

# QUALITY CHARACTERISTICS OF SOFT WHEATS AND THEIR UTILIZATION IN JAPAN. III. EFFECTS OF CROP YEAR AND PROTEIN CONTENT ON PRODUCT QUALITY

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## ABSTRACT

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Three-hundred-seventy samples of soft white and white club wheats harvested in the U.S. Pacific Northwest area in 1970-1973 and 33 samples of Western Australia and Victoria F.A.Q. wheats harvested in 1970-1973 were tested to determine variation in quality factors with respect to their utility for Japanese products. The relation between analytical data and sponge-cake or cookie baking qualities varies by crop year and growing region. Sponge-cake and cookie baking qualities of white club wheat were superior to those of soft white, even though the protein content of

white club is higher than that of soft white. Confirmation was obtained that kernel softness is the most important factor for flour in cake, cookie, biscuit, cracker, and Japanese bun production in Japan, based on a combination of tests for protein content, maltose value, flour particle size, sponge-cake and cookie baking, etc. Australia F.A.Q., soft white, and white club wheats showed their own unique and favorable characteristics for Japanese-type noodle. The most favorable wheats for average noodle quality were around 10% in protein content.

The Pacific Northwest Grain Standards and Quality Committee has conducted a quality survey of soft wheats in the U.S. Pacific Northwest area for several years (1). However, secondary processing quality, especially for the Japanese market, has not been tested systematically. We did special surveys on soft white and white club wheats from 1970 to 1973 in order to get a comprehensive understanding of the quality characteristics of the wheats which were used in the past, and to enable us to use them most effectively in the future.

Western Australia F.A.Q. (fair to average quality) and Victoria F.A.Q. wheats were introduced into Japan as the substitute for domestic Japanese wheat which had been decreasing drastically in production. Among soft wheats being used in Japan, the consumption of Australian standard white wheat from Western Australia (formerly called Western Australia F.A.Q.) is second to that of U.S. Western white. Therefore, we made similar surveys on Australian F.A.Q. wheats in 1973.

This report provides a summary of the results of our study, and discusses the effects of crop year and protein content on product quality.

## MATERIALS AND METHODS

At the harvesting periods of 1970-1973 we collected the following number of samples of soft white and white club wheats at country elevators in the U.S. Pacific Northwest area:

Crop Year	Soft White				White Club		
	Oregon	Washington	Idaho	Total	Oregon	Washington	Total
1970	2	9	2	13	...	...	...
1971	21	85	14	120	6	26	32
1972	19	62	0	81	8	28	36
1973	18	49	0	67	10	11	21

**TABLE I**  
**Summarized Quality Data of Soft Wheat Samples from a**  
**Given Region Which Reflect Season or Protein Content**

Test	U.S. Pacific Northwest Wheat						Australian F.A.Q. Wheat						
	Soft White			White Club			West Aust.			Victoria			
	1970	1971	1972	1973	1971	1972	1973	1970	1971	1973	1970	1971	1973
<b>Wheat</b>													
Test wt., kg/hl	79.2	80.6	80.5	79.4	78.7	77.9	77.9	79.9	81.0	80.1	80.9	81.5	76.6
Moisture, %	9.8	9.3	9.0	8.8	8.3	8.7	8.6	10.0	9.4	10.0	10.7	10.4	10.4
Ash, % <sup>a</sup>	1.41	1.37	1.33	1.37	1.30	1.33	1.35	1.35	1.27	1.35	1.23	1.26	1.42
Protein, % <sup>a</sup>	9.9	9.4	10.1	11.4	9.7	9.5	10.7	10.0	9.8	9.8	10.2	10.5	10.5
Vitreous kernels, %	23	45	37	41	43	32	35	60	52	56	42	40	52
Flour extraction, %	70.3	71.2	73.3	72.2	74.3	76.6	74.8	70.9	72.5	72.0	72.8	72.2	72.7
<b>Flour</b>													
Color	-0.9	-1.2	-0.9	0.6	-1.4	-1.1	0.2	-0.5	-0.4	-0.8	-0.6	-0.4	0.6
Protein, % <sup>a</sup>	7.6	7.2	7.7	9.1	7.2	7.5	8.6	8.3	8.1	8.1	8.7	8.5	9.0
Maltose valuc, mg/10 g	152	148	157	168	118	109	123	231	228	223	183	185	201
Specific surface, cm <sup>2</sup> /g	2610	2500	2650	2550	2430	2550	2460	2330	2230	2070	2410	2350	1960
MacMichael viscosity	53	46	71	74	34	35	36	85	79	76	62	63	70
Sponge-cake quality <sup>b</sup>	5.1	5.6	5.2	4.5	5.5	6.3	6.0	1.0	1.0	1.5	2.0	2.0	1.3
Cookie quality <sup>b</sup>	4.3	5.0	4.7	4.4	6.5	6.9	6.8	1.0	1.0	1.3	2.0	2.0	2.1
Noodle quality <sup>b</sup>	4.1	3.8	4.0	3.8	4.0	3.9	4.0	5.0	5.0	4.8	4.0	4.0	4.1

<sup>a</sup>As-is moisture basis.

<sup>b</sup>Scores are assigned over a 9-point range: 1 = much less preferable than a standard; 5 = standard (equal to a control); and 9 = much better than the standard.

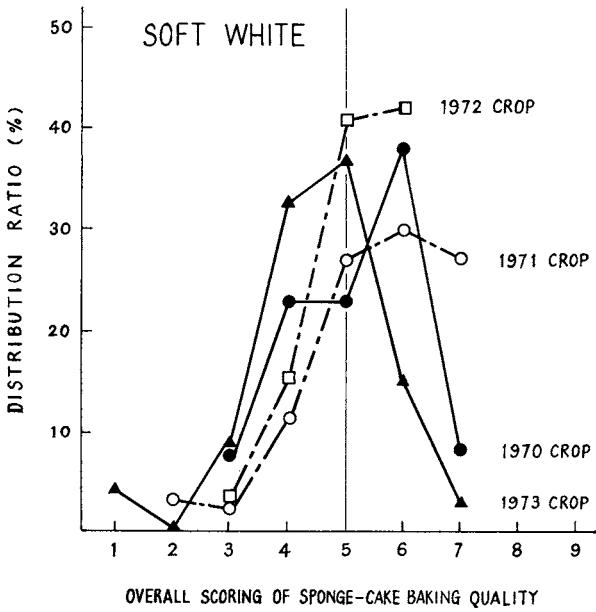


Fig. 1. Distribution of sponge-cake baking quality of soft white wheat by crop year.

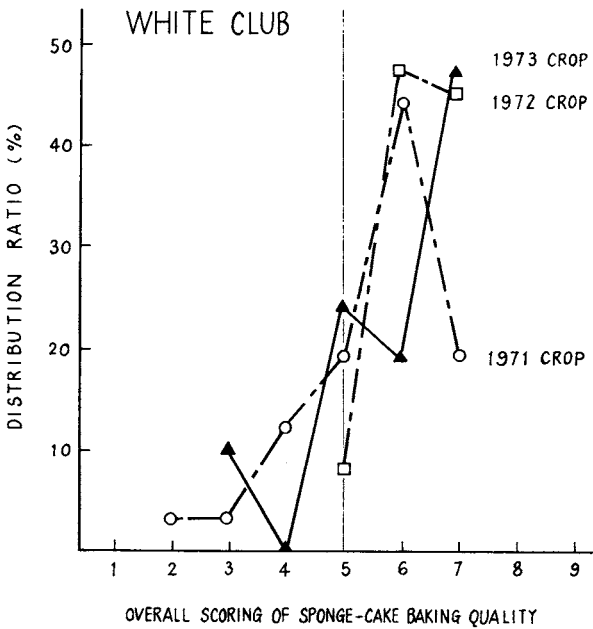


Fig. 2. Distribution of sponge-cake baking quality of white club wheat by crop year.

Similarly, at the harvesting period of 1973, 22 samples of Western Australia F.A.Q. and 7 samples of Victoria F.A.Q. wheats were collected at country elevators in Australia. For comparison purposes, two composite samples of Western Australia F.A.Q. and two composite samples of Victoria F.A.Q. harvested in 1970 and 1971 were selected from the sample storage of Nisshin Flour Milling Co., Ltd. Methods used were those described in the preceding paper (2).

**RESULTS AND DISCUSSION**

Analytical data of wheat samples, test milling results, and the results of sponge-cake, cookie, and Japanese-type noodle tests are summarized in Table I. From the data we noted quality fluctuations associated with crop year, growing region, variety, and the blending percentage of white club in Western white wheat as these influenced sponge-cake and cookie baking and Japanese-type noodle-making qualities. Figures 1, 2, and 3 give the distribution of sponge-cake and cookie baking qualities for white club and soft white varieties by crop year.

From these studies, we may generalize as follows:

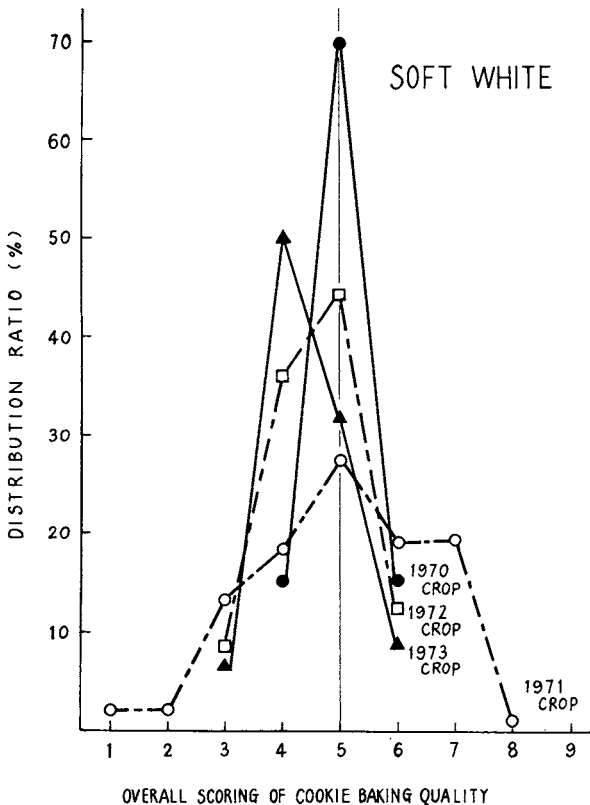


Fig. 3. Distribution of cookie baking quality of soft white wheat by crop year.

1. The level and range of fluctuation of sponge-cake and cookie baking qualities varied with crop year, although the fluctuation of wheat quality for each class by crop year for the production of Japanese-type noodles was rather small.

2. Evaluations were relatively high for samples collected at country elevators in producing areas where the type of wheat grown was adapted to conditions and farming practices.

3. Sponge-cake and cookie baking qualities of soft white wheat were not changed greatly except in 1973, when protein content was extremely high due to the unfavorably dry weather during the growing season.

4. Conversely, the quality of white club wheat tended to improve except in 1973, a time of dry weather conditions. Considering that samples of the variety Paha gave good results by the testing procedures used and the increased percentage of Paha in the elevator samples obtained, we believe the new Paha variety may be contributing to improvement of quality.

5. Sponge-cake and cookie baking qualities of Western Australia F.A.Q. were less preferable. Of the 22 samples tested, only the two having low maltose values had favorable sponge-cake baking quality and were nearly equal to the U.S. Western white wheat.

The relations between various analytical data and sponge-cake or cookie

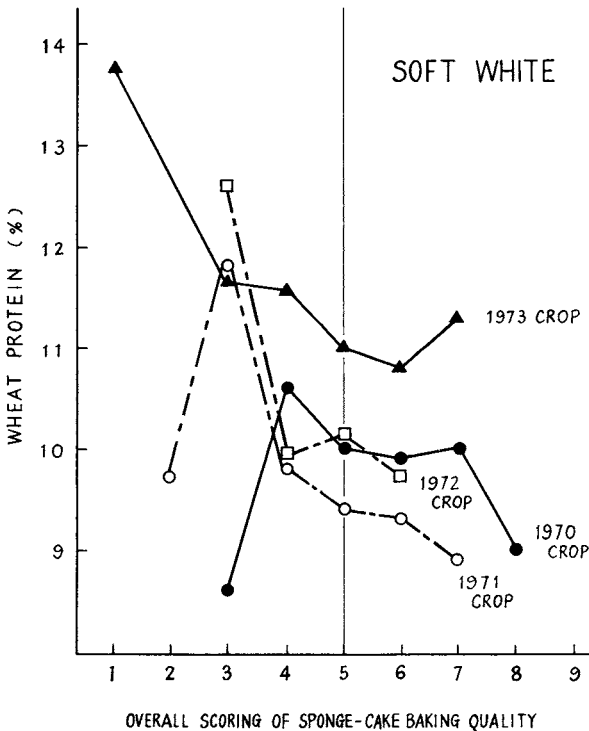


Fig. 4. Relation between protein and sponge-cake baking quality of soft white wheat by crop year.

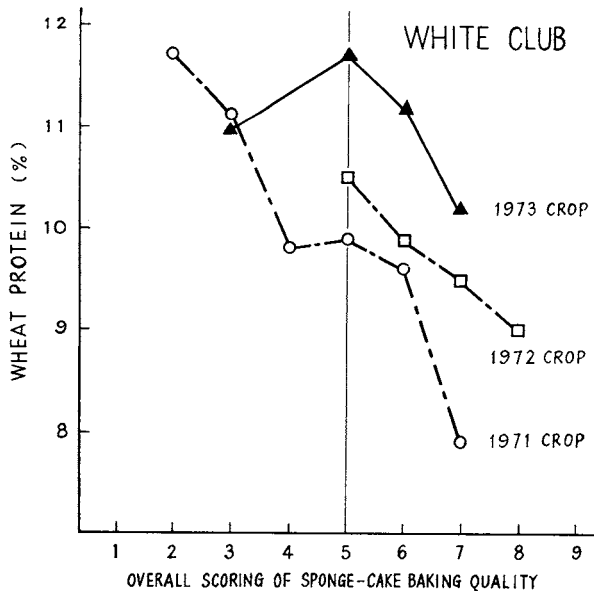


Fig. 5. Relation between wheat protein and sponge-cake baking quality of white club wheat by crop year.

baking or Japanese-type noodle-making qualities were also studied. As an example, the relation between wheat protein and sponge-cake baking quality of soft white and white club wheats is shown in Figs. 4 and 5. From these studies, we conclude as follows:

1. The relation between the analytical data and sponge-cake or cookie baking qualities varied by crop year and growing region.

2. Protein content related most directly to processing quality, whereas lower protein contents were advantageous in the case of confectionery products.

Sponge-cake and cookie baking qualities of white club wheat were superior to those of soft white, although the protein content of white club was a little higher than that of soft white.

Generally speaking, wheat samples with less vitreous kernels, fine particle size (large specific surface), low maltose value, and low MacMichael viscosity showed high suitability in sponge-cake and cookie baking. Based on a combination of these results, confirmation was obtained that kernel softness is the most important factor for flour in cake, cookie, biscuit, cracker, and Japanese bun production in Japan.

3. As we described in the preceding paper (3), gluten and starch-gelatinization characteristics have to be taken into consideration when comparing wheats of different class or variety for use in making Japanese-type noodles. However, when we discussed the effects of crop year, only protein content related directly to noodle-making quality, especially to eating quality. When we considered the variation in consumer's taste by locality, the most favorable wheat for average noodle quality was confirmed to be around 10% in protein content.

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