

PROBLEMS IN BREAD MAKING.

by

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I. Yeast.

Nature

Mode of growth

Mode of reproduction

(warmth

)

(moisture

Conditions necessary
to growth

(air

(sugar

(food----- (nitrogenous matter

)

(mineral matter

(darkness

)

Conditions affecting
growth

(salt

(sugar

(temperature

)

Chemical effects of yeast

II. Bread.

(A). Good Bread

Conditions necessary

1. Good flour

color (glutenin
constituents)
(gliadin

2. Good yeast

strength
purity

3. Good manipulation

Cleanliness of utensils
proper handling
temperature
length of fermentation

4. Good baking

size of loaf
temperature
time

5. Care after baking

cooling
storing

(B). Faults of Bread.

1. Caused by flour

constituents
mouldy wheat and flour

2. Caused by yeast

strength
purity

3. Faulty manipulation

uncleanness
kneading
 manner
 quantity
temperature
fermentation

4. Faulty baking

size of loaf
temperature
time

5. Faulty care

cooling
storing

(C). Ideal Bread.

Baking

thoroughness
color
shape

Taste

sweetness
flavor

Appearance of crumb

Texture

quality
fineness
evenness

Color.

References:

Conn.

Jago.

Operative Miller

Pure Products.

Mrs. Calvin.

Bread is no doubt the most essential food of man. It takes the most important part in the nutrition of all classes of people.

Bread is not so highly valued because of the ease of preparation but because of its nutriment, palatability, and digestibility. In it are all the substances necessary for the nutrition of man, namely; carbohydrates, proteids, fats, and mineral salts. The carbohydrates and proteids are present in about the right proportion, but the fats are deficient. Bread is one of the most constant sources of nitrogen in the daily diet. The gluten of the flour furnishes the greater part of the nitrogen. The proportion of fat can easily be raised by the use of butter.

Another reason bread is so universally used is because of its cheapness. Considering the materials used it is cheap compared to other foods because it supplies all the necessary elements and does not require the addition of other foods to make a nourishing diet.

Properly made bread is palatable by itself, and is made more so by the addition of butter, or when eaten with other foods.

Bread making is by no means a modern art, it was known some 3000 B.C. Probably the first grain cultivated for use in bread-making was barley. Next came the use of wheat, which was cultivated in Egypt 4000 B.C. and in China 3000 B.C. The home of the barley plant is in Asia Minor, that of the wheat plant in Central Asia. The use of wheat in bread making is more universal than barley, especially in the more advanced nations. It could be truthfully said that through the cultivation of these grains civilization has been fostered. The aborigines were nomadic because they were forced to change their habitations as the source of food became exhausted. When they learned to cultivate these grains which could be stored they could remain in one place, and thus gain advantages over those who had remained

nomadic. Because of this the discovery of the use of the cereals in bread making has been described by the ancients as a gift of God.

We find many references to bread - both leavened and unleavened, in the scriptures and elsewhere. In the Lord's Prayer we ask for our daily bread. Bread is often spoken of as the "Staff of Life," and "Bread of Life." We can safely conclude that bread is a very important factor in the lives of nearly all the world's people.

One of the most important factors in bread making is the leavening agent, which in nearly all cases is yeast of some sort. Since yeast is such an important factor it will be well to consider it first.

Yeast was discovered by a Dutch microscopist about two centuries ago. The phenomenon called fermentation had been known for some 3000 years but its cause remained a mystery until the nineteenth century, when it was discovered that yeasts are the natural agents which produce fermentation.

Yeast is a microscopic uni-cellular plant, belonging to the family of Fungi. The plants belonging to this family are without chlorophyll and reproduce by buds and spores.

Yeast cells have a uniform smooth outline. On the inside may be seen one or more rounded clear spots. As far as is known these are minute drops of oil, and have nothing in particular to do with the life of the cell. These drops are called vacuoles. The large dark spot is the nucleus; which appears to be floating in a semi-fluid which is the protoplasm of the cell.

Yeast exists in three states; the resting; the growing; and the spore-bearing state.

The resting state is that period when the yeast cell is alive but dormant, such as we find it in the dry yeast. When resting yeast is placed in a solution which contains proper food it begins to

consume the food and grow. As it grows it multiplies by a method known as budding. Each bud appears as a little swelling on the side of the yeast cell. The bud grows until it may be as large as the mother cell, and if the plant is vigorous a second or even a third bud may have appeared. The nucleus and the other cell contents of the mother cell divide and enter this bud, making it a complete cell. These cells may remain attached for some time and form irregular groups. When they separate they may go into the resting state or continue to develop. This depends upon the existing conditions. This method of growth is distinctly characteristic of yeasts and separates them sharply from bacteria.

Under certain conditions such as dryness and lack of food, yeast plants produce reproductive bodies known as spores. These spores are formed by the cell contents breaking up into several parts, and these parts are capable of resisting for a long time, adverse conditions, such as great heat or cold, dryness, and lack of food. Not all yeasts are known to produce spores and are sometimes classified on this basis:- those producing spores are classified as genus *Saccharomyces*; those not producing spores as genus *Tarula*. This is Conn's classification. Jago classes all yeast fungi under the genus *Saccharomyces* because they mostly live in sugar solutions.

Like all members of the fungi group yeast must have warmth, moisture, air, food, and darkness in order to grow well.

Between 25°C. and 35° C. yeast grows well, above or below this point the growth is not so vigorous or may be retarded altogether.

Moisture is absolutely necessary to the growth of the cell. The cells must have a certain amount of water in their contents before they can grow. A sugar solution over 35% prevents the growth of the cell because the sugar has such a great affinity for water that it deprives the cell of its natural amount.

Yeast requires the presence of oxygen for its growth. Pasteur and Brown have both worked upon this particular phase of yeast life - and Pasteur states that yeast grows much better in shallow than in deep dishes - the shallow dish allowing the air to reach all the plants. Brown found that fermentation is much more vigorous in the presence of oxygen than in its absence. Also that:- "Yeast cells can use oxygen in the manner of ordinary aerobic fungi and probably require it for the full completion of their life history."

Perhaps the most important condition necessary to the growth of yeast is its food. To breadmakers who expect to make their own yeast, this is a very important part and should be thoroughly understood. The food materials required for yeast are sugar, nitrogenous material, and mineral matter. Of these the saccharine matter occupies the first place. This saccharine matter does not need to be in the form of sugar to begin with. Yeast has the power to convert starchy materials into sugar. Maltoses and glucoses or sugars of the $C_6H_{12}O_6$ group are the only sugars capable of direct fermentation. Certain other sugars are capable of indirect fermentation by yeast. Among these are cane sugars, which however have to be first hydrolyzed to glucose by the action of the invertase or soluble diastatic body secreted by the yeast cells. Sugar of milk is incapable of fermentation by yeast. Yeast alone is unable to ferment starch paste or dextrin, these require some more powerful diastatic agent, such as malt extract. Yeast makes use of the starchy materials indirectly through the proteids in the starchy materials. The product of this action upon the proteids converts starch paste into dextrin and maltose, which are fermentable by yeast itself.

Yeast is able to secure some of its nitrogenous food material from the ammonical salts, but organic nitrogenous compounds

form a more suitable nutriment. The nitrogenous material of the cell itself is utilized by the cell; among these the soluble proteids are most apt to be used.

Pepsin forms a good yeast food. Albumin, whether egg albumin or vegetable albumin can not be used by the cell.

Pasteur has shown that when yeast is added to a solution of pure sugar and ammonium tartrate the development of cells and fermentation does not take place, but that on the addition of yeast ash, both growth of cells and fermentation occurs.

Yeast ash consists of potassium phosphate, and small quantities of magnesium and calcium phosphate. Potassium phosphate must be present, and can not be replaced by sodium or calcium phosphates. Magnesia in the form of sulphate or phosphate is of great value to the growth of yeast. Calcium does not seem to be altogether necessary to the growth of yeast. Large quantities of mineral salts affect the shape of the yeast cell. Calcium sulphate causes the cells to be oval in outline.

It is generally agreed that salt has a retarding influence upon fermentation, although quantities of salt under three per cent of the water used stimulates the growth of yeast. Jago concludes that salt from 1.4 % upwards retards alcoholic fermentation and diminishes the speed of gas evolution. It is used because it acts more powerfully as a retarding agent upon lactic and other foreign ferments. It also checks diastatic action and does not let the breaking down of the flour go too far.

Although sugar in some form is absolutely necessary to the growth of yeast, it is detrimental in too large quantities. It has such an affinity for water that solutions containing over 30 % sugar will take up the water from the yeast cells. When used in large amounts it has the effect of a preservative, and checks the growth.

The temperature most favorable to the growth of yeast is from 25° C. to 35° C. Between these points yeast grows well. Below 25° C. growth proceeds but not rapidly. At 9° C. all action is stopped, but the cells are still alive. Freezing does not kill the cells unless they are mechanically ruptured or injured. Above 35° C. the action of yeast is weakened and at about 60° C. the proteid begins to coagulate and the yeast is destroyed. This applies only to yeast that has been moistened. Dry yeast has been heated to 100°C. without destroying it.

The last condition necessary to yeast's growth is darkness. Since yeast belongs to a family lacking in chlorophyll or green coloring, light or sunlight would be injurious to its growth. The effect of light upon yeast is the same as that upon other fungi; too much light destroys its vitality.

The chemical effects of yeast that interest the bread-maker is the breaking up of the sugar into alcohol and CO₂. The equation is as follows:-

$$\begin{array}{rcccl} \text{C}_6\text{H}_{12}\text{O}_6 & = & 2\text{C}_2\text{H}_5\text{OH} & + & 2\text{CO}_2 \\ \text{(sugar)} & & \text{(Alcohol)} & & \text{(carbon dioxide)} \end{array}$$

This production of alcohol and carbon dioxide is the foundation of all fermentations. The CO₂ escapes from the surface of the yeast mixture in bubbles.

One of the conditions necessary to good bread is good flour. It is hard for the inexperienced eye to detect good or bad flour by its appearance. The color is about as good an index as anything. The flour should be creamy in color. If it is very white it probably has been bleached too much,; if too yellow or gray too much of the gluten has been left in. One test used by millers and bakers is to press a small amount into a cake then, wetting it and allowing to dry. The true color is shown much better in this way, and one cake can be used as a standard.

So much depends upon the constituents of flour in bread-making, that it should be better known in what proportions the different parts exist. The gluten which contains the proteids of the flour forms about 1/7 its weight. The main proteids in the gluten are gliadin and gluteniu. About 4.25 % of the gluten is gliadin and the gluteniu constitutes nearly all of the remaining proteid. The consistency of dough depends to a great extent upon the ratio of the gluteniu to the gliadin and little gluteniu makes a soft sticky dough - which is too weak to raise well. Six parts of gliadin to four parts gluteniu makes a strong flour. This proportion makes the dough tough and elastic so that it will expand under the pressure of the gas without breaking, thus making a light loaf.

Good yeast must be used if good bread is to be made. The first consideration about yeast is its strength. By its strength we mean its gas yielding power. Since the amount of gas present in part determines the lightness of the bread, yeast of good strength will make better bread than yeast of poor strength. It is better to use a small quantity of strong yeast than a large quantity of weak yeast. The strong yeast will ferment quickly and not give the foreign ferments a chance to develop, while the weak yeast will increase the time of fermentation and may be overpowered by the foreign ferments. Upon the purity of yeast the flavor of the bread depends to a great extent. A pure growth of yeast is difficult to maintain, lactic or acetic acid bacteria are present in the air, water, etc., and find a suitable medium in the yeast food.

Under the head of Good Manipulation is to be considered the cleanliness of utensils.

In order to have a pure growth of yeast it would be necessary to have every utensil as well as all material used - sterile.

In the ordinary process of bread-making about the only precaution taken is to sterilize the liquid used. The mere washing of the utensils does not make them clean in the true sense. Bacteria find good lodging places in nearly all utensils used. Those that cause sour bread are quite frequently introduced in that way.

The handling of the bread will vary according to the methods used. The two methods most commonly used - the sponge and the dough methods differ only in the first stage. The kneading is perhaps the most important item in the working of the bread. The bread should be kneaded until smooth and velvety. It should spring back into place after being pressed with the fingers. To reach this stage usually requires about thirty minutes or more and will probably require the addition of flour during the kneading. The temperature of the hands, while handling the bread will make considerable difference. Warm hands make the dough soft and sticky.

The temperature should be kept as even as possible during the period of fermentation. An increase in temperature will make the bread raise faster but it also gives lactic and other foreign ferments a start. A sudden chill will stop fermentation almost entirely. Fermentation continues until the heat of the oven kills the organisms. The same laws govern the fermentation of both sponge and dough.

From Jago:

Conditions that accelerate fermentation.

Yeast. The greater the quantity the quicker it proceeds - the strength also tends to increase the rate of fermentation.

Flour. Soft flours tend to hasten fermentation; they contain more sugar and more starch in a condition susceptible to diastasis. Their proteid matter is more likely to act as a yeast stimulant, while the softness of the gluten lessens a physical obstacle to rapid action of yeast.

Potatoes, Saccharine Extracts: These act as stimulants and tend to increase the speed of fermentation.

Water: The principal way it acts is in virtue of the proportionate quantity used. When doughs are slack fermentation proceeds much more rapidly.

Aeration: Flour well aereated is likely to work more rapidly especially in sponges. Well beaten sponges ferment more rapidly than those not well beaten.

Temperature: This governs all else. With low temperatures yeast works very slowly, if at all, and with higher temperatures fermentation is accelerated.

The conditions retarding fermentation may be summed up as the opposite of the accelerating agents - yeast, weak or in small quantities; hard, dry flours; stiff unaerated doughs; low temperature, and addition of salt.

The good baking of bread is dependent upon three conditions; the size of the loaf; the temperature of the oven; and the time in the oven. Bread should always be baked in single pans. These pans measure 9 X 4-1/2 X 2-3/4 (depth). This makes about a one pound loaf. Bread baked in single pans is surer of getting baked the entire way through. Bread baked all the way through will keep much better because the yeast plants have been killed.

When two or more loaves are baked in the same pan there is little crust and the bread dries rapidly. It is more than apt to be underdone in the center of the loaves. Besides the loaf does not look as nice as when baked alone.

The temperature of the oven for baking should be from 400° to 500° F. The bread should not be put in on increasing heat. Too low an oven temperature allows the bread to raise too long. Too great heat forms a crust too soon and will probably blister the bread.

The bread should remain in the oven from 45 to 60 minutes, according to the size of the loaf.

As soon as the bread is taken from the oven it should be turned out of the pans. If it is allowed to stand in the pans it will sweat. Put it on a rack, right side up, and allow to cool in the open air. It should be stored in tin boxes with tight-fitting covers.

Faults of good bread, and their causes:

Faults caused by flour may be the result of moulded wheat or flour, or it may be caused by the constituents in flour. Wheat that has moulded lacks in nutritive value because the mould plant uses part of the wheat for its food. Wheat or flour is better after storage for some time. If the gliadin and glutiniu are not present in the right proportions the flour will not make as good bread.

The faults caused by yeast have already been discussed more or less. Both weak yeast and foreign bacteria produce sour bread, the yeast indirectly and the bacteria directly. These bacteria may be introduced by the yeast, by dirty utensils, and through the flour.

Uncleanness of utensils adds to the sourness of bread.

Insufficient and improper kneading often give bad results in bread. The flour must be kneaded in perfectly smooth or it will make the texture poor. On contact with the air the dough forms a hard crust. This should be softened or taken off - if it is not removed it will make hard lumps in the bread.

Too high temperature during fermentation makes a small loaf with poor texture. The bread usually has a clammy feeling and does not spring back upon pressure. Too high oven temperature forms a hard crust cometimes blistered, and may make the bread coarse in texture. Too low temperature makes a heavy sour loaf.

Too long fermentation weakens the yeast and allows the foreign ferments to develop.

The loaf should be baked when it has risen twice its original size. If the oven is unevenly heated the loaf will raise unevenly unless it is turned constantly.

The bread should not be covered when taken from the pan. Bread stored in wooden boxes is apt to absorb moisture and become mouldy.

Ideal Bread:-

The ideal loaf should be so completely baked that when pressed upon it will immediately spring back upon release of pressure. The color should be golden brown on top sides and bottom. The loaf should be evenly raised in the pan with no cracked, uneven or protruding crusts. The bread should not taste acid or sour and the flavor should be rich and nutty. The flavor will vary with the constituents in the bread. The bread inside should have a soft velvety texture. It should not crumble when sliced. The holes should be numerous, small and uniform in size. Large holes in bread is a serious fault. The color of the bread should be slightly creamy.