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A Study of the Use of Missouri Soft Wheat Flour in Making Light Bread

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A Study of the Use of Missouri Soft Wheat Flour in Making Light Bread

Eva May Davis and Jessie Alice Cline

Abstract.—This bulletin deals with the results of an investigation of some of the problems involved in the use of Missouri soft winter wheat flour for bread baking purposes. Most bakers and housewives recognize the value of soft wheat flour for cakes and quick breads but as yet they have not admitted that it can be used for making good light bread. The purpose of this bulletin, therefore, is to encourage a more general and extensive use of Missouri flour within the State by showing that good yeast bread, as well as good pastries, cakes and quick breads, can be made from home grown wheat flour.[3, 10] An experimental study was made of the effect of variations of methods of procedure, and of amounts and kinds of ingredients on the texture, loaf volume, and length of time required for making bread from Missouri flour.

From the results of these experiments recipes have been formulated which prove that with slight modifications in proportion of ingredients and procedure, bread comparable in quality to that made from the flour of other states can be made from Missouri flour. Thus Missouri flour deserves to be known as an "All Purpose Flour" and to be used as such by Missouri people.

Bread, although not satisfactory in mineral and vitamin content can still be called "the staff of life" since there is no other article of diet so universally used. In nearly every part of the world some form of grain product is found to be the largest single source of energy in the food supply.

Wheat is commonly divided into two main classes, winter and spring. In general, the winter wheats are soft and the spring wheats are hard, but we have both hard and soft winter wheats. The classes comprising the greatest percentage of the total wheat acreage are as follows: hard red winter wheat, grown principally in the Central Great Plains, nearly 33 per cent of the total wheat acreage; soft red winter wheat, grown largely in the humid sections of the eastern half of the United States, over 30 per cent of the total wheat acreage; hard red spring wheat, grown principally in the north central part of the United States, 25 per cent of the total wheat acreage[4]. Thus, it can be seen that the winter wheat now occupies about two-thirds of our total wheat acreage. The acreage is divided almost equally between the soft and hard varieties of winter wheat.

The use of soft red winter wheat flour is a subject which is of interest to every baker and housewife because it is generally known that we today are facing a hard-wheat shortage. This is partially due

to increase in population but in a larger measure to increased demand by the bakers for the stronger flours[1].

More particularly should the people of Missouri be concerned with the use of soft wheat flour because Missouri people use 3,500,000 barrels of flour annually but only 15 per cent of this is produced within the State. This is due to the claim that soft wheat flour can not be used for breadmaking purposes. The majority of the bakers and half of the housewives of Missouri use flour from other states for making light bread. Thus bread in Missouri costs more than it should due to double transportation charges. A large part of the wheat is milled out of the State with the result that the supply of mill feed available to Missouri farmers is greatly reduced. Additional feed must be shipped in at a high price and this increases the cost of milk and meat. When we increase the cost of bread, milk and meat we have increased the cost of three of our most important articles of diet[12].

The first portion of this study has been confined to experimental work on making light bread by the use of the straight dough method and compressed yeast. This formula and method worked out calls for a large quantity of compressed yeast. This is not practical for the farm woman or the housewife in the small town. Compressed yeast must be perfectly fresh to do its best work, and it is also the most expensive kind of yeast. It is often advantageous to use a cheaper yeast which can be kept in a good condition over a long period of time. Therefore, the second portion of the study was done with dried yeast, while the third portion of the experimental work dealt with liquid yeast.

The results of the study as a whole show that with slight modifications in ingredients and methods excellent bread can be made from Missouri soft wheat flour using any of the three types of yeast.

REVIEW OF LITERATURE

Much research[4] has already been done on flour to determine the factors which influence its breadmaking qualities. In the last twenty years an enormous amount of work has been done on the physical qualities and chemical composition of flours and doughs to ascertain the relation between their compositions and the breads made from them. Chemists have long experimented with flours, treating them with various organic and inorganic substances with the purpose in view of improving the quality of the flour and the bread. These substances have been variously named flour improvers, yeast stimulants, yeast foods, mineral aids to baking, moistness-retaining bodies and diastatic bodies. Still other investigations have been carried on to determine the effect of variations of ingredients and methods of procedure on the resultant bread. Most

of the above has been done from the commercial or scientific standpoints on the hard wheat flours. As yet very little has been done to determine from the housewife's standpoint the modifications in the proportions and the procedure, necessary and possible for her to use in making good light bread from soft winter wheat flour.

A chemical analysis of the composition of flour will show the presence of the following constituents: fat, starch, cellulose, sugars, soluble proteins, mineral matter and water.

Flour possesses in addition to its purely chemical properties, certain physical properties which are of the highest importance. These are strength, water absorbing power, color, and flavor which largely, if not entirely, determine the commercial value of a sample of flour[9].

It seems apparent that the value of wheat, for the most part, depends upon the "strength" of the flour which can be made from it. The capacity of flour to promote yeast growth and its capacity to retain gas and to absorb water, are a few of the physical properties of flour which have been studied as factors influencing strength. Further work has been done to determine the effect of the quantity of gluten, the ratio of gliadin to glutenin, the amount of crude gluten, soluble proteins, enzymes and mineral constituents on flour strength. The practice of determining the exact percentage of gluten and its actual composition has given way more and more to an investigation of the outside factors which affect its qualities. In recent years much emphasis has been placed upon the effect on strength of the hydrogen-ion concentration of doughs made from weak and strong flours.

Thus almost every known constituent or group of constituents, and almost every known physical and chemical property of flour have been investigated with respect to their possible relation to baking strength[4].

Considerable knowledge has been attained, but we do not yet know enough about the chemistry of flour, or of the changes that various constituents undergo in the process of breadmaking, to devise any system of chemical analysis that will give conclusive and satisfactory evidence of the strength of flour for breadmaking purposes[4].

In 1911, Willard and Swanson[15] included some work on soft wheat flours in their extensive study of Kansas flours. They varied only the amount of liquid, the amount of yeast, and the amount of rising before baking, keeping all other proportions of ingredients and the method the same as those used for the hard flour tests. They decided that a "stiff dough and a short rising period give a finer texture to bread made from soft wheat flour."

In 1912 Miss Jensen[2] worked on developing a satisfactory process for making bread from winter wheat flour. She concluded that the process

for winter wheat flour differs from the process for spring wheat flour in that winter wheat requires a slacker dough; should have three risings instead of two; should never get over-light; should rise to a little less than one and three-fourths times its original volume in the last rising, and should be allowed to finish proofing in the oven. Furthermore, the total time required to make a loaf of winter wheat bread should be less than that necessary to make one from spring wheat.

Also in 1912, another investigator worked on the use of soft wheat flour for making light bread. Olson[11], of the Washington State Experiment Station, decided that the first requisite for making successful light bread is good, active yeast, and that it makes little difference whether the source is compressed yeast, dried yeast or a starter. He states that with active yeast any flour under proper methods will make good bread and attributes most failures from soft wheat flour to too little water. The dough should be slack enough that it will nearly cling to the hand. He also recommends gentle kneading because he thought that if the mixing and kneading were done with force there was danger of lessening the activity of the yeast. He reports that although the volume and texture may not be the same, yet any brand of flour will yield a well-piled loaf of good texture, if it is properly handled.

In 1920, Ward Baking Company[13] published some suggestions for the use of soft winter wheat flour in making light bread. "Flours with a strong gluten will stand more mixing than flours of the soft winter wheat type." Weaker flours with a small amount of soft gluten require more yeast and a shorter period of fermentation. Each type of flour will produce a quality loaf of a certain volume if handled properly.

Harcourt and Purdy in 1922[8] working with blending of flours suggest that it is not advisable to use the sponge process with the soft wheat flours, but instead a quick dough method, since the softer flours will not stand a long fermentation and that "soft flour doughs must never be allowed to rise to the extent of falling back". They also state that yeast requires, in addition to sugar, mineral foods which may be supplied in a very good form by the addition of potato water and the mashed substance of the potato. Potatoes contain in addition to starch and small amounts of protein a peculiar mixture of salts which serve as excellent yeast foods. They give to the crumb of bread a fine silky texture and to the crust a desirable crispness and bloom. Potatoes also influence the moisture content of the bread, due to some constituent contained in or developed by the potato, thus making the bread keep longer and giving it a nutty home-made flavor.

Weaver and Goldtrap also published in 1922 their results of studies on flour strength in relation to bread making qualities[14]. They found that when the flour was started with proper absorption and the correct

fermentation period was found, all the flours were large well-piled loaves; that the fermentation period required for soft winter wheat flour was three hours, while that for spring wheat was six hours. They were able to get just as good volume, color and texture in their bread from soft wheat flours as in their bread from hard wheat flours.

Jago[9] mentions that more yeast should be used with soft wheat flour and that this flour might be used in the dough stage of the sponge and dough process.

Bread Facts[13] gives some suggestions for the use of soft winter wheat in breadmaking. "Flours with a strong gluten will stand more mixing than flours of the soft winter wheat type." Weaker flours with a small amount of soft gluten require more yeast and a shorter period of fermentation. Weak flours have a tendency to produce crusts due to being easily over-fermented; they will also produce crumbly bread. Each type of flour will produce a quality loaf of a certain volume if handled properly.

Milk makes bread more palatable and nutritious, gives better flavor and bloom and makes bread stay fresh longer. The more milk that is used the longer the fermentation period required.

In 1923, the Department of Home Economics of Purdue University did some work on making light bread from Indiana soft wheat flour[6]. Their conclusions were: "With good yeast, proper handling and the use of correct temperatures, the flours used yielded loaves of bread which were good as to shape, color, texture and flavor". This group of workers also believes the amount of liquid is extremely important and varies with the different flours and even with the same brand of flour at different times.

Gerhard[7] says that milk is used principally to improve the bread. Any form of milk may be used but condensed milk works well in sponge doughs, also when soft wheat flour is used. The use of milk has a beneficial influence upon the interior and exterior color of the loaf and it improves the texture, flavor and crust. "Buttermilk is a very good 'rope' preventer and is used for that purpose. It has a softening effect upon the gluten and consequently works or acts just opposite to other milk products, due to its acidity. Therefore doughs made with buttermilk mature much faster, so the fermentation time of the yeast must be reduced." He also states that gelatinized starch added to the primary ferment causes a vigorous fermentation thus shortening the fermentation period and producing a fine, white loaf with good bloom, volume and keeping qualities. Before sugar is available food for the yeast it must be in the simple sugar form; he therefore suggests the use of glucose in place of cane sugar.

In 1923 and 1924 Miss Laurel E. Davis worked at the University of Missouri on soft wheat flour and arrived at very definite conclusions with regard to its use in light bread[3, 10]. She found that Missouri soft wheat flour gave a more open and uniform textured loaf with a soft dough, just stiff enough to prevent sticking to the hands and board.

At about the same time that most of the work was being done at the University of Missouri, there were investigations being carried on by the Bureau of Home Economics, United States Department of Agriculture, on the baking qualities of eleven soft red winter wheats grown mostly in Pennsylvania and Maryland[5]. Their results are in accord with the results of the investigations herewith reported. The two formulae advanced in the work at Washington as giving the best results for making bread from soft wheat flour check remarkably with the recipe formulated in Miss Laurel E. Davis' Master's Thesis in 1924[4] and later published in Bulletin 227 of the Missouri Experiment Station[3]. The straight dough process is recommended in both investigations.

From the above review of literature it seems there are several points agreed upon by most of those who have worked upon the problem of the baking qualities of soft wheat flours. They are as follows: a slack dough, just stiff enough to prevent sticking to the hands and board, the exact amount of water depending upon the flour; short fermentation and proofing periods, obtained by increasing amounts of sugar and yeast, which may be so used as to prevent weakening of the gluten; and a limited amount of gentle mixing and kneading. All of the writers agree that good, active yeast is an essential. So far as the writers have been able to determine, all the scientific work so far undertaken on soft wheat flours has been done with compressed yeast, although according to Olson[11] it makes little difference whether the source of the yeast is compressed, dried or a starter so long as it is good and active.

EXPERIMENTAL WORK

Equipment Used.—1. A "Kitchen Aid", the household size of Hobart's electric mixers, having three different speeds and a special attachment for bread mixing, was used throughout the experimental work.

2. A fermentation cabinet, constructed from an old ice chest, was used for the preliminary fermentation and the first rising. It was kept at a temperature of not less than 30°C. or higher than 35°C. This temperature was maintained by small electric light bulbs controlled by a thermostat. A container of water was placed in the cabinet to keep the air moist and prevent a crust from forming on the surface of the dough during fermentation.

3. An electric proofing cabinet was used for the dough after it was panned. This was not controlled by a thermostat, and the current had to be turned on and off so as to keep temperature between 40° C. and 45°C. during the second rising. The air in this cabinet was also kept moist by a vessel of water.

4. A loaf-volume apparatus, No. 6026 of the Central Scientific Company, Chicago, was used for measuring the volume of each loaf. This is done by displacement of millet seed, the apparatus being so constructed that the exact volume of the loaf could be read directly. This piece of apparatus consisted of the following parts: a rectangular hopper of sufficient size to contain the loaf to be tested; an auxilliary filling funnel; a measuring burette, with a graduated glass front; and a stand provided with two ring clamps for holding the hopper and funnel in place.

5. Small enameled mixing bowls, with tin lids to fit, were used for the preliminary fermentation. Larger mixing bowls were used for weighing flour.

6. All the ingredients were weighed on a Harvard trip balance, accurate to one-tenth of a gram.

7. Oiled paper was used on both pans of the balance for weighing the lard, salt, sugar and yeast.

8. Glass cylinders, of a capacity of two thousand cubic centimeters and graduated in fifty cubic centimeter divisions, were used for fermenting the dough in the first rising period.

9. The baking thermometers were Taylor's upright oven thermometers, calibrated in the Fahrenheit scale.

10. Tin bread pans, 9 x 4½ x 2¾, were used for proofing and baking. Pans of this size covered the dough while proofing.

11. Wire cake racks were used for cooling the bread.

12. The bread was stored for further study in ventilated tin bread boxes.

13. An inked pad was used for making the impressions of the loaves.

14. Fermentation tubes, all of the same size, were used for testing the activity of the yeast.

Materials Used.—The flour used was Boone County High Patent flour, made from soft red winter wheat grown in Central Missouri and milled in Columbia. Tap water, potato water, milk and buttermilk were used as the liquids. The potato water was obtained by boiling one hundred grams of peeled and diced potato with one cup of water until the potatoes were tender. These potatoes and scalded flour were used as the gelatinized starch. A pure white lard was chosen for the fat.

Fleischmann's compressed yeast was used for the first part of the experimental work; great care being taken to have it fresh each day. Yeast foam, purchased in packages of five cakes each, was the dried yeast used. Granulated sugar and table salt were also used in each loaf.

General Procedure.—The quantities of each ingredient were carefully weighed. Those for each loaf, of each experiment were weighed and mixed separately. To save time all ingredients were weighed the day before and covered tightly.

The temperatures were watched closely in all stages of fermentation, proofing and baking.

After a loaf had been out of the oven thirty minutes it was weighed to be sure it was at least a pound loaf. After the weight was taken, the volume of the loaf was obtained by means of the loaf volume apparatus. Then the bread was put away for about twenty-four hours before it was cut and the texture of the crumb studied. The bread needed to be about this old in order to get a good ink impression of the texture. A slice one-half inch thick was cut about one-third of the distance from the end of the loaf. It was then pressed down firmly upon the inked pad, then on the paper. In this way the shape, size and texture of the loaf of bread were accurately recorded.

Every experiment was repeated twelve to twenty times. Then the average was calculated and used for the series of tables.

WORK WITH COMPRESSED YEAST

Statement of Problem.—The object of this part of the experimental work was to determine from the housewife's standpoint the modifications in proportions of ingredients and procedure necessary to make good light bread from soft winter wheat flour using compressed yeast. The experimental work has been carried out along the following lines.

1. The effect of procedure on the quality of the bread with reference to fermentation and proofing periods with variation in method and time of mixing.
2. The effect of the essential and minor ingredients on the quality of the bread.

Methods Followed.—The bread was made by the straight dough method. A preliminary fermentation was made in which the yeast, sugar and water were mixed one-half hour before the dough was made, and the mixture set in the sponge case. This procedure shortens the time of fermentation and also is a fairly good test of the quality of the yeast. The yeast, sugar and water mixture at the end of this period was added to half the flour, sifted and warmed to 35° F., the melted fat and the salt.

The dough was mixed in the electric mixer one-half minute at each of the three speeds; the remainder of the flour was added and the dough mixed for one and one-half minutes at first speed and five minutes at second speed making a total of eight minutes in the mixer.

The dough was then put into a warmed and oiled glass graduate, turned over to oil the top, and pushed down firmly. The volume was noted and then the graduate placed in the fermentation cabinet until the dough rose to double its bulk. It was then turned out on the bread board and kneaded gently, using no flour, for about one minute or until the large gas bubbles were broken and the small ones evenly distributed. Next it was moulded into loaf form and placed top side down in a well oiled and warmed bread pan and turned over, thus causing the surface to be oiled and so preventing a crust from forming on the surface of the loaf. The pan was then covered with an inverted bread pan of the same size and placed in the proofing cabinet at 40° C. until the dough almost trebled in bulk or until the finger when pressed gently on the dough would leave a print or dent. At this time it was put in an oven at 350°F. for ten minutes. During this time the bread continued to rise in the oven until it had fully trebled its bulk. Then the temperature was raised to 400°-420°F. and was maintained at this point for twenty-five minutes —making a total baking period of thirty-five minutes.

The loaf was then removed from the oven and from the pan and cooled for thirty minutes on a wire cake rack. It was then weighed and the loaf volume taken.

The next morning the loaf was cut and an ink impression taken showing general appearance including shape and size of loaf, spring in oven, depth of crust and texture of crumb.

Number of Risings in Fermentation Period.—There are different opinions, even among the few who have worked with soft wheat flour, as to the number of kneadings or risings which give the best results. Therefore, the first series of experiments were run to determine the proper length of the fermentation period.

TABLE 1.—NUMBER OF RISINGS IN FERMENTATION PERIOD

No. of loaves	No. of risings in cyl.	Amt. of rising in cyl.	Amt. of proofing in pan	Loaf vol. in cc.	Total time
4	none	none	treble	1680	2 hrs. 40 min.
8	one	treble	treble	1725	3 hrs. 45 min.
15	two	treble	treble	1720	4 hrs. 30 min.
4	three	treble	treble	1740	5 hrs. 00 min.
8	two	treble treble	treble	1710	4 hrs. 30 min.
6	two	treble treble	double	1560	4 hrs. 20 min.
4	two	treble treble	one ¾	1500	4 hrs. 00 min.
4	two	double double	double	1500	3 hrs. 50 min.
4	two	double treble	double	1520	4 hrs. 30 min.
6	two	double double	treble	1700	4 hrs. 00 min.
4	one	treble	one ¾	1510	3 hrs. 00 min.
4	one	treble	double	1580	3 hrs. 30 min.
6	one	treble	two ¾	1716	3 hrs. 30 min.
3	one	four X bulk	treble	1600	4 hrs. 00 min.
4	one	double	double	1640	2 hrs. 40 min.
8	one	double	treble	1740	3 hrs. 00 min.

TABLE 2.—COMPARISON OF BEST PROCEDURES FROM TABLE 1

No. of loaves	No. of risings in cyl.	Amt. of rising in cyl. 1st	2nd	Amt. of proofing in pan	Loaf vol. in cc.	Total time
8	two	treble	treble	treble	1710	4 hrs. 30 min.
6	two	double	double	treble	1700	4 hrs. 00 min.
8	one	treble	-----	treble	1710	3 hrs. 45 min.
6	one	treble	-----	two ¾	1700	3 hrs. 30 min.
8	one	double	-----	treble	1750	3 hrs. 00 min.

The above series of experiments show that soft winter wheat flour gives the best results when the time of fermentation is short, but when the proofing is prolonged until the dough has trebled its volume in the pan. At this volume the dough gives a little resistance when touched lightly with the finger. This amount of proofing overcomes the close cake-like texture, and small volume which characteristics have led bakers to discriminate against the use of this type of flour in breadmaking. Longer proofing preceded by a short fermentation period gives a bread of open texture and a good volume. The best results were obtained by allowing the dough to double its volume in the cylinder and to treble

its volume in the pan. This method of procedure was followed for all the rest of the experiments.

Variations in the Proportion of Ingredients Used.—The object of the following series of experiments was (1) to determine the effect of the proportion of ingredients on the loaf volume and texture of the bread; and (2) to determine the proportions which give the best results with the flour and procedure used.

TABLE 3.—VARIATION IN PROPORTION OF LIQUID

No. of loaves	Per cent water	Wt. of loaf in gms. 30 min. after baking	Loaf vol. in cc.
4	48	440	1550
10	49	443	1580
4	50	458	1630
12	51	444	1700
16	52	453	1730
16	53	455	1730
4	54	453	1715
4	55	459	1700
4	56	460	1610

To a certain point loaf volume and loaf weight increase with an increase in the proportion of liquid used. The texture is close, cake like and uneven with a small percentage of water, or a stiff dough; becomes more open and uniform in texture, within certain limits, with an increase in percentage of water, and finally with too much water becomes quite coarse and crumbly.

In this series of experiments the best results were obtained when the dough was just stiff enough to hold its shape and to develop a bold, nicely rounded top surface when proofed, but so soft that it required quick handling to prevent its adhering too much to the board and hands during kneading and moulding. This consistency was obtained by the use of 52 per cent water.

TABLE 4.—VARIATION IN PROPORTION OF YEAST

No. of loaves	Yeast in gms.	Wt. of loaf in gms. 30 min. after baking	Loaf vol. in cc.	Total time
4	3.5	441	1430	4 hrs. 30 min.
4	7.0	445	1600	3 hrs. 40 min.
14	10.0	456	1710	3 hrs. 00 min.
14	14.0	457	1760	2 hrs. 22 min.
10	21.0	462	1790	2 hrs. 30 min.
6	28.0	462	1740	2 hrs. 10 min.
4	42.0	464	1700	3 hrs. 20 min.
4	56.0	468	1870	2 hrs. 40 min.

This series shows that with increased yeast there is a corresponding increase in volume up to 28 grams or two cakes per loaf, an increase in weight and a decrease in total time for rising. With increased yeast the texture becomes more and more coarse, tender and spongy, until finally it is very crumbly. Yeast beyond two cakes per loaf makes the gluten so soft that it loses its capacity for holding gas and thus the cell walls collapse and a poor oven spring results.

TABLE 5.—VARIATION IN PROPORTION OF SUGAR

No. of loaves	Sugar in gms.	Wt. of loaf in gms. 30 min. after baking	Loaf vol. in cc.	Total time
4	4.3	438.5	1500	3 hrs. 30 min.
4	8.6	445	1610	3 hrs. 20 min.
18	10.0	450	1710	2 hrs. 20 min.
18	17.2	455	1820	2 hrs. 30 min.
4	25.8	479	1870	2 hrs. 00 min.
4	34.4	486	1900	1 hr. 50 min.
4	38.7	490	1900	1 hr. 40 min.

The above series of experiments shows that with an increased amount of sugar there is a corresponding increase in loaf volume, weight of loaf, and quality of texture. The oven spring is excellent when large quantities of sugar are used; the crust browns very quickly and becomes very deep in color and thick around all sides of the loaf. The texture becomes especially spongy, silky and moist. Increased sugar seems to have a toughening action on the gluten. Sugar is necessary for the production of a good "bloom" or color of loaf, especially when the bread is made from the soft type of flour. Sugar also helps to retain freshness because the loaf takes on the desired color readily allowing less water evaporation. Seventeen grams of sugar gave the best results. More than this amount gave too sweet a taste to the bread.

TABLE 6.—VARIATION IN PROPORTION OF SALT

No. of loaves	Salt in gms.	Wt. of loaf in gms. 30 min. after baking	Loaf vol. in cc.	Total time
22	5	472	1870	2 hrs. 25 min.
12	6	475	1755	2 hrs. 45 min.
22	7	476	1737	2 hrs. 55 min.
4	8	478	1730	3 hrs. 20 min.
4	9	478	1776	3 hrs. 30 min.
4	11	487	1670	3 hrs. 49 min.
4	13	489	1635	3 hrs. 59 min.

Salt in small amounts makes the crumb of bread whiter, the dough easier to handle because the gluten is thus more elastic, retards fermentation, improves the color of the crust and brings out the nutty

flavor of the baked wheat grain. Salt increased beyond 5 grams, or about one teaspoon, increases the weight of the loaf of bread, and the length of time required for rising, and decreases loaf volume. With the larger amounts of salt there is, further, a noticeable loss in color of the crust, flavor and tenderness and fineness of texture. The texture becomes coarse, tough, rubbery and dark in color.

TABLE 7.—VARIATION IN PROPORTION OF SHORTENING

No. of loaves	Fat in gms.	Wt. of loaf in gms. 30 min. after baking	Loaf vol. in cc.	Total time
4	3.3	471	1795	2 hrs. 50 min.
22	6.5	472	1870	2 hrs. 25 min.
22	9.8	475	1895	2 hrs. 40 min.
6	13.0	477	1910	2 hrs. 49 min.
6	16.3	481	1915	2 hrs. 46 min.
6	19.5	482	1830	2 hrs. 43 min.
4	26.0	487	1760	2 hrs. 31 min.

An increase in the proportion of shortening results in increased weight, increased volume (to certain limits), elasticity and softness of gluten; also in decreased length of rising period and loaf volume, after two teaspoons per loaf. A little shortening gives a finer and more silky texture of crumb and a sheen and velvetiness of pile—as in the case of bread from hard wheat flour. Shortening also helps to prevent drying and adds nourishment. With the larger amount of lard, the texture becomes more tender, crumbly, heavy and yellow in color; the crust does not attain a rich brown color.

These series of experiments show that the small amount of gluten in the type of flour used requires a short fermentation period, but a proofing period long enough to treble its volume. It requires gentle kneading and mixing, increased yeast, increased sugar and a soft or slack dough to bring about the desired loaf volume and the moist, spongy and open texture associated with good bread. With the proper procedure and proportion of ingredients, good bread can be made from soft winter wheat flour in a very short time.

WORK WITH DRIED YEAST

Statement of the Problem.—The object of this part of the investigation was to find if dried yeast can be used in making light bread from Missouri soft wheat flour. The experimental work has been carried out along the following lines:

1. A study of the effect of procedure on the quality of the bread, with reference to the length of the preliminary fermentation period.

2. A study of the effect of the addition of various ingredients to the preliminary fermentation mixture and to the dough, on the quality of the bread.

3. A study of the effect on the quality of the bread of using different liquids when adding some form of gelatinized starch, potato or scalded flour, to the ferment.

Series I. Comparison of the Gas Production with Dried Yeast as Compared with that of Compressed Yeast.—Since the work on the use of dried yeast with Missouri soft wheat flour was based on that done with the compressed yeast, it was thought advisable to determine the comparative gas production of the two types of yeast.

Procedure.—Fermentation tubes, all of the same size, were used, and water, sugar and yeast in the same proportions as that used in a loaf of bread, cutting down the amounts so they would go into a fermentation tube: 12 grams of water, 1.2 grams of sugar and 1 gram of yeast, all combined at a temperature of 35°C. Perfectly fresh compressed yeast was used first and the amount of gas noted which was collected at the end of thirty minutes. This would show the gas production of the compressed yeast at the end of the thirty minute preliminary fermentation period, referred to above. Then dried yeast was used, using the same proportions as with the compressed, and the length of time determined for getting the same amount of gas as was obtained with the compressed in thirty minutes. The results are shown below:

TABLE 8.—RESULTS OF SERIES I, EXPERIMENT 1
Amount of gas formed in 30 minutes—compressed yeast.

Trials	Time started	After 30 minutes	Relative measure of gas
1	8:32	9:02	5.0
2	8:36	9:06	4.6
3	10:04	10:34	6.0

Discussion of Results; *Experiment* 1.—It was not deemed necessary to measure the exact volume of the gas since the arms of the tubes were of the same diameter. The length of the tubes where the gas had displaced the liquid gave a relative measure of the amount of gas. The average length was found to be 5.2 centimeters in thirty minutes.

TABLE 9.—RESULTS OF SERIES I, EXPERIMENT 2
Time necessary to reach 5.2 centimeters with dried yeast.

Trials	Time started	Time when gas reached 5.2 cm.	Number of minutes required to reach 5.2 centimeters
1	8:50	10:47	117
2	8:52	10:50	118
3	9:45	12:10	145
4	9:45	12:15	150

Conclusions.—From the fermentation tube experiments it took an average of one hundred twenty-nine minutes or approximately two hours ten minutes for the same amount of dried yeast to produce as much gas as the compressed yeast did in the thirty minutes.

Series II. Variations in One Cake and in One Package of Dried Yeast.—It was thought there might be some help in interpreting results derived from knowing whether the yeast in one cake and in one package ran uniform.

Procedure.—Twenty fermentation tubes, all of the same size, were selected. Each of the five cakes of yeast in one new package were divided in fourths. A fermentation test was run from each fourth of each cake, using the proportions referred to above: 12 grams of water, 1.2 grams of sugar and 1 gram of yeast, all combined at a temperature of 35°C. Each tube was carefully labeled and placed in the fermentation cabinet at a temperature between 30° and 35°C. They were left for two hours and ten minutes, and the amount of gas in each tube noted. The results are shown below:

TABLE 10.—RESULTS OF SERIES II, EXPERIMENT 1
Variations in one cake and in one package of dried yeast.

Cake and part of cake	Time started	Time after 2 hrs. 10 min.	Relative Gas production
1 a	8:19	10:29	3.5
1 b	8:21	10:31	3.4
1 c	8:22	10:32	3.5
1 d	8:23	10:33	3.0
2 a	8:30	10:40	4.2
2 b	8:31	10:41	3.0
2 c	8:32	10:42	2.7
2 d	8:33	10:43	3.5
3 a	8:39	10:49	6.8
3 b	8:41	10:51	4.2
3 c	8:42	10:52	4.0
3 d	8:50	11:00	8.5
4 a	11:02	1:12	3.5
4 b	11:04	1:14	2.5
4 c	11:06	1:16	1.6
4 d	11:08	1:18	7.5
5 a	11:10	1:20	6.5
5 b	11:12	1:22	6.0
5 c	11:14	1:24	2.5
5 d	11:16	1:26	9.0

The number in column one refers to the cake.
The letter in column one refers to the part of the cake.

Discussion of Results.—The four quarters of cake one ran very uniform in gas production, varying from 3.0-3.5; cake two showed more

variation, 2.7-4.2; cake 3 gave still more variation, 4.0-8.5; cake four varied still greater, 1.6-7.5; and cake five even greater than any of the others, 2.5-9.0. The range in all of the twenty quarters was from 1.6-9.0 with an average of 5.0 ± 0.3.

Conclusions.—The amount of gas produced by one cake of dried yeast varied greatly from that of another in the same package, also the amount of gas produced by one part of a cake of dried yeast varied greatly from that of another part of the same cake. If we assume that a coefficient of variation of less than ten per cent represents uniform material in biological studies, it becomes evident that a coefficient of variation of forty-three per cent represents exceedingly variable material.

Variation in the Length of the Preliminary Fermentation Period, Using 14 Grams of Dried Yeast.—In the preliminary experimental work, the dried yeast, mixed with the water and sugar and kept at a temperature of 30°-35° C. required two hours and ten minutes to produce as much gas as the compressed yeast did in thirty minutes. It was evident, then, that two hours and ten minutes would probably be the minimum period of time worth trying in determining the optimum preliminary fermentation period. The time for the preliminary fermentation period was varied from two hours and ten minutes to six hours and thirty minutes. The method and formula used were just the same as in the work with compressed yeast, except for the kind of yeast and the length of the preliminary fermentation period.

TABLE 11.—VARIATION IN THE LENGTH OF THE PRELIMINARY FERMENTATION PERIOD, USING 14 GRAMS OF YEAST

Exp.	No. of loaves	Preliminary Fermentation	Avg. time for first rising	Avg. time for second rising	Avg. total time after Preliminary fermentation	Avg. Volume in cubic centimeters
1	3	2′ 10″	2′ 34″	2′ 14″	5′ 47″	1500
2	3	3′ 15″	1′ 41″	1′ 49″	4′ 32″	1533
3	3	4′ 20″	1′ 39″	2′	4′ 39″	1483
4	3	5′ 25″	2′ 11″	1′ 59″	5′ 13″	1640
5	3	6′ 30″	1′ 48″	1′ 49″	4′ 24″	1632

The crumb in all of the bread in this series was very dark in color, due to the corn meal in the yeast. Fourteen grams of dried yeast is too large a quantity for a one pound loaf of bread. Since this large quantity of dried yeast would never give a crumb of good color it was thought advisable to try immediately a smaller quantity of yeast. Therefore one-fourth of this amount or 3.5 grams to each loaf was used.

With the fourteen grams of yeast, it seemed that three hours and fifteen minutes gave the optimum preliminary fermentation period. It would be reasonable then to assume that twelve hours would be the

minimum period of time worth trying in determining the optimum preliminary fermentation period for 3.5 grams of yeast.

TABLE 12.—VARIATION IN THE LENGTH OF THE PRELIMINARY FERMENTATION PERIOD, USING 3.5 GRAMS OF YEAST

No. of loaves	Pre. fer. period	Loaf vol. in cc.	Total time after pre. fer. period
5	12 hrs.	1556	7 hrs. 58 min.
6	18 hrs.	1600	7 hrs. 18 min.
3	24 hrs.	1543	7 hrs. 42 min.
3	36 hrs.	1500	8 hrs. 30 min.

None of the experiments of this series gave satisfactory bread from the standpoint of either texture or loaf volume, which seemed to show that the small amount of dried yeast needed something more in the long preliminary fermentation period than just the water and sugar.

Addition of Flour to the Preliminary Fermentation.—Most of the investigators on the use of soft wheat flours in breadmaking have agreed that the sponge process will not do for such flours but it was thought that a very small quantity of flour might be helpful in the preliminary fermentation.

It was found that small amounts of plain flour added to the preliminary fermentation seemed to improve the shape, oven spring, volume and texture. The small amount of flour (16.2 grams) seemed to give the best results. If as much as ten per cent of the flour is used, the total amount of flour seems to need cutting down somewhat to prevent the dough being too stiff. This then will cause too much of the gluten to be weakened by the long fermentation.

Addition of Extra Sugar to the Dough, After the Preliminary Fermentation.—As all of the loaves made so far were low in volume, as compared with the bread made from soft wheat flour and compressed yeast, it was thought that perhaps if extra sugar was added to the dough the loaves might be increased in volume. Also the results showed, so far, that the shorter the fermentation and proofing periods the better the resulting bread. There was then the possibility that extra sugar might hasten the fermentation and thus improve the bread.

Results showed that three grams of extra sugar, added after the preliminary fermentation period, shortened the fermentation and proofing periods, increased the bloom of the crust, increased the volume and seemed to improve the texture. In all of the following experiments 3 grams of extra sugar were added to the dough after the preliminary fermentation period.

In all of the previous experiments the fermentation and proofing periods were very long as compared with those where compressed yeast

was used. Also the shorter fermentation and proofing periods gave the best results with the dried yeast.

A study of the variation of the chemical composition of soft and hard wheat flours show the soft wheat flours containing less minerals than the hard wheat flours. It is contended that one of the factors of strength of flours depends on the relation between the concentration of the acids and soluble salts in the flour[2, 5] and that minerals seem to strengthen the gluten and hasten fermentation[4], therefore, potato water was used as the liquid. Results showed a greatly improved product but not a perfect one. Adding gelatinized starch in the form of potato or scalded flour gave excellent results.

Buttermilk contains eight and five tenths per cent milk solids and a little fat. It has a softening effect on the gluten due to its acidity. Doughs made with buttermilk mature much faster than doughs made with water, thus the fermentation period is shortened[3].

Addition of Minerals and Acids.—Buttermilk used as the liquid gave a loaf of greater volume, better texture, more oven spring and a much shorter total time than bread made with milk.

By the addition of lactic acid to milk, bringing it to the same acidity as the buttermilk, comparable results were obtained.

TABLE 13.—EFFECT OF ADDITION OF MINERALS AND ACIDS

No. of loaves	Pre. fer. period	Kind of liquid used	Kind of gelatinized starch used	Loaf vol. in cc.	Wt. of loaf in gms. 30 min. after baking	Total time after pre. fer. period
9	18 hrs.	plain water	none	1570	455	5 hrs. 21 min.
3	12 hrs.	plain water	none	1447	450	6 hrs. 5 min.
21	18 hrs.	potato water	16.2 gms. scalded flour	1605	460	4 hrs. 10 min.
9	12 hrs.	potato water	75 gms. potato	1825	482	2 hrs. 42 min.
6	12 hrs.	potato water	25 gms. potato	1810	452	2 hrs. 55 min.
13	12 hrs.	potato water	16.2 gms. scalded flour	1773	475	2 hrs. 45 min.
9	12 hrs.	½ milk ½ potato water	75 gms. potato	1665	495	2 hrs. 49 min.
10	12 hrs.	½ milk ½ potato water	16.2 gms. scalded flour	1650	492	3 hrs. 0 min.
9	12 hrs.	½ buttermilk ½ potato water	75 gms. potato	1699	487	2 hrs. 41 min.
10	12 hrs.	½ buttermilk ½ potato water	16.2 gms. scalded flour	1830	483	2 hrs. 39 min.
7	12 hrs.	½ milk ½ potato water 1.5 cc. lactic acid	16.2 gms. scalded flour	1765	490	2 hrs. 46 min.

These experiments show that potato and scalded flour as forms of gelatinized starch gave comparable results.

A slightly larger volume was obtained by the addition of acid in the form of buttermilk.

All loaves had good volume, excellent oven spring and a fine silky texture with thin cell walls.

WORK WITH LIQUID YEAST

Statement of the Problem.—The object of this part of the investigation was to find if liquid yeast can be successfully used with Missouri soft winter wheat flour.

The experimental work consisted of a study of the effect on the quality of the bread of the addition of various ingredients to the liquid yeast and to the preliminary fermentation mixture.

For this series of experiments the same basic formula and method were used as in the previous experiments.

These experiments show that excellent bread can be made from Missouri soft wheat flour using liquid yeast. This bread was comparable in every respect to that made with compressed or dried yeast. Results showed that liquid yeast made up at night and added to the flour, salt and lard mixture at the end of twelve hours did not give good results with this type of flour. The volume was small and the texture was coarse and hard. The dough required such a long time to double its bulk that the bread had a sour taste and smell.

With dried yeast the best results were obtained by the use of some form of gelatinized starch in the preliminary ferment of a period of 12 hours and acid added in the form of buttermilk, thus these were tried with the liquid yeast. Results showed that a much better loaf of bread was obtained by using only a small amount of the liquid yeast and the addition of potato water or buttermilk as the rest of the liquid. Potatoes as the gelatinized starch and potato water as the liquid gave the best loaf of the series. Gelatinized corn starch also gave excellent results.

Some experimenters[7] are suggesting that cane sugar, before it is available food for the yeast, must be broken down into the monosaccharide or simple sugar form. Thus corn syrup was tried in place of the cane sugar. The syrup seemed to vary from week to week in its composition and although at times excellent results were obtained with the syrup, cane sugar seemed to give the best results from day to day.

Apple and apple water with liquid yeast gave bread of excellent quality. This bread had a fine silky texture and excellent volume. It seemed to keep fresh longer than any of the bread made from Missouri soft wheat flour.

TABLE 14.—RESULTS OF EXPERIMENTS WITH LIQUID YEAST
(Variation in proportion of liquid yeast used and in kind and amount of sugar)

No. of loaves	Pre. fer. period in hours	Kind of liquid used	Kind of gelatinized starch used	Kind of sugar in starter	Kind of sugar in dough	loaf vol. in cc.	Wt. of loaf in gms. 30 min. after baking	Total time after pre. fer. period
9	12	All liquid yeast	None	cane sugar	17.2 gms. cane sugar	1602	498	5 hrs. 51 min.
9	12	All liquid yeast	None	corn syrup	17.2 gms. corn syrup	1605	500	5 hrs. 45 min.
6	18	All liquid yeast	None	cane sugar	3 gms. sugar	1450	457	6 hrs. 00 min.
6	18	All liquid yeast	None	cane sugar	6 gms. sugar	1500	460	5 hrs. 40 min.
6	18	All liquid yeast	None	cane sugar	10 gms. sugar	1500	460	5 hrs. 30 min.
9	18	All liquid yeast	16.2 gms. scalded flour	cane sugar	16.2 gms. sugar	1710	477	3 hrs. 23 min.
8	12	3 parts liquid yeast 1 part buttermilk	16.2 gms. scalded flour	cane sugar	16.2 gms. sugar	1564	496	4 hrs. 28 min.
6	12	1 part liquid yeast 1 part buttermilk	16.2 gms. scalded flour	cane sugar	16.2 gms. sugar	1650	505	4 hrs. 40 min.
15	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	cane sugar	16.2 gms. sugar	1750	505	4 hrs. 10 min.
14	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	corn syrup	17.2 gms. syrup	1712	500	3 hrs. 34 min.
11	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. corn starch	corn syrup	17.2 gms. syrup	1800	505	3 hrs. 58 min.
14	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	sugar	17.2 gms. syrup	1708	500	3 hrs. 50 min.
12	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	syrup	17.2 gms. sugar	1710	503	3 hrs. 55 min.
10	12	1 part liquid yeast 2 parts buttermilk	16.2 gms scalded flour	syrup	20 gms. syrup	1715	500	3 hrs. 55 min.
5	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	syrup	25 gms. syrup	1650	498	4 hrs. 30 min.
5	12	1 part liquid yeast 2 parts buttermilk	16.2 gms. scalded flour	syrup	30 gms. syrup	1600	490	4 hrs. 40 min
21	12	1 part liquid yeast 2 parts potato water	75 gms. potato	sugar	sugar	1870	504	4 hrs. 39 min.
15	12	1 part liquid yeast 2 parts buttermilk	75 gms. potato	sugar	sugar	1850	501	4 hrs. 30 min.
6	12	1 part liquid yeast 2 parts potato water	75 gms. potato	syrup	syrup	1600	500	7 hrs. 00 min.
15	12	1 part liquid yeast 2 parts apple water	75 gms. apples	sugar	sugar	1825	495	3 hrs. 44 min.
7	12	1 part liquid yeast 2 parts apple water	75 gms. apples	syrup	syrup	1650	480	4 hrs. 45 min.

SUMMARY

The results of the above experiments have conclusively shown that light bread can be made from the softer flours, using either compressed yeast, dried yeast or a starter, comparable in quality to that made from our best hard wheat flours, and in much less time—two and one-half to three and one-half hours being the total time after the preliminary fermentation period.

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Apparatus for Taking Loaf Volumes.
No. 6026 of the Central Scientific Company, Chicago, Illinois

The loaf volume was measured by displacement of millet seed, the apparatus being so constructed that the exact volume of the loaf could be read directly. This piece of apparatus consisted of the following parts: A rectangular hopper of sufficient size to contain the loaf to be tested, an auxilliary filling funnel, a measuring burette with a graduated glass front, and a stand provided with two ring clamps for holding the hopper and funnel in place.

EXPERIMENTS WITH FLEISCHMANN'S COMPRESSED YEAST AND MISSOURI SOFT WHEAT FLOUR

Variation in Amount of Risings Before and After Dough Is Panned.

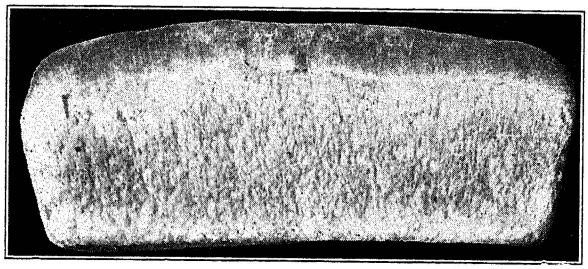


Fig. 1.—Increased in volume four times in first rising period. Trebled in volume after panned

Fig. 2.—Doubled in volume before panned (first rising period). Doubled in volume after panned.

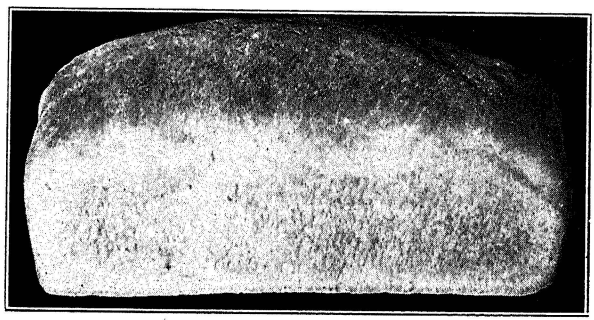


Fig. 3.—Doubled in volume before panned (first rising period). Trebled in volume after panned.

Only one rising before dough was panned, in each case.

Comparison of Best Procedures of Each Series.

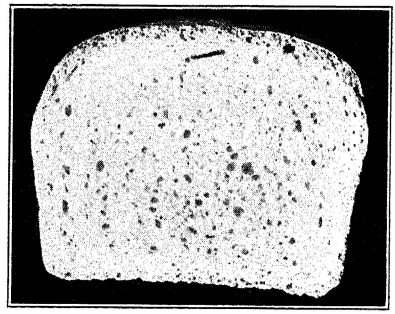


Fig. 4.—Treble; treble; treble;

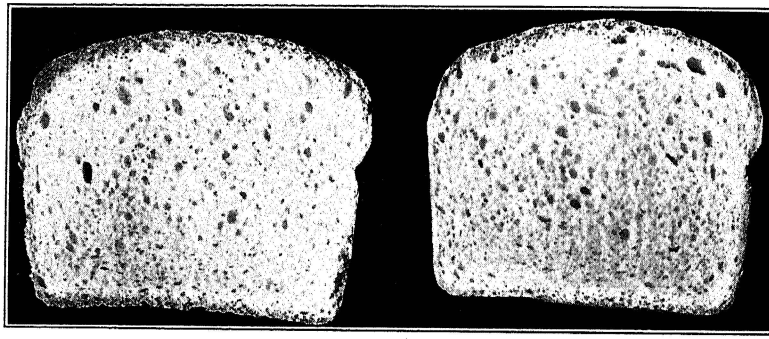


Fig. 5.—Double; double; treble. Treble; treble.

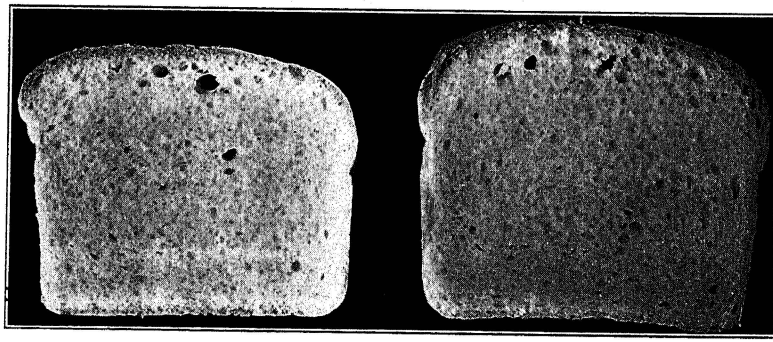


Fig. 6.—Treble; two and three-fourths Double; treble

Increasing the Liquid. The Percentages Indicate the Ratio of the Weight of the Liquid to that of the Flour Used.

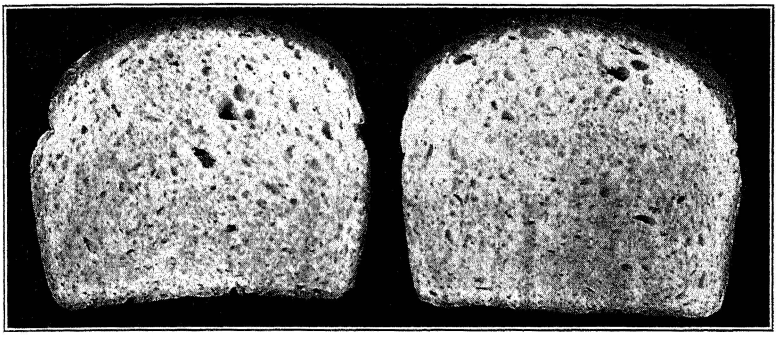


Fig. 7. 48% 49%

Fig. 8. 50% 51%

Fig. 9. 52% 53%

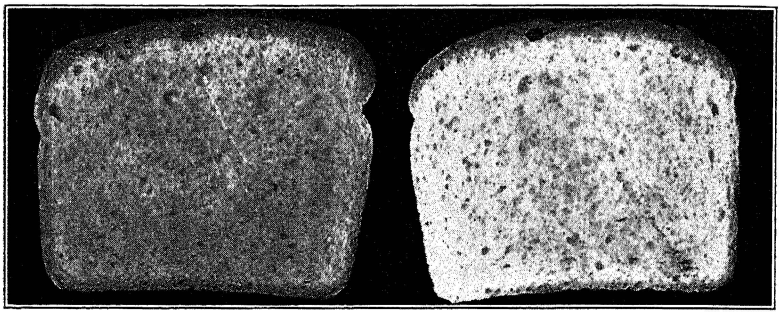


Fig. 10. 54% 55%

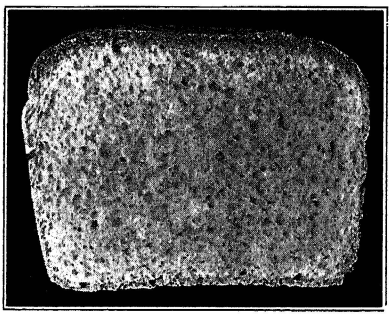
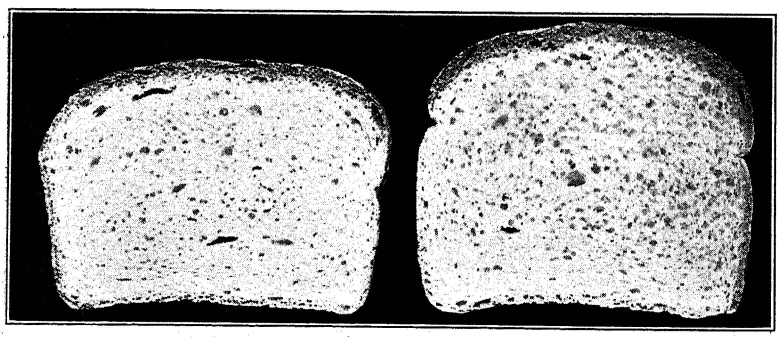


Fig. 11. 56%

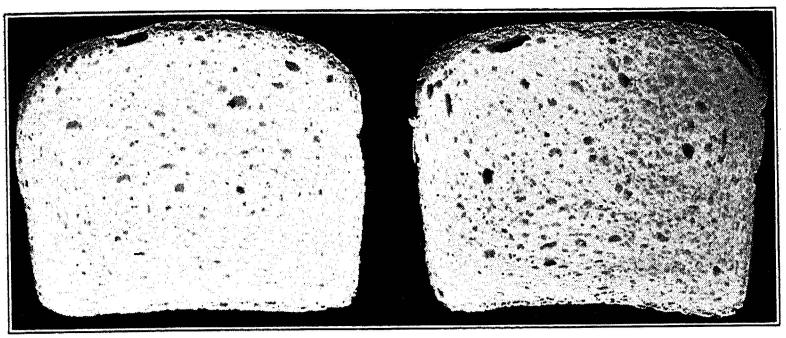
Effect of Increasing the Yeast (Figs. 12 to 15)



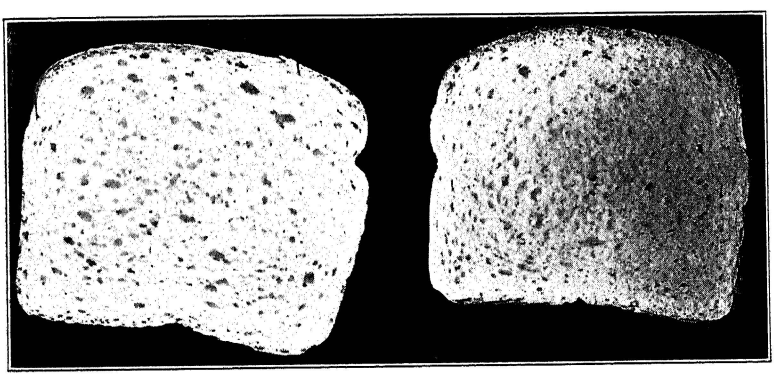
3.5 gms. (¼ cake) 7 gms. (½ cake).

Fig. 12.—Effect of Increasing the Yeast.

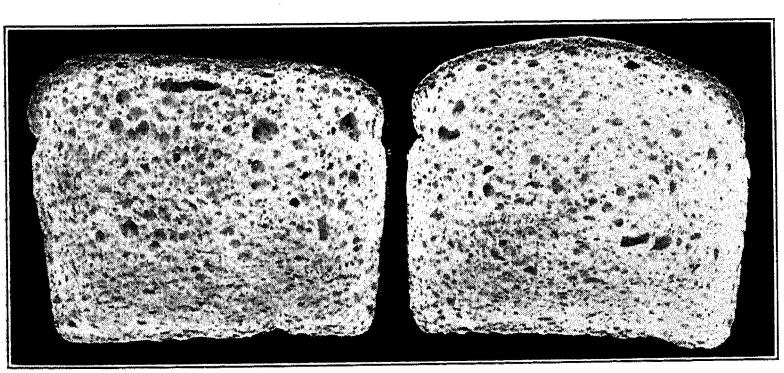
Figs. 13, 14, and 15.—Effect of Increasing the Yeast.



10 gms. (5-7 cake) 14 gms. (1 cake)

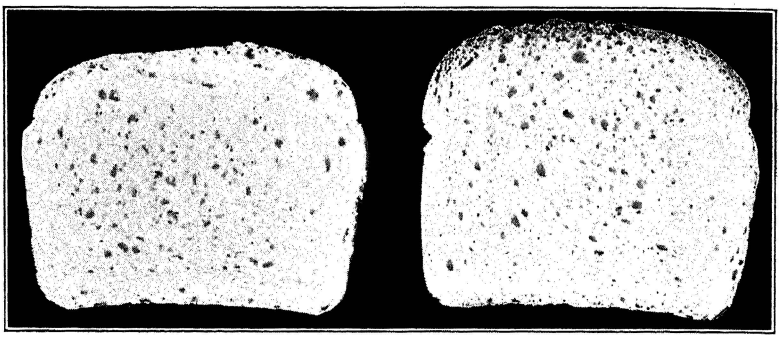


21 gms. (1½ cakes) 28 gms. (2 cakes).

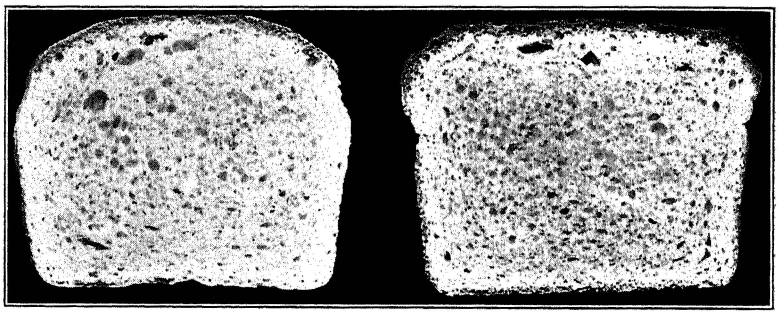


42 gms. (3 cakes) 56 gms. (4 cakes)

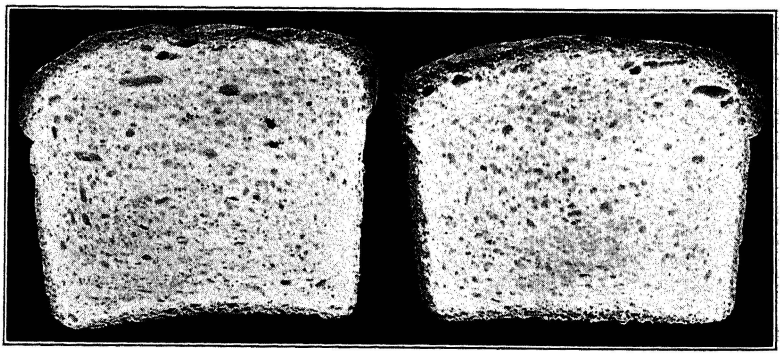
Figs. 16, 17, 18 and 19.—Effect of Increasing Sugar.



4.3 gms. (1 tsp.) 8.6 gms. (2 tsp.)



10 gms. (scant tsp.) 17.2 gms. (4 tsp.)



25.8 gms. (6 tsp.) 34.4 gms. (8 tsp.)

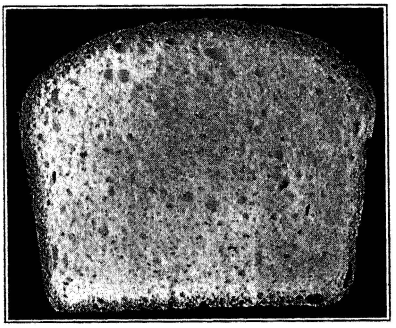
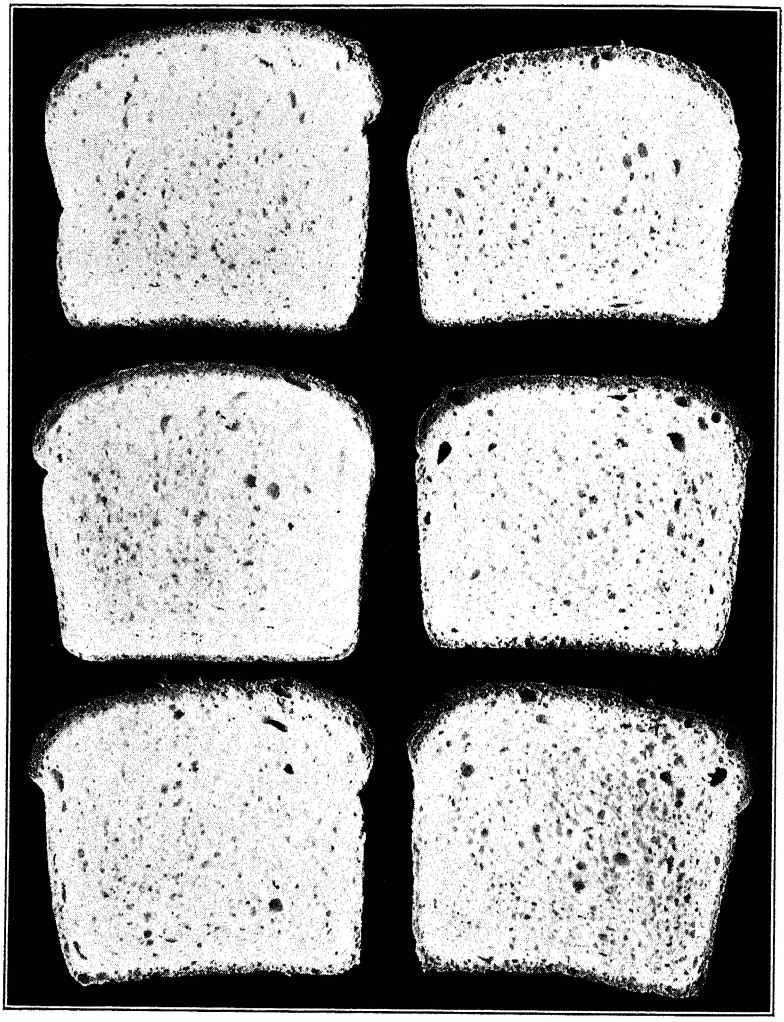


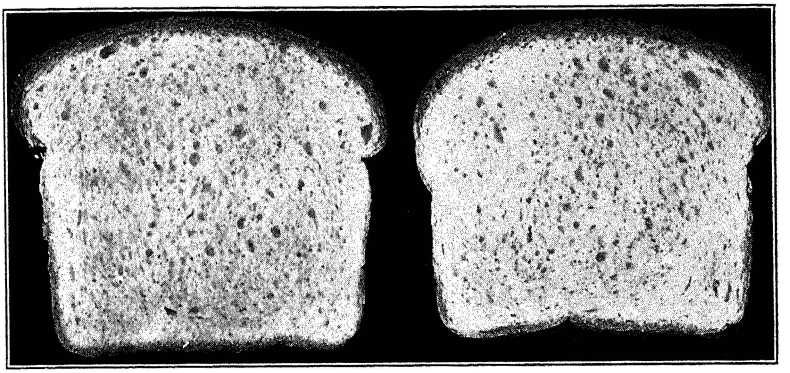
Fig. 19.—38.7 gms. (9 tsp.)

Fig. 20.—Variation of Yeast in Two Series of Experiments Having Different Percentages of Water But Same Amount of Sugar.

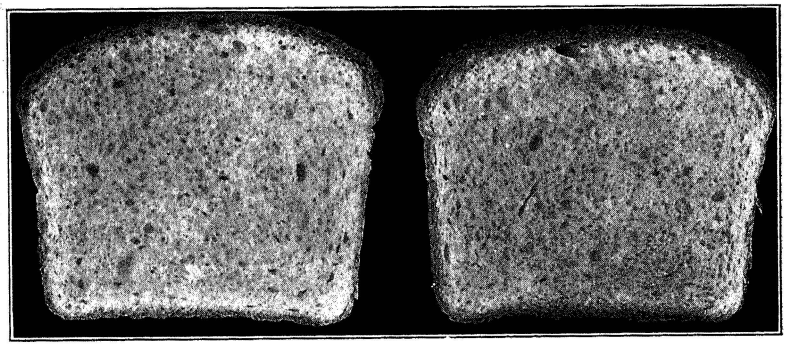


Series at left: Water constant, 169 gms. (52%); sugar constant 17.2 gms. (4 tsp.); yeast varying, reading down from top, 10 gms., 14 gms., and 21 gms., respectively. Series at right: Water constant, 172.3 gms. (53%); sugar constant, 17.2 gms. (4 tsp.); yeast varying exactly as in series at left.

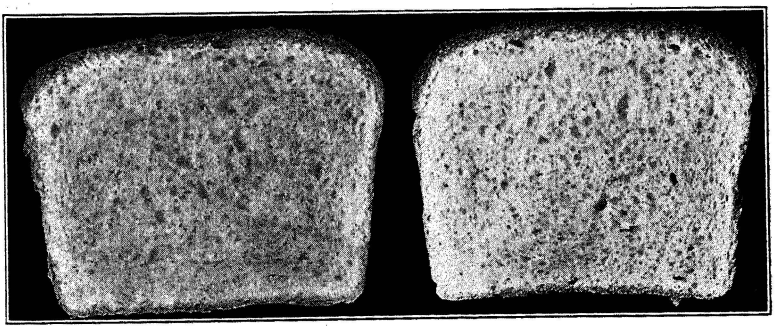
Figs. 21, 22, 23, and 24.—Effect of Increasing the Salt.



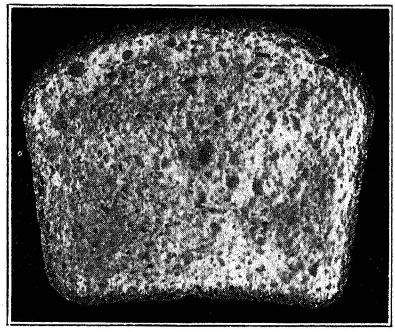
5 gms. (1 tsp.) 6 gms.



7 gms. 8 gms.

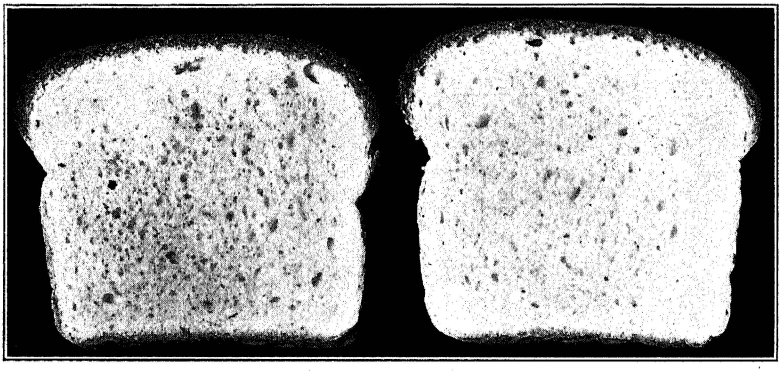


9 gms. 11 gms.

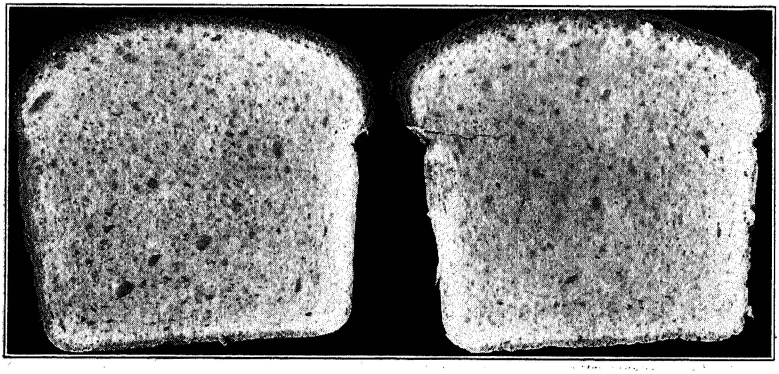


13 gms.

Figs. 25, 26, 27, and 28.—Effects of Increasing the Amount of Shortening.

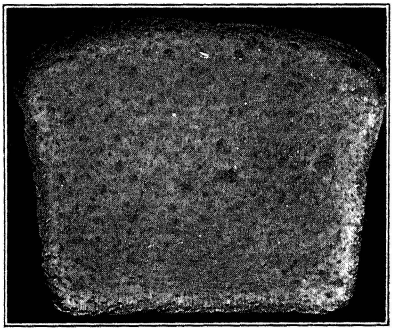


3.3 gms. (½ tsp.) 6.5 gms. (1 tsp.)



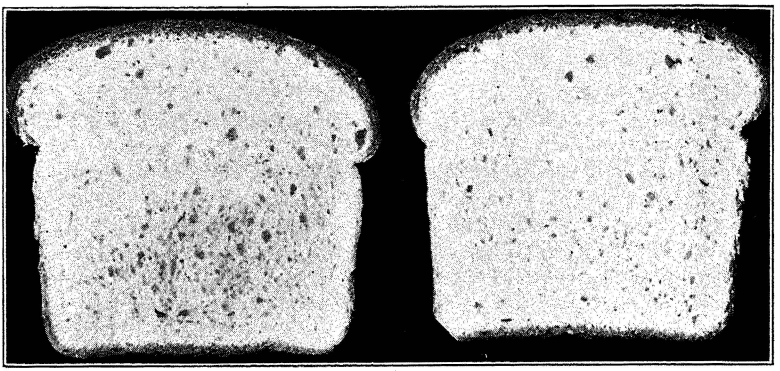
9.8 gms. (1½ tsp.) 13.0 gms. (2 tsp.)

16.3 gms. (2½ tsp.) 19.5 gms. (3 tsp.)



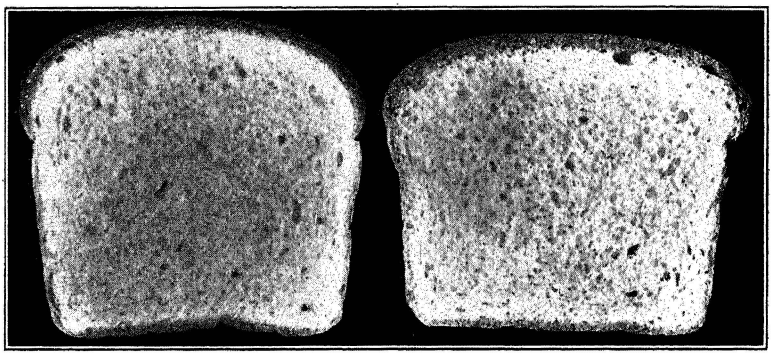
26.0 gms. (4 tsp.)

Figs. 29, 30, and 31.—Effects of Varying the Amounts of Salt and Shortening.



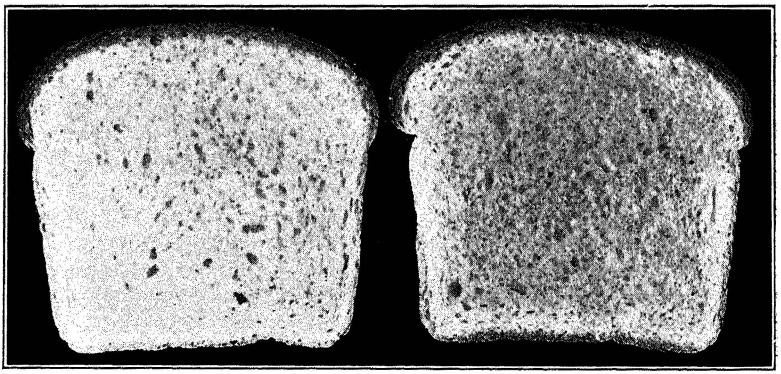
5 gms. Salt
6.5 gms. lard (1 tsp.)

5 gms. Salt
9.8 gms. lard (1½ tsp.)



6 gms. Salt
6.5 gms. Lard

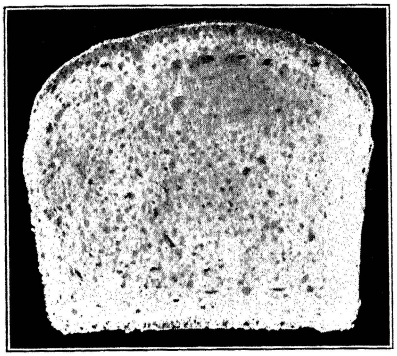
6 gms. Salt
9.8 gms. Lard



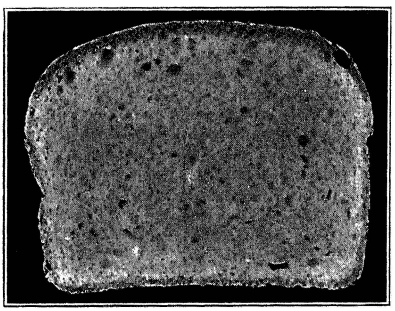
7 gms. Salt
6.5 gms. Lard

7 gms. Salt
9.8 gms. Lard

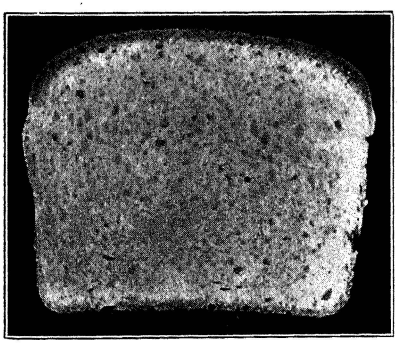
Figs. 32, 33, and 34.—Comparison of Bread Made from Hard and Soft Wheat Flour.



Soft winter wheat flour (Boone County High Patent.) Doubled bulk before panned. Trebled bulk after panned.



Hard winter wheat flour (GoldMedal). Doubled bulk before panned. Doubled bulk after panned. Ordinary home method.



Hard winter wheat flour (Gold Medal). Doubled bulk before panned. Increased in bulk by two and one-half times after panned.

To obtain best results with most bread flours, the dough must be allowed to treble its bulk twice before it is panned. This requires about seven hours total. Bread from soft winter wheat flour (Missouri) requires not more than three hours to make.

EXPERIMENTS WITH DRIED YEAST AND MISSOURI SOFT WHEAT FLOUR

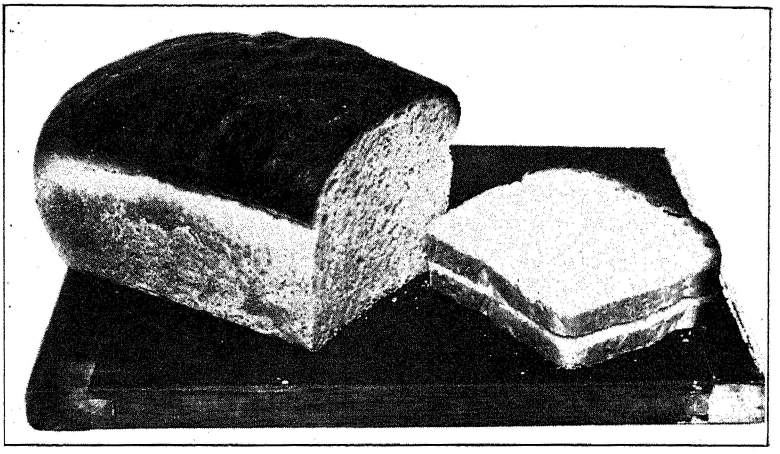


Fig. 35.—Bread made with potato and potato water.

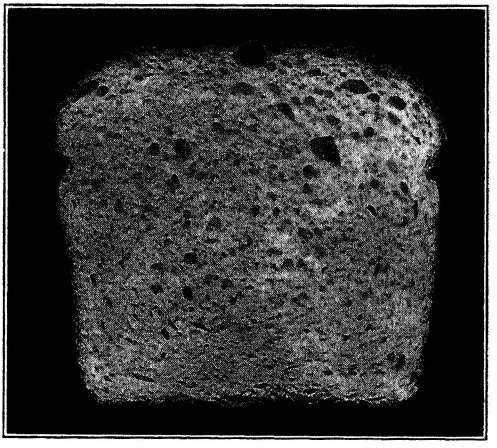


Fig. 36.—Slice from loaf made with potato and potato water.

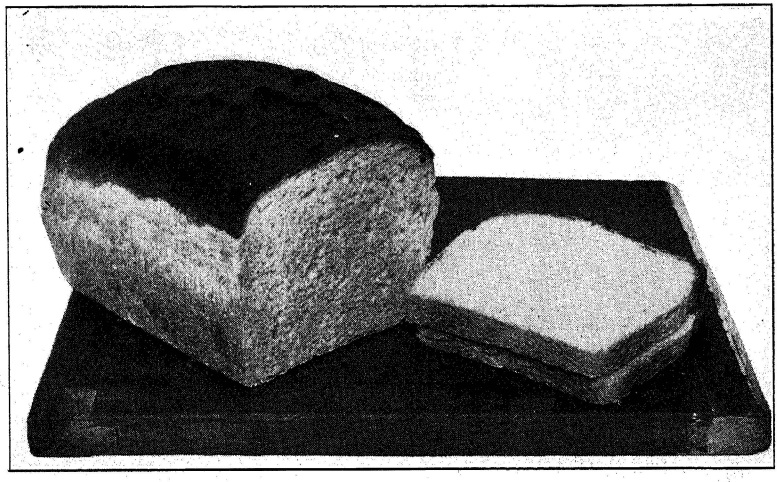


Fig. 37.—Bread made with scalded flour and potato water.

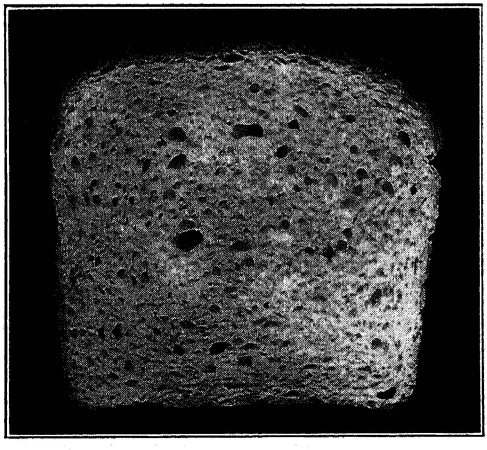


Fig. 38.—Slice from loaf made with scalded flour and potato water.

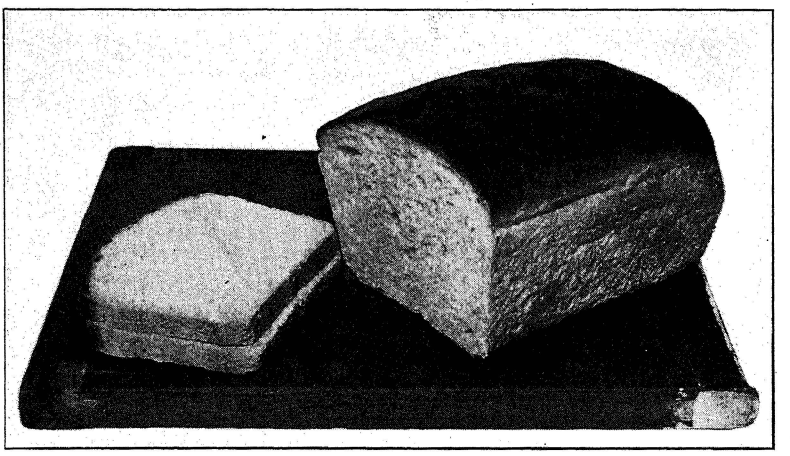


Fig. 39.—Bread made with potato and milk.

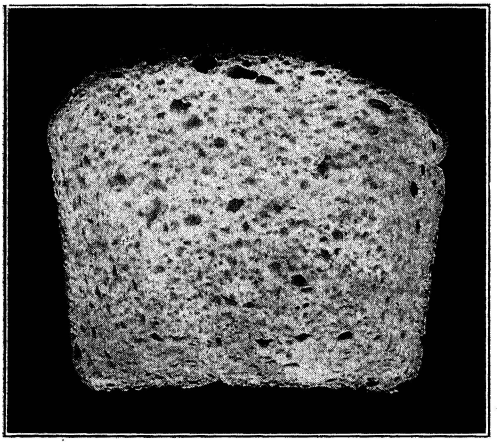


Fig. 40.—Slice from loaf made with potato and milk.

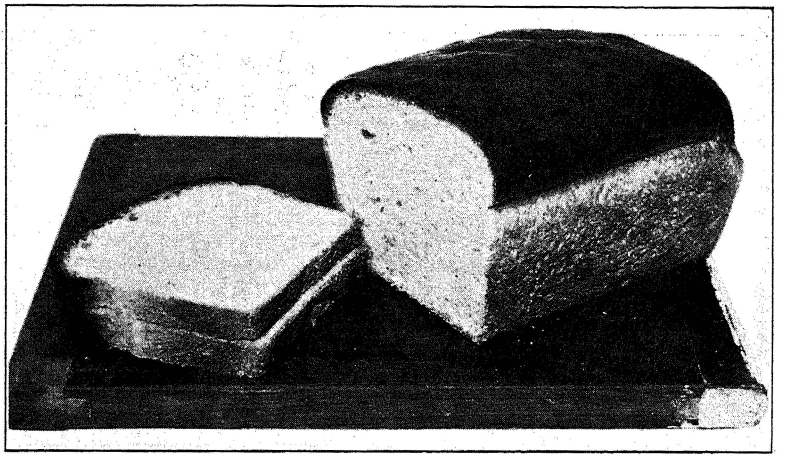


Fig. 41.—Bread made with potato and buttermilk.

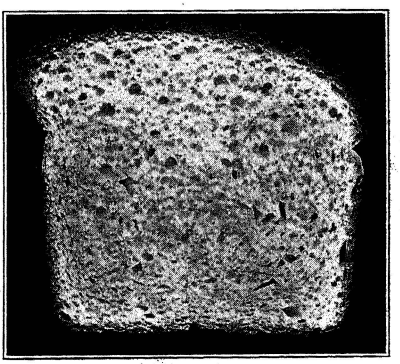


Fig. 42.—Slice from loaf made with potato and buttermilk.

EXPERIMENTS WITH LIQUID YEAST AND MISSOURI SOFT WHEAT FLOUR

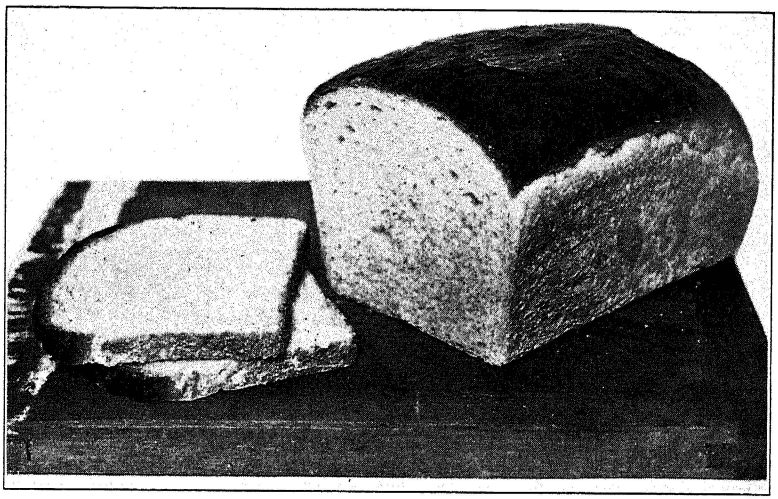


Fig. 43.—Bread made with liquid yeast, potato and potato water.

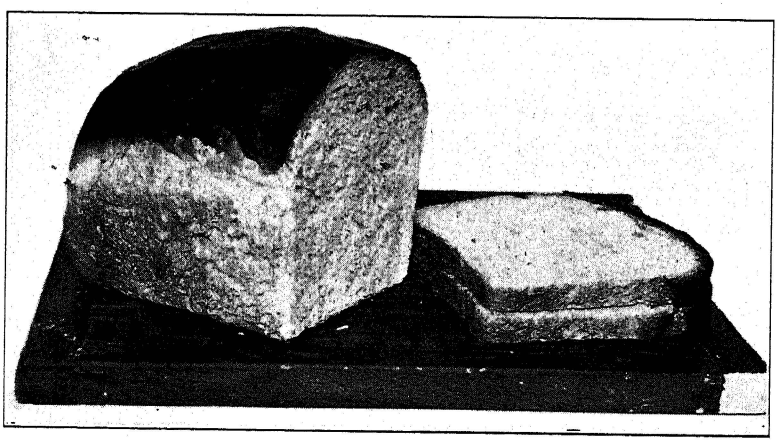


Fig. 44.—Bread made with liquid yeast, apples, and apple water.

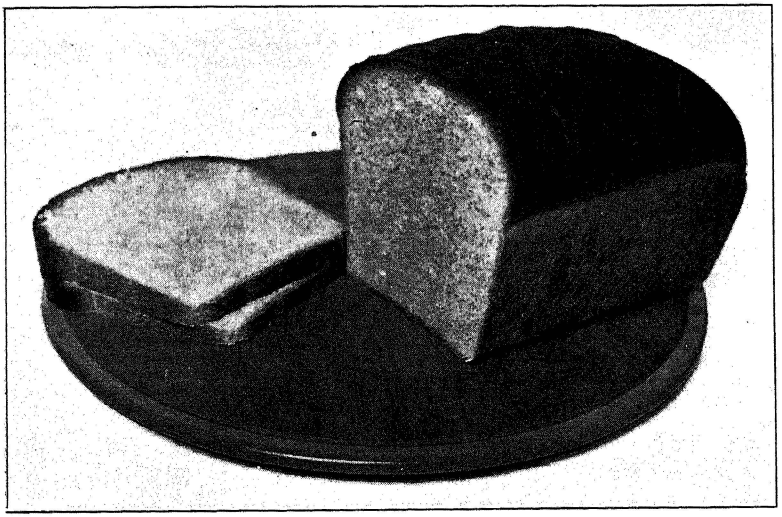


Fig. 45.—A loaf made with Fleischmann's compressed yeast.