Air-dry flour treated with phenol yields mixtures so difficult to filter that they were not investigated. Single extractions made with samples 2 and 3 gave the following values which, though not accurate, show that the protein dissolved from the air-dry flour is not pure gliadin.

No. of sample.	Crude gliadin calculated from nitrogen determination.	Crude gliadin calculated from polariscope reading.
2	5.24	4.15
3	7.80	6.43

The filtration of the extract was so slow that it may have changed more or less in concentration from evaporation or absorption of water.

Summary.

With these flours 8 to 17 per cent. more nitrogenous matter was extracted when 4 grams per 100 cc. of the solvent was used than when four times as much flour was taken.

After drying six hours in the water oven, 10 to 20 per cent. less gliadin was obtained by extracting with cold solvent. With the hot solvent the figures were nearly the same, being slightly lower. Pure gliadin remains soluble in dilute alcohol after the same treatment.

No tendency for glutenin to remove gliadin from its alcoholic solutions by absorption or with the production of a solid solution could be demonstrated.

Propyl alcohol of constant boiling-piont (70 per cent. by weight) used in an extraction apparatus gave results probably no more accurate than the others.

Anhydrous phenol dissolves a high percentage of protein matter from the flour. The dissolved matter is not pure gliadin, however, nor does it seem to consist of gliadin with but one other protein.

I acknowledge with pleasure and gratitude the encouragement I have enjoyed from Prof. J. T. Willard in making these experiments, also my indebtedness to Mr. C. O. Swanson for much valuable data concerning the samples.

KANSAS STATE AGRICULTURAL COLLEGE,
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THE EFFECT OF NITROGEN PEROXIDE UPON WHEAT FLOUR.

BY F. J. ALWAY AND R. M. PINCKNEY.

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Studies on the bleaching of flour by means of the oxides of nitrogen have been published by Avery,[1] Ladd,[2] and Snyder[3] in this country, by

[1] This Journal, 29, 571 (1907).
[2] Bull. 72, N. D. Agr. Exp. Sta. (1906).
[3] Report on bleaching of flour.

Balland[1] and Fleurent[2] in France and by Brahm[3] in Germany. All these have recognized that there is no appreciable change in the chemical composition, but as to the effect of the nitrogen peroxide upon the acidity, the color, the absorption, the taste, the odor and the baking qualities there is little agreement.

The flours referred to in this article are the same as those described in a previous publication.[4] The unbleached flours of high grade had a more or less yellow tint, the intensity of coloration varying greatly. The lower grades of unbleached flour had a gray tint; the amount of yellow coloring matter in these, appeared to be about the same as that contained in the higher grades obtained from the same wheat. These unbleached flours when treated with liquids that are able to dissolve the fat, such as ether, chloroform, benzene and petroleum ether, gave yellow solutions which lost their color when exposed to the sunshine. The more yellow a flour was, the more yellow was the solution obtained from it. The bleached flours when treated with the same solvents gave more faintly yellow colored solutions or even colorless solutions, if the bleaching had been carried far enough. If the amount of nitrogen peroxide used had been excessive, the solution was yellow. The fat from unbleached flours obtained by evaporating the ethereal solutions was yellow, that from thoroughly bleached flours colorless and that from overtreated flours yellow or yellowish brown. The lower grades of flour did not have their gray tints weakened by bleaching, and many of the samples of bakers' grade appeared more unattractive in the bleached, than in the unbleached condition, the yellow tint of the latter partly obscuring the gray color.

The Effect of Bleaching upon the Acidity of Flour.—Forty-nine pairs of flours sent by mills having bleachers were tested, and of these, thirty-nine showed no difference in acidity between bleached and unbleached. In three pairs, the bleached flour was the less acid, the differences being 0.01, 0.02 and 0.04 per cent. In seven pairs, the bleached flour was the more acid, the difference being 0.01 per cent. in five cases and 0.03 per cent. in two cases. In the two bleached flours showing 0.03 per cent. higher acidity than the unbleached, the amount of nitrites, expressed as sodium nitrite, amounted to 4.4 and 10.0 parts per million of flour. In the five other cases the nitrites amounted to 18.8, 6.2, 6.2, 3.8, 6.2 and 3.1 parts per million of flour.

An unbleached flour was treated with different amounts of nitrogen peroxide. On the following day, the acidity was determined with the following results:

[1] Compt. rend., 139, 822 (1904).
[2] *Ibid.*, 142, 180 (1906).
[3] Versuchs-Anstalt des Verb. Deut. Müller (1904).
[4] Alway and Gortner, This Journal, 29, 1503 (1907).

	Experiment No.					
	1	2	3	4	5	6
Volume of nitric oxide used to each 1000 grams of flour (in cubic centimeters)	0.0	25	25	25	50	50
Acidity, per cent	0.05	0.05	0.05	0.05	0.05	0.05

Portions of another flour, treated with different amounts of nitrogen peroxide on October 16, 1906, were tested for acidity on February 18, 1907.

Number of experiment.	Volume of nitric oxide used to each kilogram of flour (in cc.)	Acidity. Per cent.
0	0	0.07
1	10	0.07
2	20	0.07
3	30	0.07
4	50	0.07
5	75	0.08
6	100	0.08
7	125	0.10
8	150	0.10
9	175	0.09
10	200	0.10
11	300	0.11
12	400	0.11
13	500	0.11
14	1000	0.15
Same flour bleached at mill		0.07

When the amount of nitric oxide used, did not exceed 50 cc. per kilogram of flour, there was no appreciable change in acidity. Larger amounts of the oxide caused an increase in the acidity.

Those investigators who have reported an increase in acidity due to bleaching, have probably experimented with "overtreated" flours.

No difference in absorption or in the strength of the gluten was found between bleached and unbleached flours.

Baking Tests of Bleached and Unbleaced Flours.—Loaves of bread were made from 23 samples of unbleached flours as well as from the corresponding 23 mill bleached flours. The samples came from 12 different mills and represented three grades, seven pairs belonging to the patent, ten to the straight, and six to the bakers' grades. The loaves were baked on four different days, along with a bakers' commercial product, in an oven heated with wood. The color, texture, odor, and taste of the two members of each of the 23 pairs were compared.

In all cases, the bleached flour gave the whiter loaf. No difference was detected in the texture, odor, or taste of any pair. The 23 loaves from the unbleached flours weighed 12,857 grams, while the 23 loaves from the bleached flours weighed 12,904. The volume of the 23 loaves from the unbleached flours was 42,851 cc., and from the other 23 loaves, 42,735 cc. In eight pairs the unbleached loaf was the heavier, in 14 pairs

the lighter, and in one of the same weight as the bleached. In twelve pairs the unbleached loaf was the larger, in ten pairs the smaller, and in one pair of the same size. The differences in weight and volume of the two members of any pair were small, and only such as might occur in the case of two loaves made from the same flour. In all cases, the two loaves were of practically the same size and weight.

Baking tests were made with samples of a flour that had been treated in the laboratory with different amounts of nitrogen peroxide.

	Number of flour.				
	1	2	3	4	5
Vol. of nitric oxide used per kilogram of flour (in cc.)....	0	50	100	150	250
Weight of loaf (in grams).....	545	541	533	544	534
Volume of loaf (in cc.).....	1919	1827	1981	2105	1981
Color of crumb.....	Almost white	Pure white	Pure white	Pure white	White

All five loaves were baked at the same time. All were of fine even texture, and, with the exception of the last, were of agreeable odor and flavor. No. 5 had a musty odor and taste, but was eatable.

In the case of two bakings, 1 and 2, all the loaves made from bleached flours contained nitrites, while in the cases of two other bakings, 3 and 4, none of the 14 loaves contained nitrites. In the case of the first two bakings, the average amount of nitrites was 0.8, while the average amount of nitrites in the flour from which the loaves were made, was 6.0 parts per million. There was no relation between the amount of nitrite in the flour and that in the resulting bread (as shown in the following table)

AMOUNT OF NITRITES IN BREAD MADE FROM BLEACHED FLOURS.

Number of baking.	Series number of flour.	Series number of loaf.	Parts per million of nitrite	
			in flour.	in bread.
I	5	4	3.4	1.1
I	6	6	4.4	0.6
I	10	7	3.1	1.6
I	11	10	18.8	0.6
I	16	12	2.5	0.8
I	24	14	3.1	0.9
I	25	16	2.8	1.6
I	26	18	8.8	0.2
II	35	20	4.4	1.9
II	40	22	6.2	0.8
II	41	24	10.0	0.2
II	46	26	3.7	0.8
II	47	28	12.5	0.9
II	50	30	3.4	0.2
II	51	32	3.1	0.4
II	55	34	6.2	0.8

Conclusions.

(1) The yellow color of flours is due to a very minute quantity of a colored substance which is contained in the fat. When the fat is removed, high-grade flours become white. Exposure to the sunlight or treatment with nitrogen peroxide changes the colored compound into one or more colorless compounds. Both the fat and solutions of the fat from thoroughly bleached flours are practically colorless. Overtreated (so-called "overbleached") flours have a yellow to brownish-yellow color, and the fat, as well as the solutions of the fat, from overtreated flours are also colored.

(2) Bleaching with nitrogen peroxide does not increase the acidity of flours, while overtreating them with the same agent does.

(3) Neither the absorption of a flour nor the expansion of its gluten is affected by bleaching.

(4) Bread made from bleached flours does not differ in weight, lightness, texture, odor or taste from that made from unbleached flours; it is, however, in all cases whiter, where high-grade flours are used. Low-grade flours, when bleached, produce bread with an uninviting color.

(5) Bleached flours sometimes yield bread containing nitrites and at other times bread free of nitrites. In all cases the amount of nitrites in the bread is much smaller than that in the flour.

(6) The quantity of peroxide may be so increased as to seriously injure the quality of the flour, but such a quantity at the same time unfavorably affects the color.

(7) Low-grade flours when bleached do not resemble patent flours in appearance.

(8) Many of the conflicting opinions in regard to the effect nitrogen peroxide has on wheat flour are to be attributed to the investigation of flours that had been "overtreated."

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THE POWER OF SODIUM NITRATE AND CALCIUM CARBONATE TO DECREASE TOXICITY IN CONJUNCTION WITH PLANTS GROWING IN SOLUTION CULTURES.[1]

BY OSWALD SCHREINER AND HOWARD S. REED.

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Investigations upon the nature and action of toxic agents upon organisms have shown that there is not always a simple relation between them. Although the harmful effect of the toxic agent upon the organism is the main factor in the problem, it is no less true that the organism exerts an

[1] Published by permission of the Secretary of Agriculture.