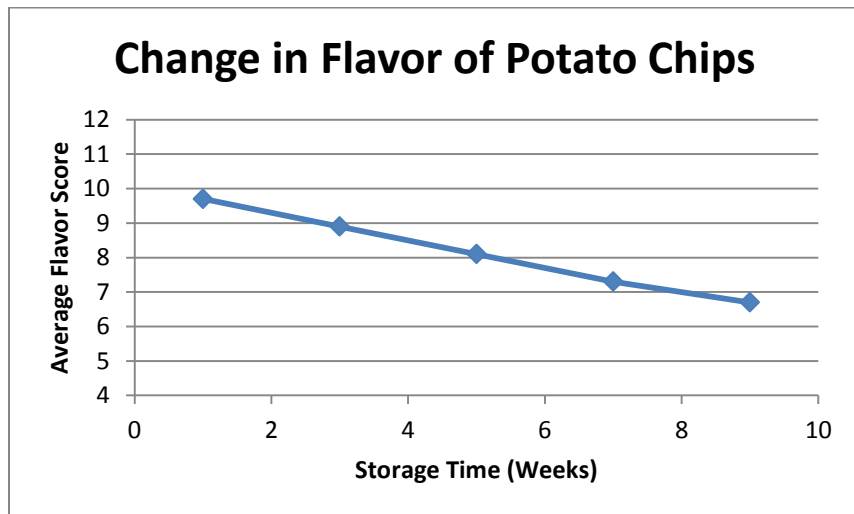


Figure 1: Change in flavor of potato chips during storage exposed to fluorescent light (1700 lux) packed in printed metallized biaxially oriented polypropylene (Source: BCL (1985), Man and Jones (2000)).

Packages removed from storage at periodic intervals are also used to determine PV and FFA of chips.

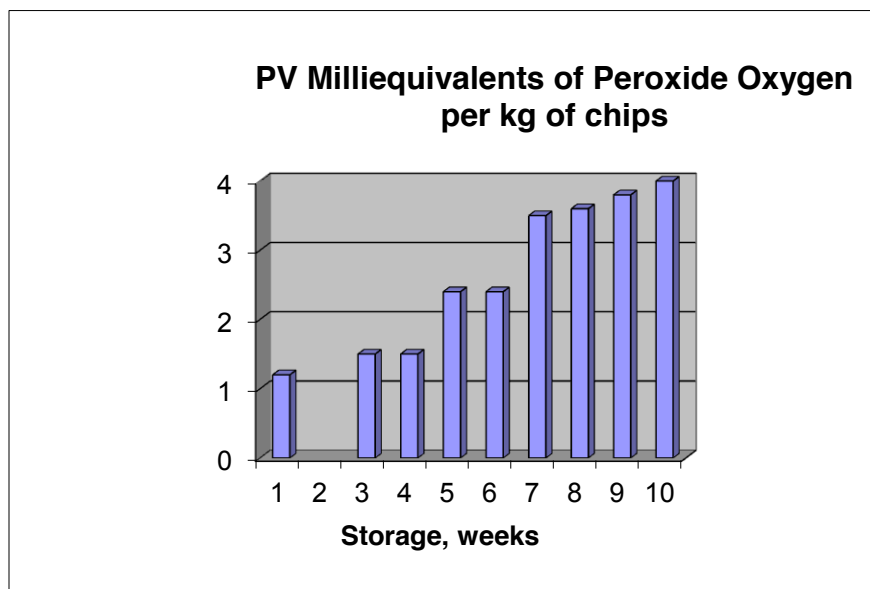


Figure 2: Peroxide Value milli-equivalents of peroxide oxygen per kg of chips. (Source: BCL (1985), Man and Jones (2000)).

Moisture uptake by chips is measured by weighing the packs. In industrial trials, packages should be also tested for seal integrity. In a distribution system, any external sources that may compromise the package seal integrity should be carefully evaluated.

## **6.2 Ready-to-Eat (RTE) Breakfast Cereal**

Ready to Eat (RTE) products have extended shelf life. However, they must be properly protected using appropriate packaging to avoid degradation. In evaluating shelf life of RTE cereals, there are a number of quality attributes that are employed for shelf-life analysis including

- Appearance
- Flavor/off flavor
- Texture – crispness
- Moisture content
- Vitamins and minerals

In evaluating the shelf life of RTE cereals, a break point testing procedure is recommended. The break point testing involves determining the moisture content of the product when the product is unacceptable. The testing protocol is as follows:

- 1) Prepare several plexiglass chambers with trays containing different amounts of water, place known weight of RTE sample in each container and seal. (The amount of water and RTE sample is predetermined to ensure that the final moisture levels of the RTE sample will be near some selected target level).
- 2) Store for 4-7 days, while the samples absorb water
- 3) Remove samples and place in glass jars to equilibrate for another 7 days.
- 4) Check the moisture content of the sample.

5) Use judges (at least six) to determine the moisture content above which the sample becomes unacceptable.

## **6.3 Cakes**

In evaluating shelf life of cakes the following attributes are most important:

- microbial spoilage typically molds and yeasts
- dryness, crumb staling
- off-flavors due to rancidity as a result of fat oxidation
- grittiness due to sugar crystallization mostly due to moisture migration
- chocolate bloom: a dull greyish appearance of chocolate coatings
- syneresis of jam/jelly fillings causing moist area above or below jam filling

- moisture loss
- structural weakness that results in crumbling of the cake when cut often due to deficiency in protein or excess fat.

Shelf life evaluation of cakes involves determining one of the critical quality attributes from the above list and then following its change using sensory panels during storage. The time when the product becomes unacceptable based on the selected quality attribute is identified as the end of shelf life.

#### **6.4 Review Questions:**

- 1) What are two key modes of deterioration of potato chips?
- 2) What chemical tests are used to determine shelf life of potato chips?
- 3) List three quality attributes of ready-to-eat cereals that are important in determining shelf life?

#### **6.5 References and Additional Reading Materials:**

Man, C.M.D. (2000). Potato chips and savory snacks. Chapter 10. In *Shelf-Life Evaluation of Foods*. Ed C.M.D. Man and A.A. Jones. 2<sup>nd</sup> Edition. Aspen Publication. Gaithensburg, MD.

Howarth, J.A.K. (2000) Ready to eat breakfast cereals. Chapter 12. In *Shelf-Life Evaluation of Foods*. Ed C.M.D. Man and A.A. Jones. 2<sup>nd</sup> Edition. Aspen Publication. Gaithensburg, MD.

Jones, H.P. (2000). Ambient packaged cakes. Chapter 9. In *Shelf-Life Evaluation of Foods*. Ed C.M.D. Man and A.A. Jones. 2<sup>nd</sup> Edition. Aspen Publication. Gaithensburg, MD.