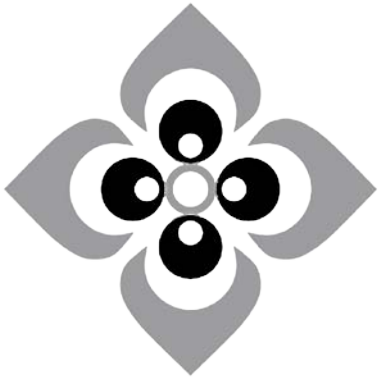

Consortium for Educational Communication

Module
on
Role Of Ingredients Used In Bread Making

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TEXT

I. Introduction and history of bread

Bread has played a key role in the development of mankind and is one of the principal sources of nutrition. Bread is one of the oldest prepared foods. Almost 30,000 years ago in Europe the presence of starch residue on rocks were found. Probably starch extract from the roots of plants was spread on a flat rock, and cooked into a primitive form of flatbread. Around 10,000 BC, with the dawn of agriculture, grains became the mainstay for making bread.

Various sources were available for making bread. Airborne yeasts were harnessed by leaving uncooked dough exposed to air before cooking. The foam skimmed from beer was used to produce a lighter kind of bread. Parts of the ancient world which consumed wine used a paste composed of juice and flour to initiate fermentation. Sometimes steeped wheat bran is used as a source for fermentation. In ancient time most common source of leavening was to retain a piece of dough from the previous day, to form sourdough.

The first commercial process was developed in 1961, which used the intense mechanical working of dough to reduce the period and the time taken to produce a loaf. This process, requires high-energy mixing and use of low protein grain, and is now widely used around the world in large factories. As a result, bread can be produced very quickly and at low cost to the manufacturer and the consumer.

Nutritionally, bread is known as good source of nutrition. Serving size of bread is standard in the USA through ounces, counting one slice of bread (white processed bread) as 1 oz (28.35gm). Bread being made from whole grains is considered as a good source of nutrients such as carbohydrates, magnesium, iron, selenium, B vitamins, and dietary fiber.

As wheat is predominantly milled for bread making, the general term baking quality refers to the specific properties of flour required for the production of leavened bread. Bread is made by different procedures which depend upon many factors including tradition, cost, type of energy available, the type and consistency of the flour available. It also depends on the type of bread desired and the time between baking and eating. Doughs are usually baked, but in some cuisines breads are steamed (e.g., mantou), fried (e.g., puri), or baked on an unoiled frying pan (e.g., tortillas). It may be leavened or unleavened (e.g. matzo). Salt, fat and leavening agents such as yeast and baking soda are common ingredients, though bread may contain other ingredients, such as milk, egg, sugar, spice, fruit like raisins, vegetables like onion, nuts such as walnut or seeds such as poppy.

II. Characteristics of wheat flour for bread making

Flour is the major ingredient of bread and is obtained through the milling process in which bran and germ part of the wheat grains are removed as far as possible. This is done to get the flour of desirable composition from baking point of view. The major components of flour are moisture (14 percent), starch (70 percent), protein (11.5 percent), ash (4 percent), sugar (1 percent) and fat (1 percent).

The flour should have color, strength, tolerance, high absorption and uniformity with following characteristics for the production of quality bread. These are explained here briefly.

1. **Colour:** Flour should have a creamy white appearance, without bran fragments otherwise the bread will have a dull white crumb. Bleaching of flour contributes towards the control of degree of creaminess.
2. **Strength:** The flour is referred as strong or weak. For the production of quality bread, strong flours needs a longer fermentation. Bread flour should have sufficient strength so that the dough made from it retains its shape during baking.
3. **Tolerance:** The ability of flour to withstand the fermentation process and to produce a satisfactory loaf over a period of time is defined as tolerance.
4. **High Absorption:** This refers to the ability of flour to hold the maximum amount of moisture without additional mixing for full development of dough. If the dough is not given the required mixing time because of limited mixing capacity, or for other reasons, the baked product will lack volume and have a dry crumb with inferior eating and keeping qualities.

   In considering bread-making flour, hard wheat with relatively high protein content is preferred. For a good quality loaf of bread, flour should contain approximately eight percent protein. If a flour has higher quantity and better quality gluten, it is called as strong flour. Dough prepared from strong flour has better gas retention capacity. Both the quantity and quality of protein is vital for the wheat flour to produce a quality loaf.

   Gas production is also a very important step for bread making process. For this purpose, the flour should have sufficient diastatic activity which depends upon the diastase enzyme. This enzyme converts flour starch into sugar.

III. Role of Ingredients for bread making

Bread making ingredients are divided as essential and optional ingredients.

Essential Ingredients: Ingredients which are must for making bread comes under this

category. They are flour, water, yeast, salt. If any one of these ingredients is missing, the product is not bread.

Optional ingredients: Sugar, fat, milk and milk products, oxidants, various enzyme preparations including malted grains, surfactants and additives to protect against molds are considered as optional ingredients for bread making.

Role of Essential Ingredients:

Let us learn in detail the role of each ingredient.

1) Water

It is an essential ingredient as without water, dough cannot be prepared.

Water has several functions in bread making. It is essential for the formulation of gluten. Gluten as such does not exist in flour. Only when flour proteins are hydrated, gluten is formed. Water helps in controlling the temperature of dough and its consistency. It helps in dissolving salts and suspends other non-flour materials uniformly in dough. Water wets and swells starch and is also required for activating enzymes. It makes the bread palatable. Water keeps the bread palatability longer, if sufficient water is allowed to remain in the finished loaf.

The water used should be fit to drink and free from contamination and disease forming bacteria. Water being a powerful solvent, has some dissolved minerals. These minerals have a beneficial effect on gas production as yeast requires them for vigorous gas production. Hard water which has high content of minerals should not be used as they have tightening effect on the gluten and retards fermentation. On the other hand, if soft water is used then the gas production and gas retention of the dough is poor. Thus, medium hard water yields excellent result in the bread production.

2) Yeast

Yeast is one of the fundamental ingredients. Its major function in bread making is to lighten the dough and to impart characteristic aroma and flavor. Yeast (*Saccharomyces cerevisiae*) is a source of several enzymes like zymase, lipase, protease, invertase, maltase, etc. Yeast utilize fermentable sugars in the fermentation process to produce carbon dioxide gas through the action of enzymes. During fermentation process, alcohol, gas (CO_2) and some acids are also produced which help in mellowing gluten and easy stretchability. The acids also add peculiar flavour to bread. For efficient action of yeast, sugars, nitrogen, minerals and vitamins are essential. The yeast is used in the form of compressed yeast or dried yeast. Compressed yeast has 30 percent solids and can be

stored for about 4 weeks under refrigeration i.e. 20°C.

3) Salt

Salt is added to impart taste to the bread. Salt is used at 1-2 percent level based on flour weight. It also enhance the taste of other ingredients and improves the flavor and characteristics of the bread. It has controlling effect on the activity of yeast and the rate of gas production. Salt also aids in preventing the formation and growth of undesirable bacteria in yeast-raised doughs. Salt makes the dough stronger and has tightening effect on the gluten proteins, which improves the gas retention of the dough. The strengthening effect of salt, improves the grain and texture of bread crumb.

Salt is hygroscopic and keeps the bread moist and fresh for longer time. Less salt increases the yeast activity, thus, more sugar will be needed for fermentation. This results in low availability of sugar for caramalization during baking forming bread with poor crust and colour and vice-versa.

Role of Optional Ingredients:

Sugar

It is used in bread production as nutrient for the yeast. It is the source of energy for yeast activity which produces carbon dioxide gas and is essential for imparting proper volume to the bread. It enhances the flavour of bread. It imparts golden brown colour to the crust of bread. The texture and grain become smoother and finer with added sugar. The added sugar in the formula is consumed in very short time by the yeast. The requirements of sugar are met further through the activity of diastase enzyme. The presence of sugar in sufficient amount is essential for the vigorous and sustained gas production in the bread making process. Hence, the flour must have sufficient amylase enzyme (diastase activity). This is also essential for good oven rise during baking process.

Fat

Fat is an important ingredient in bread making. Fat makes the bread soft and more palatable for a longer period of time than the bread prepared without shortening. Besides antistaling properties, the added fat has a lubricating effect on gluten structure. It improves the softness and slice-ability of bread. Fat should be added at the last stages of mixing as at earlier stage it adversely affects the water absorption power of the flour.

Glycerol – monostearate (GMS)

It is an emulsifying agent and acts as surfactant. Emulsifiers like GMS are used to reduce the quantity of fats. GMS is used along with the fat. GMS is an excellent flour strengthener, which enhance gluten, increases absorption and dispersion of water, thus ensuring more loaves per batch. It improves texture of bread by ensuring a fine and more uniform crumb structure. It keeps the bread fresh and soft.

Milk

Milk is used in bread formations both in liquid or dry solid forms. While using liquid milk, the water content should be adjusted according to the formula. The moisture of the milk, when combined with other ingredients contributes to both toughness and tenderness in the products. The milk solids have binding effect on the flour protein, resulting in toughening effect. The lactose of milk helps to regulate colour of crust, improve the flavor and retains the moisture.

The major advantages of adding milk solids in the bread dough are:

a) Increased absorption and dough strengthening

b) Increased mixing tolerance

c) Longer fermentation time (the buffering action of milk, the non-fat dry milk solids decreases the enzymatic activity especially the diastatic activity during the entire fermentation time, thus satisfactory loaf of a bread)

d) Better Crust Colour

e) Better Grain and Texture

f) Increased Loaf Volume

g) Better Keeping Quality

h) Better Nutrition

Improvers

Besides the above ingredients, sometimes improvers like potassium bromate, potassium iodate, ascorbic acid and calcium peroxide are added at levels of parts per million. They add active oxygen to the dough, enhances the strength of gluten with better bread quality.

Preservatives

Preservatives like calcium propionate and acetic acid are used to inhibit the growth of fungi or mold. They improve the keeping quality of bread.

IV. Methods for Bread making

There are two procedures of bread making:

1. Straight-dough process
2. Sponge-and –dough process

1. The straight-dough process is the simple method for bread making **(Fig 1).** In this method, all the ingredients are mixed to develop the dough and allowed to ferment at 25 - 26°C. During fermentation, the dough is usually punched one or more times. After fermentation, it is divided into loaf-sized pieces, round, molded into the loaf shape and placed into the baking pan.

2. In sponge-and –dough process, part of the flour (two third), part of the water and the yeast are mixed just enough to form a loose dough (sponge). The sponge is allowed to ferment for 5 hr, then it is combined with the rest of the ingredients and mixed to develop dough. After being mixed, dough is given an intermediate proofing (floor time) of 20-30 minutes. It is divided, molded and proofed as in the straight-dough procedure **(fig 2).**

I. Steps in Bread Making

The bread is prepared from four raw materials viz, flour, water, salt and yeast. The major steps in bread making are:

i) Sieving

The flour is sieved to aerate the flour; to remove coarse particles and other impurities and to make flour more homogenous.

ii) Weighing

The next step is weighing of different ingredients as per recipe/formula. Minor ingredients have to be weighed more accurately.

iii) Mixing

Mixing is one of the most important steps in bread making. The main purpose

of mixing a dough is to make and develop the gluten. Total water absorption is not obtained until the gluten has been fully developed. Mechanical mixers are used for thorough incorporation of all the ingredients, to develop the gluten and to make the dough more extensible. The straight dough should have a desirable temperature of 25° - 26°C and the sponge dough should have 23°-25°C. The different stages of mixing are: pick up stage, clean-up stage, development stage, final stage, let-down stage and break-down stage.

iv). Preparation of different solutions

Yeast is dispersed in a small part of water and the remaining part of water are used to dissolve sugar and other additives like oxidants, yeast foods etc. Sequence of addition of ingredients also affects the dough characteristics. Shortening and salt are added after the clean-up stage to reduce the mixing time.

v) Fermentation

Bread fermentation is an anaerobic process. Thus, little growth of yeast occurs during fermentation. The process of fermentation starts just after mixing and it increases during interproofing and final proofing.

The most favorable temperature for action of yeast in bread doughs is between 24°C to 30°C and humidity about 70-75 percent. During fermentation major changes would be the increased volume of dough due to the production of gas, increased temperature and number of yeast cells and finally changed consistency of dough. The enzyme of yeast acts on the starch and sugars to form carbon dioxide gas. The evolution of this gas causes the dough to rise and conditions the dough to soft, light, elastic, extensible texture. Overfermented dough become soft and sticky and under fermented dough do not bake properly and the crumb is darkish and compact.

vi) Knock-back

As fermentation proceeds, punching or remixing of the dough is done. Punching in between the fermentation increases gas retention capacity of the dough. The process of knock back equalize dough temperature throughout the dough, reducing the retarding effect of excessive accumulation of carbon dioxide within the dough and introduces oxygen for the stimulation of yeast activity. The knock-back also aids in the mechanical development of gluten by stretching and folding action. Knock-back is done when 2/3 of the normal fermentation time is over.

vii) Scaling or Dividing

After fermentation, the dough is divided into individual pieces of pre-determined uniform weight.

viii) Rounding

Each piece is rounded by hand or mechanically to give a ball shape. Rounding imparts a continuous surface skin that retains the gas and reduce the stickiness. During the scaling in pieces and rounding, most of the carbon dioxide formed in the first fermentation period gets squeezed out of the dough.

ix) Intermediate Proof

The loss of gas during scaling and rounding is compensated by submitting the dough pieces to an extra fermentation period of 5 to 30 minutes, referred to as 'intermediate proof'. It is done at a temperature of 27-30°C and 75 percent relative humidity (RH) for a time period of 5 – 30 minutes.

x) Moulding

The moulding consists of sheeting, curling and sealing. Moulding is done for the removal of extra gas formed by the process of fermentation at the time of intermediate proof.

xi) Final Proof

Final proofing is done at a temperature of 30 – 35°C, at 85 percent RH for 55-65 minutes. The function of final proofing are:

1. To relax the dough from the stress received during fermentation operation.
2. To facilitate production of gas to provide volume to the bread
3. To change tough gluten to a good mellow extensible character.

xii) Baking

At the end of the final proofing, the dough is baked for 15-45 minutes, depending on the size of dough pieces. Bread is baked at temperature of 245° - 250°C for 30 minutes. The quality of dough determines the dough volume. The crust of the loaf and texture of the crumb occurs during the baking by gelatinization of starch, which binds to the water.

The purpose of baking is to transform unpalatable dough into a light porous and readily digestible flavoured product. The duration of baking, humidity and temperature of the oven influence the quality of bread and vary depending upon

Size and shape of loaf, cooling, slicing and packaging. **Table 1** elaborates the different faults in bread making and causes for these flaws.

Conclusion: Bread is one of the oldest prepared foods Around 10,000 BC, with the dawn of agriculture, grains became the mainstay for making bread. The first commercial process was developed in 1961. Nowadays, bread can be produced very quickly and at low costs to the manufacturer and the consumer. It is a good source of carbohydrates from the whole grains and nutrients such as magnesium, iron, selenium, B vitamins, and dietary fiber. Doughs are usually baked, but in some cuisines breads are steamed or fried or baked on an unoiled frying pan e.g tortillas. Water, yeast and salt are essential ingredient to prepare cake, whereas sugar, fats, emulsifiers, improvers and preservatives are optional. There are two methods to prepare the dough. Each step involved in baking the bread is crucial for the good quality bread. Water and composition of wheat flour is highly significant in producing bread with acceptable taste, texture and shelf life.

Straight Dough Process

Preparation of ingredients

↓

Weighing

↓

Sifting and blending

↓

Tempering of water

↓

Preliminary mixing of yeast, dried milk etc.

↓

Dough mixed

↓

Dough placed in trough

↓

Dough allowed to rise, turned and folded

↓

Sponge Dough Process

Preparation of ingredients

↓

Weighing

↓

Sifting and blending

↓

Tempering of water

↓

Preliminary mixing of yeast

↓

Sponge mixed

↓

Sponge placed in trough

↓

Sponge allowed to mature

↓

Dough sent to bench or divider

↓

Dividing and scaling

↓

Rounding

↓

Intermediate proof

↓

Moulding

↓

Panning

↓

Pan proof

↓

Baking

↓

Cooling

↓

Slicing

Sponge placed in mixer

↓

Sponge broken up and mixed with dough ingredients

↓

Final dough placed in trough

↓

Allowed to rise sometimes turned and folder

↓

Dough sent to bench or divider

↓

Dividing and scaling

↓

Rounding

↓

Intermediate proof

↓

Moulding

↓

Panning

↓

Pan proof

↓

Baking

↓

Cooling

↓

Slicing

Fig. 1. Methods for Bread Making

Table 1. Various faults in bread making and their causes:

Fault	Causes	
Shape		

Poor volume	Too much salt Too little yeast Too little liquid Weak flour Under-or overmixing Oven too hot	
Too much volume	Too little salt Too much yeast Too much dough scaled Overproofed	
Poor shape	Too much liquid Flour too weak Improper molding or makeup Improper molding or proofing Too much oven steam	
Split or burst crust	Overmixing Under fermented dough Improper molding –seam not on bottom Uneven heat in oven Oven too hot Insufficient steam	
Flavor		
Flat taste	Too little salt	
Poor flavor	Inferior, spoiled, or rancid ingredients Poor bakeshop sanitation Under- or overfermented	
Texture and crumb		
Too dense or close-grained	Too much salt Too little liquid Too little yeast Under fermented Underproofed	

Too coarse or open	Too much yeast Too much liquid Incorrect mixing time Improper fermentation Overproofed Pan too large
Streaked crumb	Improper mixing procedure Poor molding or makeup techniques Too much flour used for dusting
Poor texture or crumbly	Flour too week Too little salt Fermentation time too long or to short Overproofed Baking temperature too low
Gary crumb	Fermentation time or temperature too high
Crust	
Too dark	Too much sugar or milk Underfermented dough Oven temperature too high Baking time too long Insufficient steam at beginning of baking
Too pale	Too little sugar or milk Overfermented dough Overproofed Oven temperature too low Baking time too short Too much steam in oven
Too thick	Too little sugar or fat Improper fermentation Baked too long or at wrong temperature Too little steam
Blisters on crust	Too much liquid Improper fermentation Improper shaping of loaf

Just after mixing **After first rise** **After proofing, ready to bake**

Fig: 2 Stages of dough formation prior to baking