Paper No.: 12
Paper Title: FOOD PACKAGING TECHNOLOGY
Module-15: Packaging of Bakery Products

15.1 Introduction

Bakery products are becoming a major part of the international food market, the baking industry is undergoing a period of rapid change. Baking industry must try to satisfy the healthy eating trends and the consumer demands for fresh products. Food technologists have to select the suitable type of packaging that will ensure the necessary shelf life for bakery products. The success of the product in the market must be based on the design and the production both with the very best raw materials and advanced technology.

The principal function of food packaging is to minimize reactions that affect the stability of the product. Mold spoilage is common in the bakery industry and in many cases; mold growth determines the product shelf-life of both high-moisture and intermediate-moisture baked. Baking destroys most molds. However, during cooling and packaging, recontamination can occur and cause growth to take place.

Table - 15.1 Cause of deterioration and their prevention for bakery products

Bakery food	**Cause of deterioration**	**Prevention**
Bread and Cake	Improper hygienic conditions during production	Proper hygienic conditions during production
	Fungal growth	By using modified atmospheres containing 70±100% CO_2 and 0±30% N_2 or by removing O_2
	Staling	High H_2O barrier material
Cookies and Crackers	Crispness	Proper moisture barrier in the package
	Oxidation of the fat fraction	Low O_2 atmospheres with high O_2 barrier packaging materials,Non-translucent packaging materials (light-induced oxidation)
	Fat bloom and Breakage	Control temperature

15.2 **Packaging Material Used for Bakery Products**

Different packaging material is used for different products depending on the type and composition of the product.

Table – 15.2: Packaging materials used for cereal based food packaging

Food application	Packaging materials
Fresh bread, sandwich	Waxed paper Nitrocellulose coated cellophane (MS) Low density polyethylene (PE-LD) Polypropylene (PP)
Bread bags, sandwich bags, frozen food bags Crusty bread, pies, Bread crumbs Biscuits	Linear low density polyethylene Cellulose/Polyethylene/Cellulose Polyethylene/Polypropylene Paper/ Polyvinilydene chloride/Polyethylene Paper/Polyethylene/ Polyvinilydene chloride (PAP/PE/PVDC) Oriented polypropylene/ Oriented polypropylene (OPP/OPP) Oriented polypropylene/Paper (OPP/PAP) Oriented polypropylene /Paper/Aluminium foil (OPP/PAP/Al) Oriented polypropylene/Aluminium foil/Hotmelt (OPP/Al/Hotmelt) Coextruded oriented polypropylene/ Coextruded oriented Polypropylene(OPPcoex/OPPcoex) Coextruded oriented polypropylene/ Coextruded metallized oriented polypropylene(OPPcoex/OPPcoexmet) Polyvinylidene chloride coated cellophane (MXXT)
Cakes, biscuits, Crisps, snack foods, biscuits	Aluminium foil/Paper Polyvinilydene chloride coated polypropylene/ Polyvinilydene chloride coated polypropylene (PVDC-PP/PVDC-PP)
Cereal meals Baked products	Paper/Polyethylene Polyethylene terephthalate /Polyethylene (PET/PE) Polyamide (Nylon)/ Low density polyethylene (PA/PE-LD)
MAP - Baked products	Polypropylene/ Ethylene vinyl acetate (PP/EVAC) Metallized polyethylene terephthalate /Polyethylene (PETmet/PE) Polypropylene/Low density polyethylene/Ethylene vinyl Acetate(PP/PE-LD/EVAC) Oriented poly(ethylene terephthalate)/ Polyvinilydene chloride/ Polyethylene- Polyvinyl chloride/Polyethylene (OPET/PVDC/PE-PVC/PE) Oriented metalized poly(ethylene terephthalate)/Polyethylene (OPETmet/PE) Oriented polyethylene terephthalate/ Polyvinilydene

	chloride/ Polyethylene(OPET/PVDC/PE) Polyamide/ Polyethylene (PA/PE)

15.3 Techniques for packaging of bakery products

15.3.1 Flexible packaging

Flexible packaging is the oldest form of packaging. It is produced by converting paper, film, or foil, alone or in combination, for use in consumer and industrial applications. Most flexible packaging is printed. It includes casting, extruding, metallizing, coating, printing, embossing, slitting, laminating, folding, sheeting, or heat sealing of flexible or semirigid materials, converted from films, foils, and paper. Social and economic factors have stimulated new technology in the flexible packaging industry. The reduction in the size of the average family unit, the rising number of older people, and the increasing number of single-person households have created a need for convenience foods and single-portion servings and small package sizes. These stimulate new product designs, new materials, and new manufacturing processes. Flexible packaging includes a diverse group of products such as candy wrappers, snack bags, bread wrappers, clothing, grocery bags, and multiwall bags.

15.3.1.1 Wrapping Styles

There are several popular wrapping styles, which are applied widely to a variety of biscuits (of all shapes and sizes) and other bakery products. Biscuits packed using the following two wrapping styles must be of common size and shape with a certain consistency and rather narrow tolerances in their dimensions.

15.3.1.1.1 Endfold Wrapping

This wrapping style is the classic, traditional biscuit wrapper. A portion of biscuits standing on edge is roll wrapped or fold wrapped into a heat sealable film. The longitudinal packet seal is sealed tightly in a fin seal style. The packet ends are folded neatly and heat-sealed. Due to the neat and tight surrounding of the film, this packet gives utmost mechanical protection and acceptable barrier properties for hard and semi hard biscuits and many other cracker types. Enfold wrapping is considered the most effective in terms of presentation by many marketing specialists - not only due to neat and impeccable shape, but also due to its ability to clearly distinguish the product amongst the host of pillow pack items on the retail shelves.

15.3.1.1.2 Pillow Pack Wrapping

This is the standard wrapping style for smaller biscuit packs (snack packs/single serve packs) containing one or more piles of biscuits. In addition, pillow pack wrapping is used for bigger packets with products standing on edge (Slug wrapping) as well. In this configuration, it often serves as a primary wrapper, to be overwrapped by a carton to improve presentation and acceptance. The main advantage of pillow packs on edge, is its flexibility with regard to the slug length. For instance, it allows the machine to automatically adjust the length during wrapping by means of tendency controlled check weighers. This feature ensures the highest weight accuracy. Additionally, the pillow packs typical fin seal style sealing is somewhat tighter than the enfold

wrap. This disadvantage of pillow pack slug wrapping is its limited mechanical product protection due to its rather loose packing. Further, the presentation of products packed using the pillow pack style is considered by most to be less attractive than enfold packets.

15.3.1.1.3 Packing for Odd-sized Biscuits

Besides enfold wrapping and pillow pack wrapping, which by the way cover about 85-90% of all biscuit products, there are some speciality biscuits with their own unique wrapping needs. These include an assortment of small cocktail crackers filled in bags by vertical FFS(film forming style), machines and cookies of uneven sizes whose tolerance do not allow a standard wrapping. The latter are automatically or manually loaded into decorated trays and subsequently over-wrapped on pillow pack machines.

15.3.2 Modified atmosphere packaging (MAP)

Modified atmosphere packaging (MAP) is used to increase the mold free shelf-life of bakery products.

Table-15.3: MAP gas mixture for bakery products

Food	Gas mixture		Storage Temperature ^0C	Shelf life	
	CO_2	N_2		MAP	In air
Fresh pasta	50	50	0 to+5	3–4 weeks	1–2 weeks
Bakery products	50	50	0 to+5	4–12 weeks	4–14 days
Pies	50–70	30–50	+4to+6	2–3 weeks	3–5 days
Cakes	20–40	60-80	+20 to+25	Even one year	Max. Some Weeks
Rye wheat bread	20–40	60-80	+20 to+25	2 weeks	Max. Some Days
Pre-baked bread	80–100	0-20	+20 to+25	20 days	5 days

15.3.3 Shelf Life of Packaged Bakery Goods

There are different types of product changes that can limit the shelf life of food. Essentially, the shelf-life of a food, i.e. the period it will retain an acceptable level of eating quality from a safety and organoleptic point of view, depends on four main factors (a) formulation (b) processing (c) packaging and (d) storage conditions. In today's modern processing terminology these factors are addressed in the HAACP (Hazard Analysis Critical Control Point) concept, a comprehensive quality control-quality assurance methodology that aims to ensure both food safety and high quality.

Table-15.4: Packaging materials used for atmospheric (air), modified atmosphere (MAP) and active packaging of bakery products:

Bakery products	**Packaging material (Thickness)**	**Gas permeability (cm^3/m^2.day.atm)WVP (g/ m^2.day)**	**Packaging conditions**
Bread	Laminate with EVAL	CO_2 = 2.3 O_2 = 0.45	
Bread	PE		Air+Ca-propionate
Wheat bread	Laminate with EVAL (95µm)	O_2<2 CO_2<2.3 WVP<1	Air; 100 CO_2; 50% CO_2+ 50% N_2
White bread	PP film		AP:O_2absorbent
White bread	PE		AP:O_2-absorbers+ K-sorbate
Soy bread	PVDC/PET/PVDC	20% CO_2+80% N_2	
Soy bread	PE-LLD/PA/EVAL/PA/ PE-LLD	MAP: 50/50; 20/80 CO_2/N_2+Ca-propionate	
Bread slices	Cryovac^R BB4L bag (60µm)	O_2=35 CO_2=150 WVP=20	Air-, Different MAP+/− Ca-propionate Different MAP+
Wheat and Rye bread	OPP/(PE-LD/EVAL-PE-LD) (70µm) PA/EVAL/PE (160µm) PA/EVAL/PE (160µm)	O_2=3 WVP=1 O_2=2 WVP=7 O_2=3 WVP=1.5	AP:O_2-absorbers AP: mustard oil AP: mustard oil + different MAP 80% CO_2+1%O_2+AP: mustard oil in 96% ethanol; Air
Pre-baked buns	PE-LD (80µm)		AP: ethanol emitters
High moisture/pH bakery Products	High-gas barrier bags (Cryovac^R) VF 52 metallised bag O_2=0	O_2=4 O_2=0	AP: water-ethanol and mastic oil-ethanol emitters

Meal ready – to-eat bread	PET/Al/PE		AP:O_2-absorbers
Sponge cake	OPP/(PE-LD/EVAL/PE-LD)/PE-LLD (95µm)	O_2=2 WVP=1	Different MAP
Sponge cake	PA/PE (90µm)	O_2=19.9 CO_2=164.9 WVP=2.6	Air; Different MAP+/− O_2-absorbers
Pre-baked pizza dough	Bicor™ MB777 (21µm)		Air; Different MAP+/− Ca-propionate
Fresh lasagna pasta	PVDC/PE (80µm)	O_2=8.63	AP:O_2-absorbers

With respect to shelf life, key factors include the moisture content (or a_w), pH, and the addition of microbial preservatives and antioxidants. Once the food leaves the processing stage its keeping properties and the extent to which it will retain its intended at-tributes is a function of the microenvironment in the package. The important parameters are gas composition (oxygen, car-bon dioxide, inert gases, ethylene, etc.), the relative humidity (% RH), pressure or mechanical stresses, light, and temperature. These parameters are dependent on both packaging and storage conditions.

Table-15.5: Major modes of deterioration, critical environmental factors and shelf- life by food product:

Food product	**Mode of deterioration (assuming an intact package)**	**Critical environmental factors**	**Shelf life (average)**
Fresh bakery products	Staling, microbial growth, moisture loss causing hardening, oxidative rancidity	Oxygen, temperature, moisture	2 days (bread) 7 days (cake)
Breakfast cereals	Rancidity, loss of crispness, vitamin loss, particle breakage	Moisture, temperature, rough handling	6-18 months

Pasta	Texture changes, staling, vitamin and protein loss	Too high or low moisture, temperature	Pasta with egg solids 9-36 months; Macaroni and spaghetti 24-48 months

Conclusion:

Packaging of bakery products improve the shelf life of the products and ease of storage and transportation. Packaging technologies, such as MAP, help to maintain the quality and freshness of the products. Still, there is a scope to develop new packaging technologies to minimize the risk associated with packaging material.