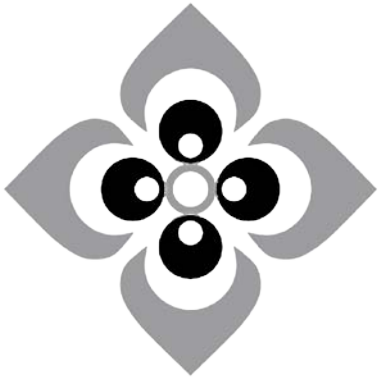

Consortium for Educational Communication

Module
on
Bread Making Processes

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TEXT

Introduction

Bread is a staple foodstuff made and eaten in most countries around the world. It is eaten as a snack, and used as an ingredient in other culinary preparations, such as sandwiches, and fried items coated in breadcrumbs to prevent sticking. Bread is an elastic solid foam, the solid part of which contains a continuous phase composed of an elastic network of cross-linked gluten molecules and leached starch molecules, primarily amylose and a discontinuous phase of entrapped, gelatinized, swollen, deformed starch granules. The main ingredient in bread making includes wheat flour, yeast, salt and water. Other ingredients that may be added include fat, sugar, milk and milk product, soya flour, emulsifiers, oxidants (such as ascorbic acid and potassium bromate), and anti-microbial agents. Each of the main ingredients has specific role to play in bread making. Wheat flour is best adopted for bread making as it contains gluten in the right proportion to make the spongy loaf. It is primarily responsible for bread structure and bite characteristics. Water transforms flour into viscoelastic dough that retains gas produced during fermentation and also provides medium of all chemical reaction to occur. Yeast ferment sugars and produces carbon dioxide, gas, and ethanol. It, thus, gives porous and leavened bread. Salt enhances flavor and strengthens the gluten network in the dough.

Bread making procedure

The following main steps are involved in the production of bread:

1. Ingredient weighing

Ingredients are weighed manually and added to the mixer. Salt, sugar, oxidizing agents and yeast are added in solution form. Generally shortening and salt are added after the clean up stage.

2. Mixing

Mixing serves three main functions:

a) To hydrate and blend the dough ingredients.

b) To aerate the dough. Air is essential for introduction of gas cells into which the carbon dioxide produced by the yeasts during fermentation diffuses, as yeasts cannot produce new gas cells.

c) To form a visco-elastic mass that is able to retain gas without rupturing.

The mixing process, while the flour is hydrating, brings about development of the gluten network in dough, and transforms thick and viscous slurry into a coherent mass. At this stage the gluten forms a continuous film or sheet suitable for processing into bread. If mixing is continued beyond this point, mechanical degradation of the dough occurs resulting in the breaking down of the dough network. The mixing time varies with the type of flour, type of mixer, speed of mixing arm, presence of salt or shortening, additive, particle size as well as damaged starch content of flour. The mixers commonly used for mixing of wheat dough are classified as: Low speed mixer, Spiral mixers, High speed and twin-spiral mixers, Chorleywood bread process compatible mixers.

3. Fermentation

The main purpose of fermentation is to obtain light aerated porous structure of bread and to develop flavour. Fermentation is achieved by yeast (*Saccharomyces cerevisiae*). Yeasts ferment sugars and continuously produce carbon dioxide in the aqueous dough phase. When the aqueous dough phase is saturated with carbon dioxide, most of the carbon dioxide diffuses into the air cells that are formed in the dough during mixing. The diffusion of carbon dioxide into gas cells increases the pressure within gas cells that provides the driving force for dough expansion. The gas formation results in the transformation of dough into foam. When fermented dough is baked, the foam structure gets converted into sponge structure that is responsible for aerated structure of breadcrumb. The temperature and relative humidity conditions

are particularly important for yeast activity and gas production. The yeast performs well at 30-35ºC and relative humidity of 85 % and above. Above 40ºC yeast cells get killed. The optimum pH range for yeast is 4 to 6.

4. Knock back

Knock back or punching of dough in between the fermentation periods increases gas retaining capacity of the dough, even out temperature variation, expel gas, subdivide gas cells, 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.

5. 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 dividing, rounding, first proof and moulding.

a. Dividing or scaling:

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.

b. Rounding

Rounding is done to set up the shape of dough pieces so that it 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.

c. First proof

To allow stresses in dough to relax, and improve handling properties, dough is rested

for some time. Average time at this stage ranges from 5 to 20 min.

d. Moulding

To convert dough pieces into cylindrical shape with appropriate internal structure. Moulding involves three separate steps; (i) sheeting; (ii) curling; and (iii) scaling.

e. 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.

6. Proving or Proofing

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. It is generally carried out at 30-35ºC and at 85% relative humidity. Proofing takes about 55-65 minutes. Proofing allows the dough to rise through the action of yeast producing carbon dioxide.

7. Baking process

To set loaf structure and develop baked flavor and color, 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. 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. The baking time of bread may range from 25 to 30 minutes depending up on size of bread loaf.

8. Cooling, slicing, and wrapping

After baking, bread is cooled prior to packaging to facilitate slicing and to prevent condensation of moisture. The bread is allowed to cool for 2 hours in cold air. For slicing reciprocating frame of blades followed by automatic wrapping is used. Packaging of bread must ensure hygiene, conserves moisture and prevents staling to keep it in as fresh a condition as possible.

Bread making processes

The processes used for commercial production of bread may be classified into three broad processing groups:

1. Long fermentation processes: In these processes prolonged fermentation period is given to the dough. It includes Straight dough bulk fermentation process and Sponge & dough process.

2. Rapid processes: In these methods a very short or no period of bulk fermentation is given to the dough. It includes activated dough development (ADD), and The Dutch green dough process.

3. Mechanical dough development process: Dough development is achieved during mixing by intense mechanical working of the dough using high-speed mixers. It includes Chorleywood bread process (CBP) frozen dough process, and microwave process

- **Straight dough bulk fermentation process**

This major traditional bread making process is the bulk fermentation process, in which dough mass is allowed to ferment over a lengthy period of time. The three essential features of bulk fermentation are:

1. Mixing of all the ingredients usually at slow speed (mixer or by hand) to form homogeneous dough.

2. Resting of the dough in bulk for a prescribed period of time (1-3 hr), during which yeast ferments to inflate the dough mass.

3. Punching or knock back to even out the temperature and increase the number of gas cells.

During bulk fermentation the dough develops by enzymatic action. The purpose of bulk fermentation period is partly flavor development and primarily for developing the dough protein structure so that it is better to retain gas during proving without subsequent coalescence. The slow inflation during bulk fermentation stretches the dough proteins biaxially, so that they align into a cooperative network that imparts superior elasticity and extensibility to the dough.

Ingredients weighing

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Mixing (slow mixing possibly by hand)

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Bulk fermentation (1-3 hr, 21-27°C)

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Punching

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Dividing & first proof (25 min)

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Moulding, piecing, & panning

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Final proofing (55 min)

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Baking

Fig.1. Straight dough bulk fermentation bread process

- **Sponge and dough bulk fermentation process**

In this process a part of flour (generally two-thirds), part of water and yeast are mixed just to form loose batter or dough (sponge) and is allowed to ferment for up to 5hr. This is followed by, mixing of the sponge with the remainder of the ingredients to develop the dough. And immediate processing of the developed dough with a short period of bulk fermentation period.

Weigh part of flour, water and whole yeast

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Mixing (sponge)

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Fermentation (3-5 hr)

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Add rest of ingredients & develop the dough

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Rest for 40 min

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Dividing & First proofing (20 min)

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Moulding, piecing, & panning

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Final proofing (55min)

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Baking

Fig.2. Sponge and dough bulk fermentation process

Advantages of bulk fermentation processes

1. Taste of bread is superior.

2. Cell structure of breadcrumb is more preferred.

3. Lesser requirement of chemicals and yeast as time available is sufficient for dough ripening.

4. Less cost of plant & machinery as simpler & less sophisticated equipments such as low speed mixers are used.

Disadvantages

1. More space requirement for processing.

2. Time consuming.

3. More expenses on labor hiring.

4. Product quality may vary from batch to batch due to poor process control.

- **Activated dough development (ADD)**

In ADD the dough development is achieved by the use of a rapid –acting reducing agent generally L-cysteine Hydrochloride and a relatively slow-acting oxidizing agent, potassium bromate or a mixture of potassium bromate and ascorbic acid. The reducing agent accelerates the uncoiling and reorientation of the protein molecules and the oxidizing agent follows up by stimulating the formation of cross-links to stabilize the desired elastic three-dimensional gluten network. Since the dough development process in ADD is mainly chemically induced, so low-speed mixers could be employed. However, extra water in the dough to compensate for the lack of natural softening and

extra yeast (1-2%) to maintain normal proving times is required in ADD.

- **The Dutch green dough process**

In this process the dough after mixing passes without delay to dividing, with some resting of dough is involved in the total process. The essential features of the process are:

1. Mixing in a spiral-type mixer or extra mixing in a speeded-up conventional low-speed mixer.

2. Dividing of dough immediately after mixing.

3. The dough is then rounded and given a resting period of 35-40 min.

4. The dough is re-rounded and given a further resting period before final moulding.

The name ‘green’ dough refers to the fact that after mixing the dough is considered to be underdeveloped or ‘green’ in bakery units. Dough development continues in the resting periods or fermentation period after each rounding. When first introduced, two or three resting periods were used. Now it is more common to use one, but to a lesser extent two resting periods.

- **Chorleywood bread process (CBP)**

In the CBP the development of optimum dough qualities is achieved in the mixer by transferring a defined energy input to the dough. The essential features of the CBP are:

1. Mixing and dough development in a single operation lasting between 2 - 5 minutes to a fixed energy input.

2. A combination of fast and slow acting oxidizing agents such as potassium bromate and potassium iodate.

3. The inclusion of a high melting point fat, emulsifier or fat and emulsifier combination.

4. The addition of extra water to adjust dough consistency.

5. The addition of extra yeast to maintain final proof times

In CBP the high speed mixing brings ingredient molecules in close contact, inclusion of air for production of gas cells, and breaks the di-sulphide bonds. As a result the development of protein network in the dough is achieved within 5 min of starting the mixing process.

- **Frozen dough process**

This process is generally used for retail or household baking for fresh bread, rolls and Danish pastries. The frozen dough require longer proof time due to decreased yeast cells during freezing cycle. The dough is made usually from strong flour or by using additional vital dry gluten. The presence of emulsifiers and oxidants overcome the deleterious effect during freezing.

- **Microwave process**

In this process the use of microwave energy is used for baking bread. The heating depends greatly on moisture, mass, dielectric properties, geometry, etc. The microwaves fall in the frequency range of 300 MH (10^6) to 300 GHz (10^9). Heating is caused due to the ionic induction and

dipole movement influenced by rapidly changing polarity of electric field. The microwave heating is quite expensive in terms of equipment and operation cost.

Advantages of mechanical dough development & chemical dough development process

1. Less time consuming.

2. Less space occupied.

3. Improved process control and reduced wastage.

4. More consistent product quality.

Disadvantages:

1. Faster working of the dough is required because of the higher dough temperatures used.

2. Reduction of bread crumbs flavour because of the shorter processing times.

3. Use of chemicals not considered wholesome by consumers.