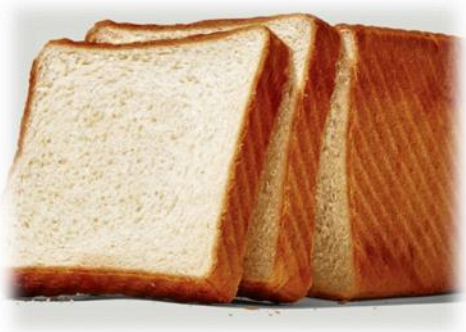
PM Formalisation of

Micro Food Processing Enterprises (PM-FME) Scheme

HANDBOOK OF

PREPARATION OF MILK BREAD



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CHAPTER 1

INTRODUCTION

1.1 Status of Baking Industry

India is the 2nd largest wheat producing country in the world next only to China. The present production of wheat in India is about 72 million tonnes indicating 6-fold increase in the three decade due to onset of green revolution. The five major wheat producing states in India are U.P., Punjab, Haryana, Bihar and Himachal Pradesh. Unlike in other economically developed nations, bulk of the wheat produced in our country is processed into whole wheat flour for use in various traditional products. About 10 per cent of the total wheat produced is processed into different products like maida, suji, atta, etc. in roller flour mill, which forms the main raw material for bakery and pasta industry. In spite of small quantities of wheat processed in a roller flourmill for use in bakery products, milling and baking industry still remains the largest organised food industry in the country. The turnover of the milling and baking industry is over 4500 crores and likely to increase at a decent rate in the near future.

1.2 Bakery Industry

Bakery industry today has an important place in the industrial map of the country. The annual turnover at present is estimated at over 2000 crores. The bakery industry comprises mainly of bread, biscuits, cakes and pastries manufacturing units. Though there are several large and small scale organised units, manufacturing both bread and biscuits, most of the bakery products in India are being produced by unorganised small family units. Bakery products once considered as a sick man's diet have now become essential food items of vast majority of population in India. It is becoming popular even in places where rice has been the staple food. The contributing factors for the popularity of bakery products are urbanisation resulting in increased demand for ready to eat convenient product, availability at reasonable cost, greater nutritional quality, availability of varieties with different textural and taste profiles and better taste. The bakery products have become popular among all cross section of populations irrespective of age group, and economic conditions.

The total numbers of bakery units are not exactly known, however, it has been reported that there are 50 large-scale units producing either bread or biscuits. Among these, 21 units produce only bread while the remaining produces biscuits. However, there are over 5000 small and medium scale units in factory sectors producing both bread and biscuits. There are over 1 lakh units in family scale small units producing various bakery products like bread, biscuits, cookies and pastries. The number of bakery units is maximum in Western region (34.2%) and minimum in Eastern region (16.0%). The per-capita consumption of bakery products is highest in Maharashtra followed by New Delhi and West Bengal.

1.3 Constraints of Bakery Industry

Bakery products not only serve as ready to eat convenient food, but also help in increasing the utilisation of surplus wheat produced in the country. Promotion of bakery industry will also create more employment potential. The growth of bakery industry could be much greater if some of the problems faced by them are solved and the major problems are:

(i) Non-availability of quality raw materials
(ii) Lack of knowledge of raw materials for specific product applications
(iii) Poor understanding of process equipments and process technology
(iv) Ignorance about testing protocols to enhance and maintain the quality of the finished products.

1.4 Introduction to Bread Making

Bread baking is one of the most important discoveries of mankind. Bread is made by baking dough which has for its main ingredients wheat flour, water, yeast and salt. Other ingredients which may be added include flours of other cereals, milk and milk products, fruits, gluten, etc. When these ingredients are mixed in correct proportions two processes commence: (i) the protein in flour begins to hydrate and forms a cohesive mass called as gluten (ii) evolution of carbon dioxide gas by action of the enzymes in the yeast upon the sugars. Three main requirements in making bread from wheat flour are formation of gluten network, aeration of the mixture by incorporation of gas, and coagulation of the material by heating it in the oven.

1.5 Principle of Bread Baking

There are three technological principles involved in baking of bread:

1) Conversion of starch: Wheat flour starch is partly converted into the sugar, which is being used by yeast during fermentation producing alcohol with simultaneous release of CO_2 gas is responsible for porous, open honeycomb texture of the baked bread.
2) Mechanical stretching: The hydrated wheat protein forms gluten fibers, which are stretched mechanically to obtain a fine, silky structure. This structure remains permanent when the protein is denatured during baking. The stretching of gluten is partially achieved by development of CO_2 gas during yeast fermentation and partly by mechanical mixing.
3) Flavour development: Bread flavor is because of the alcohol and other compounds generated during yeast fermentation, together with flavor compounds formed during baking.

CHAPTER 2

PREPARATION OF MILK BREAD

2.1 Ingredients and their Functions in Bread Making

2.1.1 Essential ingredients

Flour

Flour is essential to the structure of dough and subsequently the bread. Gluten (Gliadin and Glutenin) is the principle functional protein of wheat flour. Gluten forms fibrillar frame work when hydrated and mechanically worked. Thus the wheat flour is converted into cohesive, elastic, extensible dough. This viscoelastic three-dimensional gluten network retains gas formed by sugar fermentation and contributes to structure of dough and bread.

Starch plays important role in dough during baking. When heat is applied, gas cells expand gluten networks stretches, starch granules take up water and get partially gelatinized. This viscous paste sets to gel after baking. Satisfactory protein content for bread flour is 11 to 13% and moisture content not more than 14%.

Water

Water hydrates gluten proteins during mixing, gelatinizes starch during baking and serves as a dispersion medium for other ingredients such as yeast. Quality of water such as pH and hardness of water play important role in dough formation. Excessively alkaline water can retard the activity of yeast enzymes. Hard water containing calcium and magnesium ions, may have a tightening effect and soft water a loosening effect on dough.

Yeast

Yeast produces carbon dioxide and ethanol by fermentation of fermentable sugars. During fermentation it also helps in formation of flavour precursors. Rate of fermentation of dough by yeast is controlled by temperature, nutrient supply, water, pH, sugar concentration, salt and level and type of yeast. Generally two type of yeasts are used in baking: Compressed yeast and dried yeast. Both the types consist of living cells of Saccharomyces cerevisiae.

Salt

Salt acts as flavour enhancer and helps control the fermentation by yeast. It also toughens the gluten and gives less sticky dough.

2.1.2 Optional ingredients

The optional ingredients used in bread formulation are listed in Table along with their functions.

Functions of optional ingredients in the bread

S.No.	Ingredient	Example	Function
1.	**Mineral yeast food**		Controls fermentation
i.	Water conditioner (Calcium salts)	Calcium acid phosphate Calcium sulfate Calcium peroxide	
ii.	Yeast conditioners (Ammonium salts)	Ammonium chloride Ammonium phosphate Ammonium sulfate	
iii.	Dough conditioners (Oxidizing agents)	Potassium bromate Dehydro ascorbic acid Potassium iodate Dicalcium phosphate	
2.	**Sugar**	Sucrose High fructose corn syrup	• Energy source for yeast • Fermentable carbohydrate • Flavour Sweetness and flavour compounds generated during fermentation and baking • Crust colour: Caramelization and non enzymatic browning • Delays staling of bread by increasing hygroscopicity and thus tenderizing the crumb
3.	**Shortening**	Edible fats and oils containing dough conditioners and	• Facilitates dough handling and processing

		emulsifiers (Calcium stearoyl-2-lactylate, sodium stearoyl-2-lactylate, Mono and diglycerides, Polysorbate 60, Succinylated monoglycerides, Ethoxylated monoglycerides, Sucrose esters)	• Eases gas cell expansion in dough • Increases loaf volume • Improves crumb grain uniformity and tenderness • Lubricates slicing blades during slicing • Extends shelf-life
4.	**Dairy products**	Skim milk powder Sweet cream butter milk Sweet dairy whey Caseinate Whey protein concentrate	• Nutrition: high in lysine and calcium • Flavour enhancement • Improves crust colour (Maillard browning) • Buffering effect in dough and liquid ferments
5.	**Mold inhibitors**	Sodium propionate Calcium propionate Sodium diacetate Potassium sorbate Vinegar	• Retardation of spoilage due to mold growth • Retards formation of rope by *B. subtilis*
6.	**Wheat gluten**	Wheat gluten	• Enhances dough strength • Increases water absorption • Increases bread loaf volume • Imparts greater stability to the dough during fermentation
7.	**Malt**	Malt flour Malt extract Dehydrated malt extract	• Contributes fermentable sugar (maltose) • Enhances flavour • Contains amylases, which converts starch to sugar • Improves crust colour • Extends shelf-life because of improved water absorption

8.	**Enzyme supplements**		
i.	Amylases	Cereal amylase: barley malt Fungal amylase: *Aspergillus oryzae* Bacterial amylase: *B. subtilis*	• Convert starch to sugar • Aid crust colour • Improve dough handling • Extend shelf-life
ii.	Protease	Fungal protease: *Aspergillus spp.* Bacterial protease: *B. subtilis* Bromelain (Fruit)	• Weaken dough due to cleavage of peptide bonds in wheat protein • Reduce dough mixing time • Increase pan flow
iii.	Lipoxygenase	Soya	• Whiter bread crumb • Improves shelf-life • Increases dough strength and mixing dough tolerance

2.2 Methods of Bread Making

Based on the way dough is prepared, different methods of bread making can be broadly grouped into three: Conventional (bulk fermentation) dough development methods, mechanical dough development methods, chemical dough development method.

The major production methods used in wholesale bread production are the dough method, liquid fermentation method, straight dough method, no-time dough method, frozen dough method, continuous bread manufacturing, Chorleywood bread process.

2.2.1 Sponge and dough process

This is the most common commercial method used to manufacture bread. Sponge is prepared by mixing flour with water and yeast and allowed to ferment for a certain period of time. Subsequently balance flour, water and other ingredients are added to sponge. The ratio of sponge to dough is maintained at 70:30. After through mixing, dough is allowed to ferment for 3 to 5 hours at 30◦C. The dough is then divided into pieces to yield bread loaves of desired weights. The dough pieces are then rounded, given rest period of 7 min and then sheeted, shaped and panned. The proofing of dough is carried out for 55 min at 42◦C and 85% relative humidity (RH). The bread loaves are subsequently baked at 230◦C for 18 to 20 min, cooled, sliced and wrapped.

2.2.2 Liquid fermentation process

Principle of this method is same as sponge and dough method, except that it uses a liquid instead of plastic sponge.

2.2.3 Straight dough method

All formula ingredients are mixed in single step at the mixer. The dough is mixed to a full gluten development and then fermented. Fully fermented dough is then handled same as sponge and dough method. This procedure is used by retailers or for specialty breads.

2.2.4 No-time dough process

This method is same as straight dough method, except mixing is carried out mainly mechanically by the action of high-energy input of special mixers. This mixing step is further enhanced by addition of various ingredients such as Lcysteine, yeast foods and proteolytic enzymes. The mixed dough is given short or no fermentation, then divide, rounded, moulded, proofed and baked. This method is suited for frozen dough manufacturing and retail bakeries.

2.2.5 Frozen dough method

Frozen doughs are used for baking in in-store bakeries. Frozen doughs are generally manufactured by a straight dough method. The dough units are immediately frozen using fast freezers to a core temperature of 7◦C, then stored at 15◦C. In in-store bakeries the doughs are deposited in a retarder at 1 to 4◦C, then proofed at 32 to 43◦C for 75 to 90min and baked. The expected shelf-life of frozen dough is about 8 to 12 weeks.

2.2.6 Continuous bread process

In this method the dough is prepared continuously and automatically in enclosed chamber. This process introduced in United States is represented by two systems: Do-maker process developed by John C. Baker and Amflow process which was introduced by American Machine and Foundry Co. In both the methods high amounts of oxidants are required due to high mechanical dough abuse during mixing and extrusion operations.

2.2.7 Chorleywood process

This process is used widely world over. It was originated in United Kingdom. The basic principle is closed high-speed mixer with special mixer configuration blades. The mixing is generally accomplished under vacuum. Two types are mixers are widely used: Tweedy and Stephan. The oxidants used in this process are ascorbic acid and azodicarbonamide (ADA).

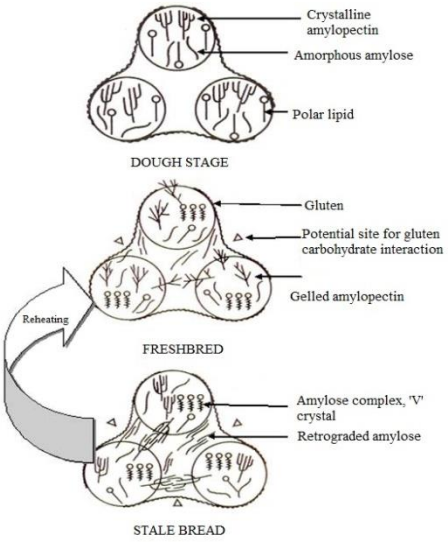
2.2.8 Staling of Bread

Bakery products undergo physic-chemical, sensory and microbial changes during storage. The generic term for this is staling. Staling means series of changes that causes a decrease in consumer acceptance other than that resulting from the action of spoilage microorganisms. The typical characteristics of staling of bread are that, the crust looses crispness and crumb becomes firm. Other associated changes are loss of flavour and emergence of stale flavor. The main cause for staling of bread is moisture migration from crumb to crust. The complete mechanism of staling of bread is not yet understood. But the theory given by Schoch and French is the most accepted one. According to this theory, retrogradation of starch is the underlying reaction of staling.

Starch gelatinizes during baking and amylose is leached out. Amylose component crystallizes upon cooling and impart firmness to the bread, which is an indication of freshness of the bread. During storage amylopectin retrogradation proceeds slowly and causes firming of the bread. This process is heat-reversible because retrograded amylopectin can be reverted to its amorphous state, which reduces firmness. Zobel and Kulp have described physico-chemical changes of the starch granule which is shown in Fig. 11.3

2.2.9 Ropy Bread

Bread ropiness is caused if the bread dough is contaminated with *B. mesentericus*. The spores of the bacteria are not killed during baking. A sticky, gummy material which can be pulled into threads develops in the centre of the loaf within 1 to 3 days after baking. The bread also develops an off-flavour.



MECHANISM OF BREAD STALING

2.3 Bread Manufacturing

Production of bread consists of number of steps. The flow diagram for manufacture of bread given below.

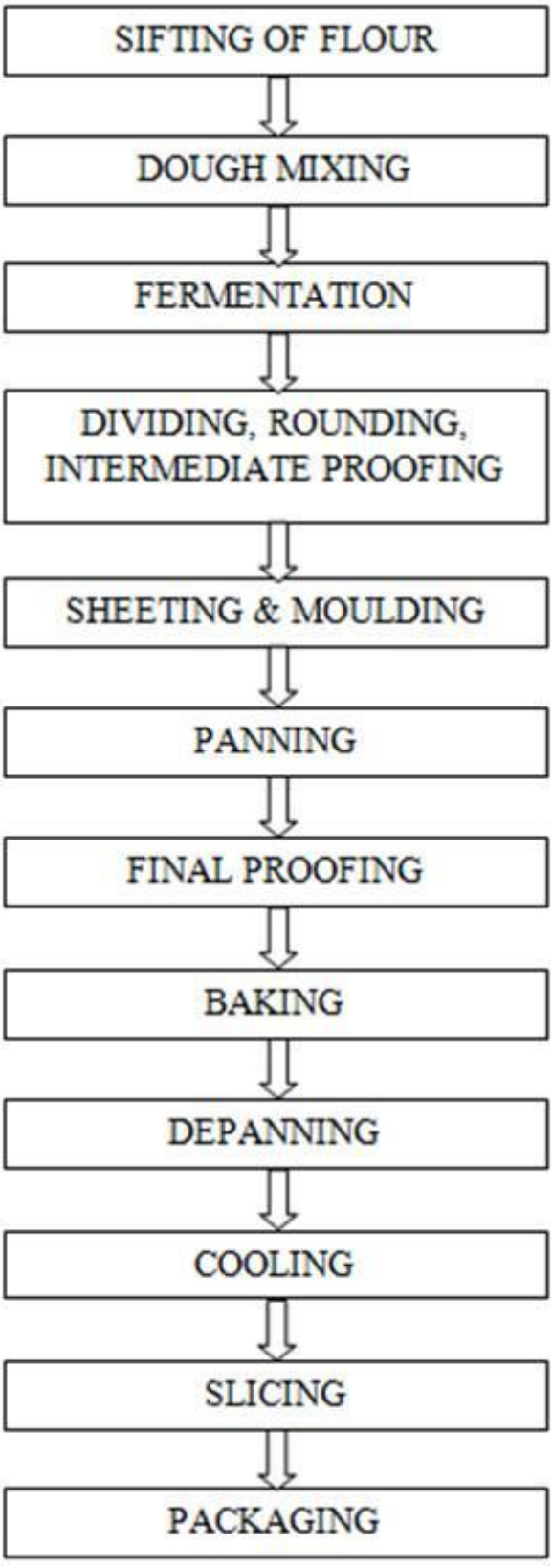
The first step of bread making involves sifting of flour to remove any foreign matter and coarse particles, and to aerate and make the flour more homogeneous. The next step is dough mixing, which is accomplished by various methods of preparation of dough. Once the dough is formed, it is divided into pieces of requisite size. The divided dough is rounded to a ball shape and then passed through intermediate proofer, where the roughly stretched gluten fiber get time to recover their extensibility so that they can be moulded well without breaking the surface skin. After intermediate proving, the dough is passed through a set of pairs of roller to form a sheet. The sheeted dough is now passed through pressure board to get moulded into cylindrical shape.

The moulded dough pieces are then placed into greased individual bread baking tins. The panned dough pieces are then passed through final prover under controlled temperature and humidity. After complete proofing, the dough tins are transferred to the baking oven. Once baking is completed, the breads are de-panned, cooled and then sliced. Sliced breads are then packaged in suitable packaging material, generally polypropylene pouches.

2.3.1 Milk Bread Formulation

S.No.	Ingredients	Actual Weight in gms.
1)	Flour	1000 g
2)	Milk Powder	25 g
3)	Sugar	250 g
4)	Yeast (C)	15 g
5)	Water	550 ml
6)	Shortening	50 g
7)	Bread Improver	3.0 g
8)	Salt	10 g

2.3.2 Flow Diagram for Bread Manufacturing



2.4 BREAD MAKING PROCEDURE

The following steps are generally considered essential for the production of good quality bread.

2.4.1 SIEVING

The flour is generally sieved before using in bread primarily for following reasons:

1. To aerate the flour
2. To remove coarse particles and other impurities
3. To make flour more homogeneous.

2.4.2 WEIGHING

The next step is weighing of different ingredients as per formulation. Minor ingredients have to be weighed more precisely. Salt, sugar, oxidizing agents and yeast are added in solution form. Yeast is added as a suspension, which is mixed well each time before dispensing. Sequence of addition of ingredients also affects the dough characteristics. Generally shortening and salt are added after the clean up stage.

2.4.3 MIXING

Mixing of flour and ingredients involves i.e. hydration & blending, dough development and dough breakdown. The process of mixing begins with hydration of the formula ingredients. The mixing, whilst the flour is hydrating, brings about development of the gluten network in dough, which is evidenced as an ascending part of the mixing curve. The dough system subsequently becomes more coherent, losing its wet and lumpy appearance, and it achieves a point of maximum consistency or minimum mobility. This is the point to which dough should be mixed for producing bread of superior loaf quality. At this stage the dough is converted into a viscoelastic mass from thick and viscous slurry. At this stage the gluten forms a continuous film or sheet suitable for processing into bakery applications. If mixing is continued beyond this point, mechanical degradation of the dough occurs resulting in the breaking down of the dough network. Eventually the dough becomes wet, sticky and extremely extensible, and is capable of being drawn out into long strands. This is generally referred to as the dough being ‘broken down’. Such dough will create problem in dough handling and frequent break down in the plants and ultimately results into processing losses.

2.4.4 FERMENTATION

Optimally mixed dough is subjected to fermentation for a suitable length of time to obtain light aerated porous structure of fermented product. Fermentation is achieved by yeast (*Saccaromyces*

cerevisiae). The yeast in dough breaks down the sugars to carbon dioxide and ethanol. The gas the dough into foam. The foam structure of dough is discrete and has stability during fermentation. When fermented dough is baked, the foam structure gets converted into sponge structure that is responsible for aerated structure of breadcrumb. The conditions under which fermentation occurs affect the rate of carbon dioxide production and flavour development in the dough. The temperature and relative humidity conditions are particularly important for yeast activity and gas production. In the temperature range of 20 to 40ºC, the yeast fermentation rate is doubled for each 10ºC rise in temperature. Above 40ºC yeast cells are started to get killed. The yeast performs well at 30-35ºC and relative humidity of 85 % and above. The optimum pH range for yeast is 4 to 6. Below pH 4 the yeast activity begins to diminish and it is inactivated below pH 3. Osmotic pressure also affects the activity of yeast.

2.4.5 KNOCK BACK

Punching of dough in between the fermentation periods increases gas retaining capacity of the dough. The knock back has the objectives of equalizing dough temperature throughout the mass, reducing the effect of excessive accumulation of carbon dioxide within the dough mass and introduces atmospheric oxygen for the stimulation of yeast activity. The knock back also aids in the mechanical development of gluten by the stretching and folding action. Usually knock back is done when 2/3 of the normal fermentation time is over.

2.4.6 DOUGH MAKE-UP

The function of dough make-up is to transform the fermented bulk dough into properly sealed and moulded dough piece, when baked after proofing it yields the desired finished product. Dough make-up includes (a) scaling; (b) rounding, inter-mediary proof and moulding.

2.4.7 Scaling or dividing

The dough is divided into individual pieces of predetermined uniform weight and size. The weight of the dough to be taken depends on the final weight of the bread required. Generally, 12% extra dough weight is taken to compensate for the loss. Dividing should be done within the shortest time in order to ensure the uniform weight. If there is a delay in dividing, corrective steps should be taken either by degassing the dough or increasing the size of the dough. The degassers are essentially dough pumps which feed the dough into the hopper and in the process remove most of the gas. The advantages of using degassers are: (i) more uniform scaling, (ii) uniform pan flows and (iii) uniform grain and texture of bread.

2.4.8 Rounding

When the dough piece leaves the divider, it is irregular in shape with sticky cut surfaces from which the gas can readily diffuse. The function of the rounder is to impart a new continuous surface skin that will retain the gas as well as reduce the stickiness thereby increasing its handling. Rounder are of two types i.e. umbrella and bowl type.

2.4.9 Intermediate proofing

When the dough piece leaves the rounder, it is rather well degassed as a result of the mechanical it received in that machine and in the divider. The dough lacks extensibility and tears easily. It is rubbery and will not mould easily. To restore more flexible, pliable structure which will respond well to the manipulation of moulder, it is necessary to let the dough piece rest while fermentation proceeds. Intermediate proofer contains a number of trays that are chain driven. The dough piece is deposited in the tray with completed number of laps at predetermined rate. Average time at this stage ranges from 5 to 20 min.

2.4.10 Moulding

The moulder receives pieces of dough from the inter-mediate proofer and shapes them into cylinders ready to be placed in the pans. Moulding involves three separate steps; (i) sheeting; (ii) curling; and (iii) scaling. Sheeter degasses the dough and sheeted dough can be easily manipulated in the later stages of moulding. Sheeting is accomplished by passing the dough through 2 or 3 sets of closely spaced rolls that progressively flatten and degas the dough. The first pair of rolls is spaced about 0.25" apart where the degassing takes place. The successive two rollers are spaced 0.125" and 0.06" apart for optimum grain and texture development in the finished products. The sheeted dough piece next enters the curling section. A belt conveyor under a flexible woven mash chain that rolls into a cylindrical form carries the sheeted dough. The rolling operation should produce a relatively tight curl that will avoid air entrapment. The curled dough piece finally passes under a pressure board to eliminate any gas pockets with in and to seal the same.

2.4.11 Panning

The moulded dough pieces are immediately placed in the baking pans. Panning should be carried out so that the seam of the dough is placed on the bottom of the pan. This will prevent subsequent opening of the seam during proofing and baking. Optimum pan temperature is 90°F.

2.4.12 PROVING OR PROOFING PROCESS

Proving or proofing refers to the dough resting period during fermentation after moulding has been accomplished and moulded dough pieces are placed in bread pans or tins. During this resting period the fermentation of dough continues. The dough finally proofed or fermented in baking pan for desired dough height. It is generally carried out at 30-35ºC and at 85% relative humidity. Proofing takes about 55-65 minutes. During proofing the dough increases remarkably in volume. The dough expands by a factor of 3-4 during proofing. During proofing care has to be taken that the skin of dough remains wet and flexible so that it does not tear as it expands. A high humid condition is also required to minimise weight loss during proving. Temperature, humidity and time influence proofing. Proof temperature depends on the variety of factors such as flour strength, dough formulation with respect to oxidants, dough conditioners, type of shortening, degree of fermentation and type of product desired. During proofing lower humidity gives rise to

dry crust in the dough. Excessive humidity leads to condensation of moisture. Dough is generally proved to a constant time or constant height.

2.4.13 THE BAKING PROCESS

After proofing the dough is subjected to heat in a baking oven. Baking temperature generally varies depending up on oven and product type but it is generally kept in the range of 220-250ºC. During baking the temperature of dough centre reaches to about 95ºC in order to ensure that the product structure is fully set. When the dough is placed in the oven, heat is transferred through dough by several mechanisms such as convection, radiation, conduction, and condensation of steam and evaporation of water. Heat transfer inside dough is said to occur through the mechanism of heat conduction and evaporation/condensation. The baking time of bread may range from 25 to 30 minutes depending up on size of bread loaf. After baking, bread is cooled prior to packaging to facilitate slicing and to prevent condensation of moisture in the wrapper. Desirable temperature of bread during slicing is 95-105°F.

Kneader

Moulder

Slicer

Rotary Oven

CHAPTER 3

PACKAGING OF MILK BREAD

3.1 Introduction to Packaging

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.

3.2 Packaging Material Used for Bakery Products

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

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

3.3 Techniques for packaging of bakery products

3.3.1 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.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 Modified atmosphere packaging (MAP)

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

MAP gas mixture for bakery products

Food	**Gas mixture**		**Storage Temperature ◦C**	**Shelf life**	
	CO2	**N2**		**MAP**	**In air**
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

3.4 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.

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

Bakery products	Packaging material (Thickness)	Gas permeability (cm3/m2.day.atm)WVP (g/ m2.day)	Packaging conditions
Bread	Laminate with EVAL	CO2 = 2.3 O2 = 0.45	
Bread	PE		Air+Ca-propionate
Wheat bread	Laminate with EVAL (95µm)	O2<2 CO2<2.3 WVP<1	Air; 100 CO2; 50% CO2+ 50% N2
White bread	PP film		AP:O2absorbent
White bread	PE		AP:O2-absorbers+ K-sorbate
Bread slices	CryovacR BB4L bag (60µm)	O2=35 CO2=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)	O2=3 WVP=1 O2=2 WVP=7 O2=3 WVP=1.5	AP:O2-absorbers AP: mustard oil AP: mustard oil + different MAP 80% CO2+1%O2+AP: mustard oil in 96% ethanol; Air

With respect to shelf life, key factors include the moisture content (or aw), 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.

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

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.

CHAPTER 4

FOOD SAFETY AND STANDARDS

4.1 FSSAI STANDARDS, REGULATIONS, LICENSING

BREAD whether sold as white bread or wheat bread or fancy or fruity bread or bun or masala bread or milk bread or of any other name, shall mean the product prepared from a mixture of wheat atta, maida, water, salt, yeast or other fermentive medium containing one or more of the following ingredients, namely:-

Condensed milk, milk powder (whole or skimmed), whey, curd, gluten, sugar, gur or jaggery, khandsari, honey, liquid glucose, malt products, edible starches and flour, edible groundnut flour, edible soya flour, protein concentrates and isolates, vanaspati, margarine or refined edible oil of suitable type or butter or ghee or their mixture, albumin, lime water, lysine, vitamins, spices and condiments or their extracts, fruit and fruit product (Candied and crystallized or glazed), nuts, nut products , oligofructose (max 15%) and vinegar: Provided that it may also contain food additives specified in these regulations including Appendix A:

Provided further that it may also contain artificial sweetener as provided in regulation 3.1.3 of this regulation and label declaration in Regulation 2.4.5 (24, 25, 26, 28 & 29) of Food Safety and Standards (Packaging and Labeling) Regulations, 2011.

Provided also that it shall conform to the following standards, namely:—

(a) alcoholic acidity (with 90 per cent alcohol) Shall be not more than equivalent of 7.5 ml. N NaOH per 100 g of dried substances.
(b) ash insoluble in dilute HCL on dry weight basis —

(i) bread except masala bread or fruit bread Not more than 0.1 per cent
(ii) ma sala bread or fruit bread Not more than 0.2 per cent

Provided also that it shall be free from dirt, insect and insect fragments, larvae, rodent hairs and added colouring matter except any permitted food colours present as a carry over colour in accordance with the provision in regulation 3.1.17, in raw material used in the products.

Provided also that bread may contain baker's yeast at the levels required under "good **manufacturing Practices]** It may contain Oligofructose (dietary fibres) upto 15% maximum subject to label declaration under labelling regulation 2.4.5 (43) of Food Safety and Standards (Packaging and Labeling) Regulations, 2011.

7.0 Bakery wares

7.1 Bread and ordinary bakery wares and mixes

Includes all types of non-sweet bakery products and bread-derived products.

7.1.1 Breads and rolls

Includes yeast-leavened and specialty breads like white or brown or multigrain bread and Indian breads (like kulcha, chapatti, roti, parantha, nan, pav etc.), wheat rolls, milk rolls, challa bread, pizza-base or pizza-bread, soda bread etc.

7.1.1.1 Yeast-leavened breads and specialty breads

Includes all types of non-sweet bakery products and bread-derived products such as include white bread, rye bread, pumpernickel bread, raisin bread, whole wheat bread, pain courant francais, malt bread, hamburger rolls, whole wheat rolls, and milk rolls.

Food Category System	Food Category Name	Food Additive	INS No	Recommended maximum level	Note
7.1	**Bread and ordinary bakery wares and mixes**	Acesulfame Potassium	950	1,000 mg/kg	188
		Aspartame	951	4,000 mg/kg	191
		Ammonium Persulfate	923	2,500 mg/kg	
		Brilliant blue FCF	133	100 mg/kg	
		Diacetyltartaric and fatty acid esters of glycerol	472e	6,000 mg/kg	
		Neotame	961	70 mg/kg	

		Sucralose (Trichlorogalactosucrose)	955	650 mg/kg	
		Tartaric acid	334	GMP	
		Sucrose esters of fatty acid	473	GMP	
		Sodium stearoyl-2-lactylate	481(i)	5,000 mg/kg	Singly or in combination
		Calcium stearoyl-2- lactyalate	482(ii)	5,000 mg/kg	
		Polyglycerol esters of interesterified ricinoleic acid	476	2,000 mg/kg	
		Acid calcium Phosphate	341	10,000 mg/kg	
		Sodium diacetate	262(ii)	4,000 mg/kg	
		Acid sodium Pyrophosphate	450	5,000 mg/kg	
		L- Cysteine monohydrochloride	920	90 mg/kg	
		Curcumin	100	GMP	
		Benzoyl peroxide	928	80 mg/kg	
		Acid calcium Phosphate	341	10,000 mg/kg	
7.1.1	**Bread and rolls including yeast leavened breads, specialty breads and soda breads**	Mineral oil, medium viscosity	905e	3,000 mg/kg	36, 126
		Xylanase		GMP	Only for breads, FS03
		POLYSORBATES		3,000 mg/kg	
		Tertiary butylhydroquinone (TBHQ)	319	200 mg/kg	195, 15
		PHOSPHATES		9,300 mg/kg	229,33

4.2 Food Safety

Part I - General Hygienic and Sanitary practices to be followed by Petty Food Business Operators applying for Registration (See Regulation 2.1.1(2))

SANITARY AND HYGIENIC REQUIREMENTS FOR FOOD MANUFACTURER/ PROCESSOR/HANDLER

The place where food is manufactured, processed or handled shall comply with the following requirements:

1. The premises shall be located in a sanitary place and free from filthy surroundings and shall maintain overall hygienic environment. All new units shall set up away from environmentally polluted areas.

2. The premises to conduct food business for manufacturing should have adequate space for manufacturing and storage to maintain overall hygienic environment.

3. The premises shall be clean, adequately lighted and ventilated and sufficient free space for movement.

4. Floors, Ceilings and walls must be maintained in a sound condition. They should be smooth and easy to clean with no flaking paint or plaster.

5. The floor and skirted walls shall be washed as per requirement with an effective disinfectant the premises shall be kept free from all insects. No spraying shall be done during the conduct of business, but instead fly swats/ flaps should be used to kill spray flies getting into the premises. Windows, doors and other openings shall be fitted with net or screen, as appropriate to make the premise insect free The water used in the manufacturing shall be potable and if required chemical and bacteriological examination of the water shall be done at regular intervals at any recognized laboratory.

6. Continuous supply of potable water shall be ensured in the premises. In case of intermittent water supply, adequate storage arrangement for water used in food or washing shall be made.

7. Equipment and machinery when employed shall be of such design which will permit easy cleaning. Arrangements for cleaning of containers, tables, working parts of machinery, etc. shall be provided.

8. No vessel, container or other equipment, the use of which is likely to cause metallic contamination injurious to health shall be employed in the preparation, packing or storage of food. (Copper or brass vessels shall have proper lining).

9. All equipments shall be kept clean, washed, dried and stacked at the close of business to ensure freedom from growth of mould/ fungi and infestation.

10. All equipments shall be placed well away from the walls to allow proper inspection.

11. There should be efficient drainage system and there shall be adequate provisions for disposal of refuse.

12. The workers working in processing and preparation shall use clean aprons, hand gloves, and head wears.

13. Persons suffering from infectious diseases shall not be permitted to work. Any cuts or wounds shall remain covered at all time and the person should not be allowed to come in direct contact with food.

14. All food handlers shall keep their finger nails trimmed, clean and wash their hands with soap, or detergent and water before commencing work and every time after using toilet. Scratching of body parts, hair shall be avoided during food handling processes.

15. All food handlers should avoid wearing, false nails or other items or loose jewellery that might fall into food and also avoid touching their face or hair.

16. Eating, chewing, smoking, spitting and nose blowing shall be prohibited within the premises especially while handling food.

17. All articles that are stored or are intended for sale shall be fit for consumption and have proper cover to avoid contamination.

18. The vehicles used to transport foods must be maintained in good repair and kept clean.

19. Foods while in transport in packaged form or in containers shall maintain the required temperature.

20. Insecticides / disinfectants shall be kept and stored separately and `away from food manufacturing / storing/ handling areas.

4.3 LABELLING

Labeling Requirements

All food products sold in India that are prepackaged are required to comply with the Food Safety and Standards (Packaging and labelling) Regulations, 2011. The Food Safety and Standards Regulation, 2011 is a notification issued by the Food Safety and Standards Authority of India under the Ministry of Health and Family Welfare. In this article, we look at the regulations pertaining to food labelling in India.

Applicability of Food Labelling Regulations

The food labelling regulations require all “Prepackaged” or “Pre-packed food” to comply with the labelling regulations in India. As per the rules, prepackaged food means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.

General Labelling Requirements

The following labelling requirements must be complied with by all prepackaged food sold in India:

- The label must be in English or Hindi or Devnagri language. In addition to the above, the label can contain information in any other language, as required.
- The label must not contain information about the food that could be deemed to be false, misleading, deceptive or otherwise create an erroneous impression regarding the product.
- The label must be affixed to the container in such a manner that it would not easily be separated from the container.
- The contents or information presented in the label should be clear, prominent, indelible and readily legible by the consumer.
- If the container is covered by a wrapper, then the wrapper must contain necessary information or make the label of the product inside readily legible by not obscuring.
- The name of the food must be mentioned along with the trade name and description of the food contained. In case the food contains more than one ingredient, then a list of ingredients must be presented in descending order of their composition by weight or volume, as the case may be, at the time of its manufacture;

Nutritional Information

Nutritional Information or nutritional facts per 100 gm or 100ml or per serving of the product must be given on the label along with the following information:

- energy value in kcal;
- the amounts of protein, carbohydrate (specify the quantity of sugar) and fat in gram (g) or ml;
- the amount of any other nutrient for which a nutrition or health claim is made:

- It is important to note that any “health claim” or “nutrition claim” or “risk reduction” claim made in the label will be thoroughly scrutinized by the FSSAI authorities. Hence, any such claim must be validated by test data. As per the rules, the following is the definition for “health claim”, “nutrition claim” and “risk reduction” claim:

- “Health claims” means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health and include nutrition claims which describe the physiological role of the nutrient in growth, development and normal functions of the body, other functional claims concerning specific beneficial effect of the consumption of food or its constituents, in the context of the total diet, on normal functions or biological activities of the body and such claims relate to a positive contribution to health or to the improvement of function or to modifying or preserving health, or disease, risk reduction claim relating to the consumption of a food or food constituents, in the context of the total diet, to the reduced risk of developing a disease or health-related condition;

- “Nutrition claim” means any representation which states, suggests or implies that a food has particular nutritional properties which are not limited to the energy value but include protein, fat carbohydrates, vitamins and minerals;

- “Risk reduction” in the context of health claims means significantly altering a major risk factor for a disease or health-related condition;

Veg or Non-Veg Symbol

All packaged food that is “Non-Vegetarian” must have a symbol that is a brown colour filled circle inside a square with a brown outline. If a food contains only egg as a non-vegetarian ingredient, then the manufacturer may provide a declaration that the product contains only egg and add the non-vegetarian symbol.

Non-Veg Symbol

Packaged vegetarian food should have a symbol that consist of green colour filled circle inside a square with green.

Veg Symbol

Information Relating to Food Additives, Colours and Flavours

Food additives contained in the food product must be mentioned along with class titles along with the specific names or recognized international numerical identifications. Addition of colouring matter should be mentioned on the label along with certain statements like “CONTAINS PERMITTED NATURAL COLOUR(S)”, just beneath the list of the ingredients on the label. In case of addition of extraneous flavouring agent, then it should be mentioned in a statement like “CONTAINS ADDED FLAVOUR” just beneath the list of ingredients on the label.

Name and Complete Address of the Manufacturer

The name and complete address of the manufacturer must be mentioned on every package of food. In the case of imported food, the package must contain the name and complete address of the importer in India.

Net Quantity

All packaged food must carry the bet quantity by weight or volume or number, as the case may be. The net quantity of the commodity contained in the package must exclude the weight of the wrappers and packaging materials.

Lot Number of Batch Identification

A lot number or batch number or code number must be mentioned on all packaged food so that it can be traced while manufacturing and distribution. Only bread and milk including sterilised milk are not required to comply with this regulation.

Date of Manufacture or Packing

The date, month and year in which the commodity is manufactured, packed or pre-packed must be mentioned on the label. In the case of food products having a shelf life of more than three months, then the month and the year of manufacture can be given with the “Best Before Date”. In case of products having a shelf life of fewer than three months, the date, month and year in which the commodity is manufactured or prepared or pre-packed must be mentioned on the label with best before date.

Country of Origin for Imported Food

For imported food, the country of origin of the food should be declared on the label of the food. In case a food product undergoes processing in a second country which changes its nature, the country in which the processing is performed should be considered to be the country of origin for the purposes of labelling.

Instructions for Use

Instructions for use, including reconstitution, should be included on the label, if necessary, to ensure correct utilization of the food.

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