

Results of Baking Tests With Mixtures of Flour From Certain Cereal Grains With Wheat Flour

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The war has not changed the milling of wheat for home consumption and the only way we may be said to have a war loaf is in the increased cost of the bread. For export to the British Isles the miller must extract a slightly greater per cent of bread flour from the wheat than he has done in the past. It is really a straight grade flour and makes a very satisfactory loaf of bread. Furthermore, as shown in a previous article published in this Journal, it does make a more economical use of the wheat. This is because there is a loss of 75 to 80 per cent of the food value of the wheat in converting it into meat, and, consequently the more of the wheat we can safely use as food the more economical will be the process. This is particularly true in countries that do not produce enough wheat for their own use, and especially so under present conditions of shipping. The offal of the wheat is not wasted, as it forms food for cattle, sheep and hogs, but the wheat is pre-eminently our flour and bread producing grain and all that is fit for use for human food should be reserved for this purpose.

The British Government fully recognizes this fact and have demanded of the home miller that he furnish 81 pounds of flour from every 100 pounds of wheat milled. It may be argued that the whole of the wheat should be used for making bread, but that raises a point which we do not wish to discuss at the present time. It may be stated, however, that it is possible to make a 81 per cent extraction flour into bread without changing the processes heretofore followed in baking, and it is very probable that such an extraction produces very nearly all that is capable of being digested by human beings. The law further allows the miller, if he wishes, to substitute 5 per cent of the flour of certain named grains for the wheat flour.

To ascertain the effect of diluting wheat flour with that made from other grains we made a series of baking tests with different percentage mixtures of flour from corn, rye, barley and oats. Before presenting the results it may be well to briefly discuss the composition of the several grains.

PROTEINS.

One of the most important food constituents in all foods is the proteins. All these grains contain this constituent, but the principal part of the protein in wheat is known as gluten. Gluten as such does not exist in the wheat, but is found when the pulverized wheat, that is, the flour, is mixed with water by the union of two protein bodies in the wheat, namely, gliadin and glutenin. These two constituents together make the whole of the protein, except a little over one per cent. The protein of rye, like that of wheat is made up of several nitrogenous constituents and among these is gliadin which in its chemical and physical properties resembles that from wheat. The rye, however, does not contain any protein compound corresponding to the glutenin of wheat and therefore,

rye flour does not form a gluten similar in quality to that of wheat, although it comes more nearly doing so than any other cereal. The protein of oats has very little agglutinating power, and consequently oat flour is not suitable for making bread, or rather it is very little used for that purposes. The proteins of corn are composed principally of two constituents but they do not form a gluten when mixed with water. It naturally follows that a dough made of corn flour will not retain gas and rise like that made from wheat flour. The barley flour is the same in this respect. All these grains contain an alcohol soluble protein somewhat similar to the gliadin of wheat, but there is no material resembling the glutenin with which to form gluten similar to that found in the dough made from wheat flour. It naturally follows that when wheat flour is mixed or diluted with the flour from any of these grains that the percent of gluten in the mass is reduced and the expansive power of the dough will also be reduced.

OTHER FACTORS

There are other factors that enter into the question of the suitability of a flour for making bread, but the information on some of these is very confused and will not be discussed at this time. An interesting point in this connection is as to whether the pure starch will give as good a result as the flour from any of these grains. We have therefore included in the baking tests bread made from wheat flour diluted with potato starch.

In all the tests exactly the same weight of flour was used for each loaf of bread and every care was taken to give each dough a chance to "work" out to the best advantage. A mixture of 5, 10, 15 and 20 per cent of the flour from each of the grains was made with a 76 per cent extraction of wheat flour. The results of the tests are given in the following table:

The 76 per cent extraction flour was purchased from one of our large mills, but the rye-corn, oat and barley flour was made in our own laboratory. The potato flour was purchased and an examination shows that it is practically potato starch.

In the first place the 76 per cent extraction flour made a very good loaf of bread, very similar to that from the ordinary straight grade flour. The addition of 5 per cent of the different flours decreases somewhat the volume of the loaf, or, in other words, reduced the expansive power of the dough. The barley-wheat mixture gave the best volume, corn second, rye third and the potato starch the smallest volume. It is possible that the diastatic value of barley may have had something to do with the mixture in which it occurs having the largest volume. With the introduction of more corn and oat flour the size of the loaf rapidly decreased. This was particularly noticeable in the case of the corn.

COMPARATIVE FIGURES.

To secure comparative figures regarding the quality of the bread a loaf was made with the 76% flour and

Table Showing the Results of Baking Tests with Varying Mixtures of the Flour from Several Grains with 76 Per Cent Extraction Wheat Flour.

Name.	Volume C.C.	Color.	Texture.	Appearance.	Av.
1 Standard 76% Manitoba	2590	100.0	100.0	100.0	100.0
2 " + 20% Rye	2110	100.0	91.0	92.0	94.3
3 " + 15% "	2110	101.0	93.0	94.0	96.0
4 " + 10% "	2330	101.0	95.0	94.0	96.6
5 " + 5% "	2390	101.0	98.0	97.0	98.6
1 Standard 76% Manitoba	2600	100.0	100.0	100.0	100.0
2 " + 20% Corn	1830	85.0	70.0	70.0	75.0
3 " + 15% "	1970	90.0	80.0	75.0	81.6
4 " + 10% "	2220	94.0	85.0	80.0	86.3
5 " + 5% "	2530	98.0	92.0	90.0	93.3
1 Standard 76% Manitoba	2590	100.0	100.0	100.0	100.0
2 " + 20% Oat	1840	70.0	70.0	60.0	66.6
3 " + 15% "	1970	85.0	75.0	70.0	76.6
4 " + 10% "	2130	90.0	75.0	80.0	81.6
5 " + 5% "	2310	95.0	90.0	90.0	91.6
1 Standard 76% Manitoba	2590	100.0	100.0	100.0	100.0
2 " + 20% Barley	2250	80.0	85.0	95.0	86.6
3 " + 15% "	2360	80.0	85.0	95.0	86.6
4 " + 10% "	2350	90.0	90.0	95.0	91.6
5 " + 5% "	2550	98.0	97.0	98.0	94.3
1 Standard 76% Manitoba	2590	100.0	100.0	100.0	100.0
2 " + 20% potato starch	2080	105.0	88.0	85.0	92.6
3 " + 15% "	2140	104.0	90.0	93.0	95.6
4 " + 10% "	2280	103.0	92.0	91.0	95.3
5 " + 5% "	2300	103.0	95.0	89.0	96.3

this loaf was taken as standard and assigned 100 points. The comparative color and texture of the crumb of the bread and the general appearance of the loaf are indicated by percentage figures. The corn used was a yellow variety and this possibly partly accounts for the low figures given for the color of the corn-wheat mixture. The bread in which the starch was used naturally gave the best color, but in texture and general appearance of the loaf it did not show up as well as some of the others. In these latter qualities the rye-wheat mixture gave the nicest loaf. This is what might be expected when we refer to what was said previously about the protein of the rye kernel. The last column of the above table gives an average figure for quality of loaf and here it will be seen that again the rye mixture leads.

The object of the baking was particularly to see what influence the 5 per cent mixture of the flour of the various grains had on the quality of the bread and incidentally to ascertain what effect greater quantities would have on the quality. The five per cent mixture all gave fair loaves of bread, but naturally not as nice bread as if made from whole wheat. We did not have an 81 per cent extraction all wheat flour, but it is very doubtful if it would have given as nice a loaf as that obtained from the rye and barley.

WEEKLY EXPORTS OF GRAIN AND FLOUR.

Exports of breadstuffs from all Atlantic ports last week (including New York, Philadelphia, Baltimore, Newport News, Portland, Montreal, Mobile and Quebec), and the preceding week were as follows:

	Last week.	Prev. week.
Flour, barrels..	148,086	26,643
Wheat, bushels..	10,360,350	5,075,947
Corn, bushels..	357,941	261,719
Oats, bushels..	3,900,182	2,935,616
Peas, bushels..	111,783	3,240
Rye, bushels..	431,706	258,462
Barley, bushels..	221,139	26,300

And from July 1, 1916, to June 9, 1917, and for the corresponding period of 1915-16:

	1916-17.	1915-16.
Wheat, bushels..	241,427,905	324,103,151
Flour, bushels..	11,732,065	14,755,253

Total as wheat, bushels..	294,222,197	390,501,812
Corn, bushels..	48,078,018	27,793,186
Oats, bushels..	99,986,806	100,925,950

CANADIAN IMPORTS INCREASE.

Canada's imports from the United States for April, amounted to \$75,736,134, as compared with \$48,914,013 in April, 1916. Statistics of the United States foreign trade by countries, just issued by the Bureau of Foreign and Domestic Commerce, showed in April, 1917, total exports to the Allied nations of \$424,895,144, against \$315,797,446 in April, 1916, an increase of 35 per cent. Imports from these countries to the United States increased \$10,435,955 over April, 1916. Comparisons follow:

EXPORTS FROM UNITED STATES.

	1917.	1916.
United Kingdom..	\$173,361,524	\$139,771,201
Canada..	75,736,134	48,914,013
Australia..	6,131,550	6,104,114
France..	95,683,979	55,822,792
Russia in Europe..	29,316,840	11,346,179
Russia in Asia..	5,115,696	26,413,583
Italy..	29,086,439	19,384,592
Japan..	10,462,982	8,040,972

IMPORTS INTO UNITED STATES.

	1917.	1916.
United Kingdom..	\$26,552,596	\$25,931,717
Canada..	27,034,545	15,913,365
Australia..	2,115,591	5,231,716
France..	10,460,449	9,804,732
Russia in Europe..	116,327	481,854
Russia in Asia..
Italy..	4,662,888	5,968,768
Japan..	16,066,048	14,840,437

AUSTRALIAN WOOL RELEASED.

Washington reports that sixteen million pounds of Australian wool, released by the British Government to American users, will be distributed by the Bureau of Foreign and Domestic Commerce. An arrangement has just been completed between the American and British governments, under which American importers desiring to obtain British-controlled goods will apply to the Bureau instead of, as heretofore, to the British Government through the British Embassy. Most of the detail of apportionment of the goods will be handled by trade associations, the Bureau approving their administration of the plan.