2-1-1929

Bulletin No. 162 - Making Bread From Wyoming Flour

University of Wyoming Agricultural Experiment Station

Follow this and additional works at: http://repository.uwyo.edu/ag_exp_stabulletins

Part of the Agriculture Commons

Publication Information
University of Wyoming Agricultural Experiment Station (1929). "Bulletin No. 162 - Making Bread From Wyoming Flour." University of Wyoming Agricultural Experiment Station Bulletin 162, 53-76.
Making Bread From Wyoming Flour

Bulletins will be sent free upon request.
Address: Director of Experiment Station, Laramie, Wyoming.
UNIVERSITY OF WYOMING
Agricultural Experiment Station
LARAMIE, WYOMING

BOARD OF TRUSTEES

Officers
FRANK A. HOLLIDAY ............................................. President
D. P. B. MARSHALL ............................................ Vice President
FRED W. GEDDES ................................................ Treasurer
FAY E. SMITH ..................................................... Secretary
E. O. FULLER .................................................... Fiscal Agent

Executive Committee
FRANK A. HOLLIDAY FRED W. GEDDES JOSEPH A. ELLIOTT

Members
Appointed Term Expires
1921 JOSEPH A. ELLIOTT 1933
1921 FRED W. GEDDES 1933
1923 FRANK A. HOLLIDAY 1929
1923 D. P. B. MARSHALL 1929
1923 P. J. QUEALY 1931
1925 HARRIETT T. GRIEVE 1931
1925 J. M. SCHWOOH 1931
1927 WILL M. LYNN 1933

FRANK C. EMERSON, Governor of Wyoming Ex Officio
KATHARINE A. MORTON, State Superintendent of Public Instruction Ex Officio
A. G. CRANE, Ph.D., President of the University Ex Officio

STATION STAFF*

A. G. CRANE, Ph.D., President
J. A. HILL, B.S., Wool Specialist, Director
FAY E. SMITH ..................................................... Secretary
O. A. BEATH, M.A............................................... Station Chemist
HELEN BULBROOK, M.S................................. Assistant Home Economist
ROBERT H. BURNS, M.S.............................. Assistant Wool Specialist
C. L. CORKINS, M.S........................................... Entomologist
T. J. DUNNEWALD, M.S............................ Assistant Soil Investigations
T. E. ECKERT, M.S........................................... Research Pathologist
CECIL ELDER, D.V.M., M.S.......................... Assistant Chemist
H. F. EPPSON, B.S........................................... Assistant Chemist
C. HAROLD GILBERT, M.S.......................... Assistant Research Apiculturist
C. S. GILBERT, M.A........................................... Assistant Research Apiculturist
GLEN HARTMAN, B.S........................................... Assistant Agronomist
FRANK E. HEPMAN, M.S............................... Head of Weather Station
FRED S. HULTZ, Ph.D............................ Assistant Animal Husbandman
FRANK J. KOHN B.S............................... Assistant Poultry Specialist
AUBREY M. LEE, D.V.M................................. Assistant Veterinarian
O. C. McCREARY, Ph.D............................... Assistant Chemist
ELIZABETH J. MCKITTERICK, M.S.................... Home Economist
A. R. McLAUGHLIN, M.A., D.V.M., Ph.D........................ Research Assistant Physiologist and Pharmacologist
O. A. NEGAARD, B.S........................................... Assistant Agronomist
AVEN NELSON, Ph.D............................... Botanist and Horticulturist
LEO J. PASCHAL, B.S................................. Assistant Animal Husbandman
HARRY PEARSON, B.S............................... Assistant Animal Husbandman
T. R. PHELPS, D.V.M............................... Assistant Veterinarian
W. L. QUAYLE, B.S.............................. Director of Experiment Farms
JOHN W. SCOTT, Ph.D............................... Zoologist and Parasitologist
†A. P. STURTEVANT, Ph.D.............................. Associate Apiculturist, in charge of U. S. Bee Culture Field Station

HARVEY L. SWEETMAN, M.S............................... Assistant Research Entomologist
A. F. VASS, Ph.D........................................... Assistant Agronomist
S. S. WHEELER, M.S........................................... Assistant Animal Husbandman
VIRGINIA WHITTIER, M.A............................................. Assistant Research Zoologist
JAMES S. WIANT, Ph.D............................... Assistant Agronomist, Plant Pathologist
H. S. WILLARD, M.S........................................... Assistant Animal Husbandman
REBA DAVIS, B.L.S........................................... Librarian
ALMA MAYCOOK ............................................ Clerk

†In cooperation with the U. S. Department of Agriculture.
Making Bread From Wyoming Flour

ELIZABETH J. McKITTRICK
EDITH G. GRUNDMEIER

INTRODUCTION

In every state where any amount of wheat is raised, there is considerable interest in the question of its suitability for use in bread-making. It is generally recognized that flours from different kinds of wheat do not make equally good bread. Loaves made in exactly the same way and under the same conditions, but from different kinds of flour, will vary in size, shape, texture, color and flavor. Likewise, in different parts of the country, different qualities of flour are produced from the same variety of wheat. With such variation in the bread-making qualities of flour due to different varieties and to different conditions of production, it is important and of much value for each state to know the quality of flour produced and to investigate methods for making good bread from it.

No work has been reported on bread-making from Wyoming flours even though there has been some complaint about them from time to time. It has been and is now the custom of many Wyoming housewives to use flour shipped in from outside the state. Consumption of home-grown products where these are of good quality should be supported to encourage local production, and to benefit both the home producer and consumer by lower prices due to elimination of shipping costs.

Statistics show that Wyoming produces much more wheat than is necessary to supply the state with flour. The preliminary figures for 1927 (1)* give Wyoming a wheat acreage of 226,000 acres and a production of 4,412,000 bushels of wheat, an average of 19.5 bushels per acre. The U. S. Census Bureau (2) estimates the population on January, 1928, at 247,000. Since the average consumption of wheat per capita for the United States in 1926 was 4.3 bushels (1) it is readily seen that, with a production of 4,412,000 bushels of wheat and a population of 247,000, Wyoming raises four

*The figures in parentheses correspond to numbered references under "Literature Cited" at the end of this bulletin.
times the amount of wheat required for its own consumption. It is, then, of interest and importance to the state to investigate the use of Wyoming flours in bread-making and to determine whether the high altitude presents new factors in baking.

HISTORY AND LITERATURE

Considerable material which deals with flour from a particular section has been published, from time to time, by experiment stations. These bulletins are alike in one respect, in that they deal with some problems connected with the making of good bread from wheat raised within the state. In Missouri (3, 4), Indiana (5), and Arizona (6, 7) it was the problem of making satisfactory bread from soft wheat flour. In Ontario (8), the question of blending hard western wheat with the weaker Ontario wheats was studied. In Wisconsin (9) bread from home-grown wheat was compared with that made from the same variety but grown in another state. In Idaho (10) the bread-making qualities of dry-land with irrigated wheat, both grown in the state, were compared. Illinois (11) published a bulletin which contains a general discussion on the subject of bread-making. Montana (12) published a bulletin which deals with the effect of various amino compounds on baking quality and the effect of aging on flour. The Kansas State Agricultural College (13, 14, 15) and the University of Minnesota (16, 17, 18, 19, 20, 21) as well as the U. S. Department of Agriculture (22, 23, 24, 25, 26), have carried on extensive investigations on wheat, flour, and baking tests.

Very little work has been done on Wyoming wheat. However, some samples from the experiment stations at Sheridan and Archer, Wyoming, were used in a varietal test by Shollenberger and Clark (20). With one exception these results are not available as they were included in the general average of results from the same variety in all states. Marquis wheat, a variety of hard red spring wheat, was reported sectionally from twelve western experiment stations, and the results were as follows: Samples grown at Archer the years 1917-21, inclusive, had an average of 14.2 per cent crude protein, which is a little below the general average, 15.17 per cent, for this variety. These samples yielded an
average of 70.5 per cent straight flour. This is very slightly above that of the average yield, 70.3 per cent, from all stations. The water absorption of 61.4 per cent for these samples was above the average 60.1 per cent from all of the stations, and was exceeded by only one station. The average loaf volume of 2,264 cc. corresponds to the general average of 2,260 cc. From this information is is seen that Marquis wheat grown in Wyoming compares favorably in quality to that from other sections of the West.

STATEMENT OF PROBLEM

The purpose of the work reported in the following pages was to determine the quality of Wyoming hard and soft wheat flours, the methods of handling, and the proportions in recipes which will insure the best possible results; and to determine whether baking bread at this altitude (7,159 feet) requires a longer time or a higher temperature, or both, than at the lower altitudes in which other experimental baking laboratories have been located. As yet only hard wheat flour has been experimented upon.

METHOD OF PROCEDURE

Equipment. The equipment used included a Cenco balance for weighing, small tin boxes in which flour was weighed, crockery mixing bowls, calibrated expansion tubes, special bread pans, like those used in the Montana baking laboratory (27), an electric proofing cabinet, and an electric oven. After the problems were worked out satisfactorily with this laboratory equipment they were then carried out under as nearly home conditions as possible to test the practicability of the recipe and the method of procedure.

Material Used. Since the quality of flour from but one class of wheat could be considered at a time, the wheat having the largest acreage in Wyoming, hard red spring wheat, was selected for experimentation. The brands of flour used were: “Wheatland” from Platte County, “Diamond D” and “Best-Out-West” from Sheridan County, “Wyoma,” made from an irrigated Marquis wheat from Fremont County, and “Kaycee,” made from hard spring wheat of the Marquis variety, from Johnson County.
Laramie tap water was used in amounts as indicated by a predetermination of the absorption of the flour. Fleischmann's compressed yeast was used, obtained fresh when needed. Commercial salt and sugar were used. Crisco served as shortening.

DETERMINATIONS ON FLOURS

1. Absorption. The percentage of water required to make a stiff dough from a definite quantity of flour is called the absorption power. The absorption power of each flour used was determined from time to time by the method used in the Montana Grain Inspection Laboratory (2) which is as follows:

Place 25 grams of flour in a cup and add water from a burette. Stir and work with heavy spatula until the dough just begins to get sticky when pressed lightly in the hand. The cubic centimeters of water used times four equals the per cent of absorption.

The following table shows the water absorption of various flours used:

<table>
<thead>
<tr>
<th>Flour</th>
<th>Percentage Absorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best-Out-West</td>
<td>.67</td>
</tr>
<tr>
<td>Diamond D</td>
<td>.65</td>
</tr>
<tr>
<td>Kaycee</td>
<td>.66</td>
</tr>
<tr>
<td>Wheatland Royal</td>
<td>.69</td>
</tr>
<tr>
<td>Wyoma</td>
<td>.70</td>
</tr>
</tbody>
</table>

2. Wet and Dry Gluten. The official method was used for the determination of wet and dry gluten. A summary of the results obtained in our work appears in the following table:
TABLE II
PERCENTAGE WET AND DRY GLUTEN IN WYOMING FLOURS

<table>
<thead>
<tr>
<th>Kind of Flour</th>
<th>No of Tests</th>
<th>Per cent Wet Glut'n</th>
<th>Per cent Variation</th>
<th>Per cent Dry Glut'n</th>
<th>Per cent Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wyoma</td>
<td>5</td>
<td>38.56</td>
<td>4.4</td>
<td>12.36</td>
<td>.8</td>
</tr>
<tr>
<td>Wheatland</td>
<td>6</td>
<td>33.73</td>
<td>6.8</td>
<td>11.87</td>
<td>.4</td>
</tr>
<tr>
<td>Best-Out-West</td>
<td>4</td>
<td>39.12</td>
<td>2.0</td>
<td>13.28</td>
<td>.4</td>
</tr>
<tr>
<td>Diamond D</td>
<td>5</td>
<td>40.52</td>
<td>4.0</td>
<td>13.36</td>
<td>.4</td>
</tr>
<tr>
<td>Kaycee</td>
<td>4</td>
<td>40.60</td>
<td>5.2</td>
<td>13.50</td>
<td>.4</td>
</tr>
</tbody>
</table>

From all available sources it was found that the dry gluten from hard wheat flours ranges from 11.5 to 14.5 per cent. It can be seen from the above table that the dry gluten figures for Wyoming flours fall within this range. A high dry-gluten figure is indicative of rapid rising but is not essential for the making of good bread if all other properties of the flour are what they should be.

3. Crude Protein. The chemical determination most commonly used as an indication of the strength of a flour is that of crude protein. At Kansas State Agricultural College, Wyoming flours gave the following results:

TABLE III
CRUDE PROTEIN IN WYOMING FLOURS

<table>
<thead>
<tr>
<th>Flour</th>
<th>Average Per Cent Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best-Out-West</td>
<td>10.20</td>
</tr>
<tr>
<td>Wheatland</td>
<td>10.60</td>
</tr>
<tr>
<td>Wyoma</td>
<td>11.65</td>
</tr>
<tr>
<td>Diamond D</td>
<td>12.70</td>
</tr>
<tr>
<td>Kaycee</td>
<td>13.70</td>
</tr>
</tbody>
</table>

The average crude protein in hard red spring wheat is 13.67, and in straight flour from this wheat is 11.9 (26). This table shows that Wyoming flours do not vary from the average of straight flour protein as much as 2 per cent in any case.
Proportion of Ingredients. The proper proportion of all ingredients needed to be determined and also the way in which they should be combined and handled to secure the best product. A tentative recipe was chosen as a working basis and experiments were made, using one ingredient as the variable until the proper quantity of each was determined. As soon as the recipe giving best results was obtained methods of handling and conditions of experimentation were varied so that a superior method and optimum conditions could be determined. All experimental work was done with single loaves.

1. Water. Increase in the percentage of water used increased both the weight and volume of the loaf, and improved the texture and shape of the loaves up to a certain point. Too much water caused a loaf to be flat on top and made a discolored streak at the sides. No hard and fast rule can be given for the amount of water to be used. It may be different for each new sack of flour, so that a trial baking with each new lot is necessary. Enough should be added to make a soft dough without being sticky. This amount usually fell between 65 and 70 per cent of the weight of flour used.

2. Yeast. The yeast used in all cases was Fleischmann's compressed yeast. A cake weighed from 13.5 to 14 grams. The quantities used varied from 3 to 10 grams per loaf. The chief effect of varying the amount of yeast was shown in the time of rising which decreased as the amount of yeast was increased. With 3 or 4 grams of yeast the loaf was very slow to rise, and the texture was inferior to that of loaves made with more yeast. A lighter finer texture was observed when 6 or more grams of yeast were used. No bad effects on either flavor or texture were observed when 10 grams were used but as 7 grams produced a well-leavened loaf in a reasonable length of time, this amount was used.

It is probable that the use of dry yeast or liquid yeast would give good results with Wyoming flours though no work has been done with these. Most hard wheat flours stand up well in the long rising process that is usually employed in using dry yeast. If the yeast is of good quality and active, the kind probably would make little difference with these flours.
3. **Salt.** Salt was varied from none to 10 grams (2 teaspoonfuls) per loaf. Increase in salt improved the flavor up to 5 grams (1 teaspoonful) per loaf. When more was used the bread was somewhat salty. The time of rising was increased by increasing the amount of salt used as salt tends to check the fermentation. The weight of the loaf was also increased and the volume decreased. Since 5 grams (one teaspoonful) of salt gave the best flavor and texture this amount was used.

4. **Sugar.** As compared to salt, sugar affects the rising time in the opposite way. It serves as a food for the yeast plant so that an increase in sugar tends to hasten fermentation, and so to decrease total time of bread-making. It also tends to increase volume and weight. Amounts used varied from none to 18 grams (4 teaspoonfuls) per loaf. The flavor was not as greatly affected by these variations as it was by the variations with salt. However, bread with no sugar had a rather flat taste and that containing four teaspoonfuls per loaf was distinctly sweet in flavor. The use of 11 grams (21/2 teaspoonfuls) gave the best results in flavor and color, and decreased the time of rising.

5. **Fat.** The quantity of fat was varied from none to 30 grams (7 teaspoonfuls). Addition of fat increased the weight and volume of the loaf. It also gave tenderness to the crumb, improved the flavor of the bread, and the character of the crust. If the fat was omitted entirely pockets were of frequent occurrence and were often observed on the surface of the dough while rising. The best results for both flavor and quality of the bread were obtained with 9 grams (2 teaspoonfuls).

**Method of Handling.** The three methods tried were: the sponge method, the straight dough method, and the method used by Montana. The Montana method is briefly as follows: Mix yeast, salt, sugar, fat and water, and allow to stand 30 minutes at 90° F. before proceeding with the straight dough method. Experiments showed that the straight dough method gave as satisfactory results with Wyoming flours as the sponge method. Hence, the latter was discontinued. Data were compiled by taking an average of scores of 24 loaves made by the straight dough method and 24 loaves made by the Montana method to show that bread made by
the straight dough method was as good as that made by the longer process.

From these results it was concluded that for Wyoming flours the straight dough method was most satisfactory since it saved time and gave as good results. However, if there were any doubt about the yeast being of good quality the 30-minute fermentation period allowed for in the Montana method might be an advantage since it serves as a test for the yeast. At the end of 30 minutes, the yeast mixture foams and this preliminary fermentation is an index of the strength of the yeast. Inasmuch as the laboratory was supplied regularly with fresh yeast, time was saved by using the straight dough method.

1. Mixing and Kneading. The yeast was dissolved in water at 90° F. (32°C.) and added to the sugar, salt and fat. Flour was added gradually until all but one-half cup had been added. About 5 minutes was required for this. The dough was then ready for kneading. It was found by varying the time of kneading that 15 minutes was sufficient. This first mixing and kneading should be very thorough so that a smooth dough is obtained. All of the flour should be worked in at this time because the addition of flour after the fermentation process has begun causes poor texture in the bread.

When in the first kneading the yeast and sugar have been evenly distributed, it was found that subsequent kneading periods of one minute in length, just long enough to distribute the gas bubbles, were sufficient.

2. Fermentation. Through varying the fermentation period it was determined that for the first rising a loaf should attain a maximum volume of 1,800 to 2,000 cc, or four times its original volume at a temperature of 83°F. The gas was then removed by kneading one minute. For the second rising it was allowed to reach a volume of 1,400 to 1,500 cc, or three times its volume, and the gas was removed as before. It was found that a rest period before panning improved the bread. Consequently the dough was allowed to rest 5 minutes on the board before it was molded and placed in the pan.
Rising in the pan is an important part of the process. The proper period or extent of rising is difficult to determine exactly. The loaves for this work were allowed to rise until an indentation in the dough did not spring back but remained in the dough. With most flours the loaves usually increased in the pan to 2½ times their volume when panned.

3. Baking. A temperature range of 410 to 425°F. for 35 to 40 minutes has proved most satisfactory for baking. It may be safely said that at this altitude of 7,159 feet a higher baking temperature is required than at a low altitude.

4. Temperature and Humidity. In order that fermentation may proceed evenly and that no undesirable characteristics be developed in the bread due to too slow or too rapid growth of the yeast, it is very important to maintain the fermentation temperature at 83°F. For this a thermometer is a necessity if uniform results are to be obtained. In cold weather the room, mixing bowl and ingredients should be warm. The water should be heated to the proper temperature before it is used. After it is mixed the dough should be placed in a covered crock or jar which can be kept at a fairly constant temperature. The bread may be set in a pan of water kept at 85 to 90°F. (lukewarm) to maintain an even temperature. An oven thermometer is an inexpensive household convenience and dependable indicator of oven temperature.

It is important also in the bread-making process to have sufficient humidity present to prevent the formation of dry surfaces during fermentation. Crusts forming at this time caused streaks in the bread and uneven texture. They also prevent a final thin tender crust on the bread. Since, in Wyoming, there is less relative humidity than in other places, it has been found necessary to add water vapor to the proofing cabinet during fermentation. In the home the moist condition may be obtained by setting the bread bowl in a pan of water and covering it with a damp cloth. Steam from the teakettle raises the humidity in most home kitchens. This will prevent the formation of undesirable crusts. Greasing the surface of the bread also helps prevent their formation. Bread baked in a moist oven has a thinner and more desirable crust.
This condition can be obtained by keeping a pan of water in the oven.

**Recipe.** In making bread from Wyoming flours, if the above mentioned points are taken into consideration and attention is given to the details of the process, loaves of good quality can be obtained by every housewife.

The following recipe and method of procedure has been found to give the best results:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour</td>
<td>340 grams</td>
<td>3 cups</td>
</tr>
<tr>
<td>Water</td>
<td>65 to 70%</td>
<td>½ to 1 cup</td>
</tr>
<tr>
<td>Fat</td>
<td>9 grams</td>
<td>2 teaspoonfuls</td>
</tr>
<tr>
<td>Sugar</td>
<td>11 grams</td>
<td>2½ teaspoonfuls</td>
</tr>
<tr>
<td>Yeast</td>
<td>7 grams</td>
<td>½ cake (Fleischmann’s Compressed)</td>
</tr>
<tr>
<td>Salt</td>
<td>5 grams</td>
<td>1 teaspoonful</td>
</tr>
</tbody>
</table>

**Procedure Used in Standard Laboratory Tests at University of Wyoming.** Weigh salt, sugar and fat into a beaker. Add yeast dissolved in water heated to 90°F. Add flour gradually until all but one-half cup is used. Sift the remainder of the flour onto the bread-board and knead into the bread. Put dough into a warmed and oiled expansion tube and place in a proofing oven at 83°F. with a relative humidity of 75-80% to rise to 1,800-2,000 cc. Remove dough, knead down, and return to container for a second rising. This time allow to rise to 1,400°-1,600°cc. Then knead down the dough. Allow to rest 5 minutes to recover, and pan. Set to rise in the pan at a temperature of 95°. Pan-proof until an indentation in the dough does not “spring back” but remains in the dough. Bake in oven at 410-425°F. for 35 minutes. Remove from pan, place on a wire rack and allow to cool. After 30 minutes, weigh and take the volume by displacement of clover seed. Place bread in a tin receptacle over night and score the next day.

**Procedure Used for Measured Ingredients.** Measure sugar, salt and fat into a mixing bowl. Add yeast well dissolved in water heated to lukewarm. Add flour gradually until all but about one-half cup is used. Sift the remainder of the flour onto the bread-
board and knead into the bread. Put dough into a warmed and oiled mixing bowl and place in a warm moist place to rise until it reaches 4 times its bulk, knead down and return to bowl for second rising. This time allow to treble in bulk, then knead down the dough, allow to rest 5 minutes and pan. Let rise to 2½ times its bulk in the pan at a slightly higher temperature than during the fermentation period. Bake in a hot oven (410-425°) for 35 minutes. Remove from the pan, place on a wire rack, and allow to cool. Place cold loaves in a tin receptacle for future use.

As will be noted for experimental purposes, the amount of flour is kept always the same, and the water varied. In the home it may be easier to vary the flour.

CHARACTERISTICS OF GOOD BREAD

The object in making bread from any flour is to make a loaf pleasing to the sight, agreeable to the taste, high in nutritive value, and wholesome.

1. **External Appearance.** The volume of the loaf indicates the strength of the flour to expand, retain its shape and give a large loaf. According to the Institute of Baking, a loaf should have good but not excessive volume and while the volume varies in different sections of the country, a standard plain top loaf weighing one pound should have a volume not less than 1,800 cc.

The crust should be an even golden brown color over the entire loaf. It should be smooth and when cut should be an even thickness over the entire loaf, thin, crisp, and tender.

The loaf should be symmetrical in form and expand with good break and shred.

*Internal Appearance.* The crumb is of primary importance and it includes color, grain and texture. The color should be creamy white, uniformly colored, without streaks. The grain of the loaf should be fine and uniform with small oval-shaped, thin-walled cells. The texture should be soft and velvety and not doughy and crumbly. It should be elastic, so that the cut surface will show no impression when pressed with the fingers.

*Scoring the Bread.* The first score card which appears below with its explanation is the official score card of the American Insti-
tute of Baking. The second one was published by the Division of
Home Economics of the Kansas State Agricultural College.

**SCORE CARD NO. 1**

<table>
<thead>
<tr>
<th><strong>External Appearance</strong></th>
<th><strong>Perfect Score</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetry of form</td>
<td>3</td>
</tr>
<tr>
<td>Volume</td>
<td>10</td>
</tr>
<tr>
<td>Color of crust</td>
<td>8</td>
</tr>
<tr>
<td>Evenness of bake</td>
<td>3</td>
</tr>
<tr>
<td>Character of crust</td>
<td>3</td>
</tr>
<tr>
<td>Break and shred</td>
<td>3 30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Internal Appearance</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>10</td>
</tr>
<tr>
<td>Color of crumb</td>
<td>10</td>
</tr>
<tr>
<td>Texture</td>
<td>15</td>
</tr>
<tr>
<td>Flavor (aroma)</td>
<td>15</td>
</tr>
<tr>
<td>Taste</td>
<td>20</td>
</tr>
</tbody>
</table>

**EXPLANATION OF FOREGOING SCORE CARD**

**External Appearance**

*Symmetry of Form.* The ideal loaf should be properly proportioned as to length, height and breadth. Too short a loaf gives an apparently greater volume, but at the sacrifice of economy in use.

*Volume.* The loaf should have good but not excessive volume. A standard plain top loaf, weighing one pound, should have a volume of not less than 1,800 cc. The volume varies in different sections of the country.

*Color of Crust.* While the demands of the different parts of the country vary somewhat, the ideal crust color is best described as a golden brown.

A well baked loaf of suitable materials will be uniformly colored. Sides, ends and bottom should not show a pale or dead color but should be a golden brown.
Evenness of Bake. The loaf should be evenly baked on all sides. The part inside the pan may be lighter in color than the top, but it should be evenly colored with no white or burned spots. The top crust may have a glaze or not, to suit the requirements of various localities.

Character of Crust. A good crust is even surfaced, reasonably free from humps or wrinkles, but it may be slightly checked as a result of contraction during cooling. It should be tender and the top crust should be of uniform thickness.

Break and Shred. A smooth top loaf should have an even break, be well shredded and with no indication of a loosened or shell top; a split top loaf should be well split, not blind, with the cut surfaces well shredded and uniform. The split top loaf should show no break at the sides. The corners of the loaf should be well defined, slightly rounded, and there should be no break as they approach the top. The crust should be even, smooth and uniform in color.

Internal Appearance

Grain. Grain is a condition of the crumb or interior of the loaf and defines the character of the cell structure and the size of the cell. The ideal grain is close and firm, with small, elongated, thin-walled cells. The cells are uniform in size, evenly distributed throughout the loaf, and not larger than small bird shot, and their greatest diameter is vertical rather than horizontal.

Color of Crumb. While whiteness is desirable and denotes the use of high grade flours, the tint of the ideal loaf is described as creamy white. The crumb should show no dark streaks or patches, but should be uniformly colored.

Texture. Texture is determined by the sense of touch. It depends upon the physical condition of the crumb and to a minor degree is influenced by the grain. It is an expression of the elasticity, softness or pliability and smoothness or silkiness of the crumb.
The cut loaf should be so elastic that when pressed by the finger it resumes its original shape. The ideal texture is soft and velvety without weakness or doughiness, and should not crumble.

**Flavor or Aroma.** No term used in describing bread is more confusing than flavor. As here used it is the aroma as recognized by the organs of smell.

The aroma will be noted by a skilled baker as sweet, rich, fresh, malty, musty, metallic, cheesy or sour. The flavor of an ideal bread is best described as true wheat, sweet, nutty.

**Taste.** The most important attribute of good bread is a pleasing and satisfying taste. The taste of bread is determined by the organs of taste as distinguished from the organs of smell.

The ideal taste is the same as the ideal flavor: namely true wheat, sweet and nutty.

### SCORE CARD NO. 2

**External Appearance**

<table>
<thead>
<tr>
<th>Item</th>
<th>Perfect Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Appearance</td>
<td>5</td>
</tr>
<tr>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td></td>
</tr>
<tr>
<td>Lightness</td>
<td>15</td>
</tr>
<tr>
<td>Crust</td>
<td>10</td>
</tr>
<tr>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>Smoothness</td>
<td></td>
</tr>
<tr>
<td>Quality</td>
<td>30</td>
</tr>
</tbody>
</table>

**Internal Appearance**

<table>
<thead>
<tr>
<th>Item</th>
<th>Perfect Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crumb</td>
<td>35</td>
</tr>
<tr>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>Grain</td>
<td></td>
</tr>
<tr>
<td>Texture</td>
<td></td>
</tr>
<tr>
<td>Flavor</td>
<td>35</td>
</tr>
</tbody>
</table>

Scoring: 100
Both score cards agree for the most part on the per cent allowed on the various points, but there is some difference in the terms used. Both were used in scoring bread in the laboratory and usually the breads were scored by two persons. In addition to the scoring done in our laboratory quite a number of loaves of bread from each variety of flour used were scored by the W. E. Long Company, Scientific Service for Bakers, Chicago, and by the American Institute of Baking, Chicago.

*FIGURE 1. EXTERNAL APPEARANCE OF LOAVES FROM DIFFERENT FLOURS
1 Check Flour, 2 Diamond D, 3 Wheatland, 4 Wyoma, 5 Best-Out-West

*FIGURE 2. INTERNAL APPEARANCE OF LOAVES FROM DIFFERENT FLOURS
1 Check Flour, 2 Diamond D, 3 Wheatland, 4 Wyoma, 5 Best-Out-West

*These pictures were made before we began using Kaycee flour.
DISCUSSION OF RESULTS

We have had good loaves of bread from all of the Wyoming flours tested and while some have scored higher than others, they have all compared quite favorably with loaves made from other standard flours that have been used as checks. Six loaves of bread made from each flour, using the standard method, gave an average score for each Wyoming flour very near to that of the flours used as checks—some a little higher and some a little lower. The Wyoming flours all work faster than the other flours used and consequently the time required to make a loaf is about 30 minutes less with them, which is an advantage. Figure 1 shows the external appearance, and Figure 2 the internal appearance of a group of loaves baked from Wyoming flours, together with a loaf baked from a flour used for comparison.

One of the main difficulties encountered was a splitting of the loaves at the top side or even almost entirely around the top crust. This is known as ragged break or shelling. The factors which might be the cause of shelling were investigated. Less yeast was tried. The bread was as good as that containing seven grams but the process required a longer time, the change did not prevent the break. Fermentation periods were varied with the result that the same volumes as given before seemed to produce the best loaves. The time of pan-proofing was next varied over a long period of time. From this experimentation it was decided that although the first and second periods of fermentation were right, the time of pan-proofing made a real difference in the break and shred, and in the volume of the loaf. If the loaf is under-light, or over-light, it is apt to break with a poor shred, or else the top may shell off entirely.

Some work was done adding egg yolk (28) in varying amounts to the bread, the theory being that the egg lecithin would introduce a surface film and decrease the cohesiveness of the gluten. This weakening of the gluten would render it softer and less tenacious and in turn would prevent the ragged break. However, the addition of the egg yolk did not seem to help the appearance of the loaf. It did shorten the time required to make a loaf but not enough to recommend it for that reason alone. On the other hand
the grain seemed to be coarser and the crumb had a yellow tint which came from the egg yolk, the intensity depending upon the color of the yolk used.

Since it seemed impossible, in the laboratory at Laramie to prevent the unsightly cracking of the loaves it was decided that it must be due to the high altitude or to some other local factor. This led to our baking bread at Manhattan, Kansas, which has an altitude of approximately 1,000 feet. This was made possible through the courtesy of the Milling Department of the Kansas State Agricultural College. Bread was baked in their laboratories, using the same equipment used in our laboratories. Conditions were duplicated as nearly as possible and the baking was done by the same person. Although Wyoming flour and materials (including tap water) were used the unsightly crack or very ragged top could not be produced. The addition of small amounts of alcohol, sodium chlorate, ammonium chloride and lactic acid was tried. None of these added ingredients improved the loaf enough to warrant further work with them.

Experimental evidence showed that the hard water of Laramie was not responsible for the crack. The relative humidity in the laboratory at Kansas State Agricultural College was much higher than it is here. Hence, upon resuming work in the laboratory at Wyoming, steam was introduced into the proofing cabinet to see if a humidity could be produced that would do away with the crack. The relative humidity was varied from 32 per cent to saturation and it was found that the maintenance of 75 to 80 per cent relative humidity during fermentation did much to improve the break. The moisture prevented the formation of dry surfaces before the baking stage was reached so that crusts did not form too rapidly to allow for expansion of the gasses in the loaf without breaking it at the sides. Upon experimenting with the oven, it was found that if the top of the oven is too hot crusts will form too quickly and a ragged break tends to form.

It was found that if the relative humidity during fermentation and the period of pan-proofing were controlled, and an even oven heat maintained, results equal in every respect to those obtained in Kansas were also obtained in the laboratory at Laramie.
SUMMARY

By the use of standard methods of baking, excellent loaves of bread were made from each of the 5 brands of Wyoming flour used. The loaves were as good as any made from the flours used as checks. These included some of the most highly advertised flours on the market.

The Wyoming flours compared favorably with the check flours in water absorption, wet and dry gluten, and crude protein. The water absorption varies not only for each kind of flour, but also for each new sack of flour of the same variety.

The straight dough method of mixing gave as good or better results with Wyoming flours as any other method tried.

A temperature of 83°F. for the fermentation periods gave the best results.

A temperature of 95°F. for pan-proofing gave best results.

A hot oven of a temperature ranging from 410° to 425°F. for 35 minutes was most satisfactory for baking bread at an altitude of 7,159 feet. It may safely be stated that a higher baking temperature is required here than at lower altitudes.

Since the relative humidity at Laramie is very low it was found necessary to raise the humidity in the fermentation and proofing cabinets by introducing steam. In the small home kitchen this additional moisture may be furnished by the steaming tea kettle.

ACKNOWLEDGEMENTS

The authors are indebted to Miss Helen Bulbrook, of the Experiment Station staff of the University of Wyoming, for checking most of the experimental data, and for general assistance in completing the bulletin.

The authors wish to acknowledge the cooperation of the Milling Department of the Kansas State Agricultural College for use of its laboratories, and of the American Institute of Baking for its generosity in scoring bread baked in our laboratory.

The flour used in these studies has been furnished by the following Wyoming mills: Denio Barr Mills, Sheridan, Wyoming; Kaycee Flour Mills, Kaycee, Wyoming; Lander Roller Mills, Lander, Wyoming; Wheatland Mills, Wheatland, Wyoming.
LITERATURE CITED

27. Montana Grain Inspection Laboratory.
The following publications of the Wyoming Experiment Station may be had upon request. (Revised list, January, 1929.)

**ANNUAL REPORTS—**
1909-10 to 1919-1920; 1921-1922; 1923-1924 to date.

<table>
<thead>
<tr>
<th>No.</th>
<th>CIRCULARS—</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Root Crops.</td>
</tr>
<tr>
<td>16</td>
<td>The Effect of Alkali on Portland Cement.</td>
</tr>
<tr>
<td>17</td>
<td>Feeding Yearling Steers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>BULLETINS—</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Sweet Clover.</td>
</tr>
<tr>
<td>111</td>
<td>Alfalfa in Wyoming.</td>
</tr>
<tr>
<td>112</td>
<td>The Poisonous Properties of the Two-Grooved Milk Vetch (<em>Astragalus bisulcatus</em>).</td>
</tr>
<tr>
<td>113</td>
<td>The Effect of Alkali upon Portland Cement.</td>
</tr>
<tr>
<td>115</td>
<td>Barley in Wyoming.</td>
</tr>
<tr>
<td>116</td>
<td>Winter Grains.</td>
</tr>
</tbody>
</table>
| 117 | Cattle Feeding:  
|    | Oat and Pea Silage for Beef Cows.  
|    | Oat and Pea Silage for Growing Cattle. |
| 118 | Oats in Wyoming. |
| 119 | Spring Wheats in Wyoming. |
| 120 | The Chemical Examination of Three Species of Larkspurs. |
| 121 | Swamp Fever in Horses. |
| 122 | Chemical and Pharmacological Examination of the Woody Aster. |
| 123 | Homegrown Feeds for Range Steers. |
| 129 | Sunflowers, their Culture and Use. |
| 130 | Native Feeds for Fattening Lambs. |
| 131 | Effects of Alkali and Weathering upon the Wool of Range Sheep. |
| 134 | Wintering Range Calves. |
| 135 | Garbage for Fattening Pigs. |
| 136 | Avian Type of Tuberculosis in Cattle: Injection and Testing. |
| 137 | Wyoming Forage Plants and their Chemical Composition. |
| 138 | Experimental Transmission of Swamp Fever or Infectious Anemia by Means of Secretions. |
| 139 | Climatological Data for Wyoming. |
| 141 | The Micrometer Caliper as an Instrument for Measuring the Diameter of Wool Fibers. |
| 143 | Chemical Examination of Three Delphiniums. |
| 144 | Lupine Studies II—The Silvery Lupine. |
| 145 | Wyoming Hay for Milk Production. |
| 146 | Wyoming Forage Plants and Their Chemical Composition—Studies No. 7. |
148. Wyoming Corn for Pork.
150. Fallow for Small Grains.
152. A Study of Potato Seed Treatment for Rhizoctonia Control.
153. Type in Beef Cattle.
155. Type in Two-Year Old Beef Steers.
157. Wyoming Forage Plants and Their Chemical Composition—Studies No. 8.
158. Use of Calcium Cyanide in the Apiary.
159. Surface Tension of Disinfecting Solutions for American Foulbrood.
160. Lessons from the University Dairy Herd.

Address requests: Bulletin Department, Experiment Station, Laramie, Wyoming.

*Very limited number.