Micro Baking Evaluation of Some U.S. Wheat Classes for Suitability in Iranian Breads[1]

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ABSTRACT

Micro baking techniques were developed for making the four most popular Iranian breads: barbari, lavash, taftoon, and sangak. Four U.S. wheat classes were tested for suitability in Iranian breads, using five wheat varieties and a western white composite. The soft white winter wheats produced the most desirable breads. The one soft white spring wheat produced satisfactory bread, although finished breads were excessively brown. Hard red winter wheat was strong and too dark most of the time. Club wheat was weak, making dough handling difficult and bread texture porous.

A large proportion of calories and protein in the Iranian diet is derived from wheat. Iranian breads generally are produced from soft white wheat flours of higher extraction rates than those of Western types of breads and have shorter fermentation times as well (Kouhestani et al 1969).

The present food resources of Iran do not satisfy domestic demands, and additional quantities of certain foods, principally wheat, are imported. In 1978, Iran imported 40 million bushels of soft white wheat from the United States alone (OWC 1979).

Four breads are popular in urban Iran. Barbari is made from flour of 77% extraction, is oval in shape, and is 70–80 cm long, 25–30 cm wide, and 3.5 cm thick. Sangak is a sourdough flat bread made from flour of 87% extraction. It is triangular and 70–80 cm long, 40–50 cm wide, and 3–5 mm thick. Sometimes its surface is sprinkled with sesame or poppy seeds. Taftoon is a round flat bread made from flour of 84% extraction, is 40–50 cm in diameter and 5 mm thick, and has small holes on its surface. Lavash is a paper-thin bread made from flour of 82% extraction, rectangular in shape, and 60–70 cm long, 30–40 cm wide, and 2–3 mm thick.

Traditional Iranian bread production methods are often unsanitary and also lack uniformity. Available ingredients, formulations, and bread-making procedures vary greatly from village to village or city. Nevertheless, a few years ago, attempts to mechanize production of Iranian breads began. Today, a number of baking plants are producing barbari, lavash, and taftoon breads. Attempts to mechanize sangak baking are in progress (Faridi and Finney 1980).

Ingredient nonuniformity makes mechanizing Iranian bread production inordinately difficult. Iranian wheat varieties are numerous and vary greatly in their chemical, nutritional, and functional (break-baking) properties. So until more uniform wheats are produced, Iran may depend on imported wheat for her modern bakery plants.

Although methods have been developed for evaluation of the quality of soft wheat flour as it is used in the United States (Yamazaki 1969, Yamazaki and Lord 1971) and in Japan (Nagao et al 1976, 1977), no method of evaluating soft wheat for production of flat breads has yet been reported.

This report describes experimental laboratory baking for evaluating the suitability of wheat in the four popular Iranian flat breads.

MATERIALS AND METHODS

Five U.S. wheat varieties representing hard red winter (McCall), soft white winter (Nugaines, Sprague), soft white spring (Twin), white club (Paha), and a composite called Western White (55% Nugaines, 27% Sprague, and 18% Moro) were studied. Each variety also represented a composite of three or four crops (Table I), all grown in the U.S. Pacific Northwest. Equal amounts of wheat from each crop year were used to make the composite.

A Buhler mill model ML202 was used to mill each composite to four extraction levels: 77% for barbari, 82% for lavash, 84% for taftoon, and 87% for sangak. To attain desired extraction levels, the short and bran streams were reground as needed in a Hobart coffee grinder and sieved through a 94-mesh stainless steel screen. All flours were stored in airtight cans at 34° F until studied.

Physicochemical Methods

All samples were analyzed for protein, moisture, and ash contents by AACC (1962) methods. Mixograms were obtained with 10-g portions of samples (Finney and Shogren 1972), and the water absorption level was that predominantly used in Iranian bakery shops. A gassing power test was performed on all samples with a gasograph model 12b (Rubenthaler et al 1980), using a mixture consisting of 10 g of flour (14% mb), 150% water absorption, and 0.76 g of fresh baker's yeast. Readings were taken after 2 hr of fermentation (30° C). Farinograph tests were performed (AACC 1962) to determine the appropriate consistency line for barbari, taftoon, and sangak. Flour color was measured by Agtron (AACC 1962).

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Bread-Baking Procedures

Shogren et al (1969) described a 10-g loaf-baking procedure for the Western type of bread. Maleki and Daghir (1967) described a micro baking technique for Arabic bread. The general methods we used for Iranian bread production were based on those of Faridi and Finney (1980). Micro baking techniques, similar in principle to commercial procedures, were developed for baking experimental loaves.

Barbari bread was prepared by mixing ingredients (Table II) to optimum. After being fermented for 2 hr at 85° F and 90 rh, the dough was punched and rested for 20 min, then sheeted to a 6-mm thickness and trimmed to form a 19 × 10 cm oval. One teaspoon of paste (a boiled mixture of 10 g of flour and 200 ml of water) was spread on, and three grooves were made, mainly for decorative purposes. The dough was then proofed for 15 min and baked for 12 min at 500° F..

Lavash bread was prepared by mixing ingredients (Table II) to optimum. After being fermented for 2 hr at 85° F and 90 rh, dough pieces were sheeted to 1 mm, cut into rounds of 11 cm in diameter, and baked for 80 sec at 630° F. Although the traditional bread is more rectangular, the micro-bake loaves were shaped round for easier handling and improved uniformity for scoring.

Sangak bread was prepared by mixing all ingredients (Table II) to optimum. Sourdough mother slurry was first prepared. It consisted of a 10% flour and water slurry inoculated with *Lactobacillus plantarum, Lactobacillus brevis,* and *Leuconostoc mesenteroides* (Azar et al 1977). The slurry was left overnight, and enough of it was used to inoculate new slurries so that their pH dropped to 4.0 in about 10 hr. A mother dough was prepared with 100 g of sangak flour, 80 cc of slurry, and 0.25 g of fresh baker's

TABLE I
Wheat Varieties, Classes, and Composites Evaluated

Variety	Class	Crop Year 1974	1975	1976	1977	1978
Paha	Club		X	X	X	
Moro	Club			X	X	X
Twin	SWS[a]	X		X	X	X
Sprague	SWW[b]		X	X	X	X
Nugaines	SWW		X	X	X	X
McCall	HRW[c]			X	X	X

[a] Soft white spring.
[b] Soft white winter.
[c] Hard red winter.

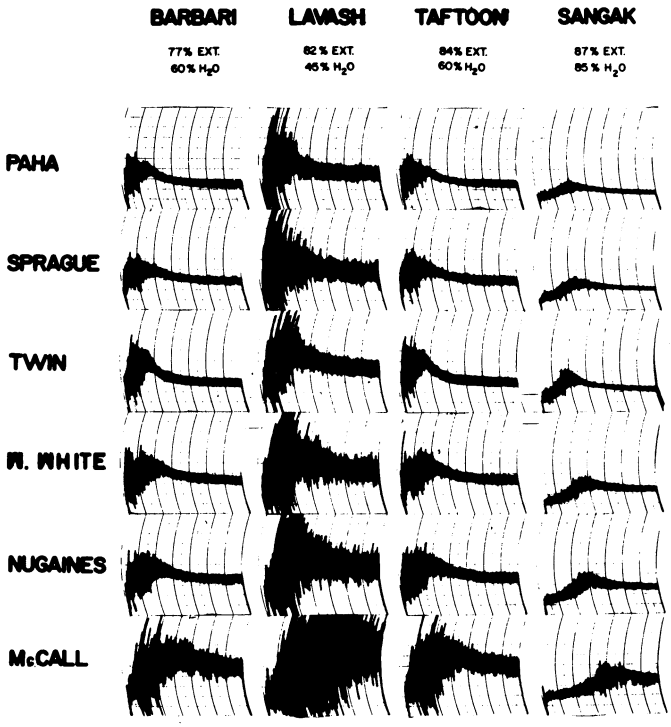

Fig. 1. Mixograms (10-g) of five wheat varieties and a western white composite milled to four extractions and hydrated to 60, 45, 60, and 85% for the Iranian flat breads Barbari, Lavash, Taftoon, and Sangak, respectively.

TABLE II
Bread Formulas Used to Produce Four Iranian Flat Breads

Ingredients[a]	Breads: Barbari	Lavash	Taftoon	Sangak
Flour	100	100	100	100
Yeast[b]	1	0.5	1	...
Sourdough	...	...	...	20
Salt	2	1.5	1	1
Date syrup[c]	...	...	2.5	...
Water	Variable	Variable	Variable	Variable

[a] On percent flour basis.
[b] Fresh baker's yeast supplied by Standard Brands Inc., Sumner, WA.
[c] Dates were boiled, filtered, and concentrated to 55° Brix Index.

TABLE III
Protein, Moisture, and Ash Contents of Five U.S. Wheat Varieties and a Western White Composite Used to Produce Iranian Flat Breads

Bread	Flour Extraction (%)	Wheat Variety	Protein[a,b] (%)	Moisture (%)	Ash[a] (%)
Barbari	77	Paha	10.8	9.1	0.56
		Sprague	9.9	8.9	0.56
		Twin	12.2	9.0	0.66
		Western White	9.9	9.0	0.53
		Nugaines	9.8	9.0	0.52
		McCall	11.4	8.9	0.53
Lavash	82	Paha	10.9	8.9	0.63
		Sprague	10.3	8.8	0.60
		Twin	12.7	9.0	0.72
		Western White	10.0	8.9	0.58
		Nugaines	10.0	8.9	0.59
		McCall	11.7	8.9	0.60
Taftoon	84	Paha	11.0	9.0	0.64
		Sprague	10.3	8.8	0.64
		Twin	12.8	9.0	0.74
		Western White	10.2	8.9	0.61
		Nugaines	10.0	8.8	0.62
		McCall	11.6	8.9	0.63
Sangak	87	Paha	11.2	9.0	0.75
		Sprague	10.5	8.7	0.71
		Twin	13.1	9.0	0.77
		Western White	10.4	8.8	0.70
		Nugaines	10.2	8.7	0.74
		McCall	11.7	8.9	0.71

[a] 14% moisture basis.
[b] N × 5.7

TABLE IV
Gassing Powers (in Gasograph Units) of Flours from Five U.S. Wheat Varieties and a Western White Composite Used to Produce Iranian Flat Breads

Wheat Variety	Breads[a]: Barbari	Lavash	Taftoon	Sangak
Paha	32.4	35.6	37.8	39.5
Sprague	29.9	32.3	33.1	35.4
Twin	32.1	33.1	33.9	35.2
Western White	33.9	34.9	36.9	38.7
Nugaines	37.8	38.8	40.7	43.1
McCall	50.1	53.3	55.4	56.8

[a] Flour extraction required: Barbari, 77%; Lavash, 82%; Taftoon, 84%; Sangak, 87%.

yeast. Every day, new doughs were inoculated with mother dough to keep microorganisms active.

After the dough was prepared, it was fermented for 2 hr, sheeted on a moistened stainless steel plate to 4 mm with a moist roller, and cut into rounds 11 cm in diameter. These were transferred upside down by a spatula to another moist stainless steel plate and then slid onto a hot pebble bed in the oven to bake at 520° F for 5 min. Intermittently between bakings, pebbles were sprayed with soapy water to ensure easy removal of bread.

Taftoon bread was prepared by mixing all ingredients (Table II) to optimum. After being fermented for 1 hr at 85° F and 90 rh, dough pieces were sheeted to 2.5 mm and cut into rounds 11 cm in diameter. These were punctured for decorative purposes, as well as to prevent puffing during oven baking, and were baked for 2.5 min at 600° F.

Effect of proof time on the color of Taftoon bread was determined by removing the upper crust immediately after baking of samples proofed from 0 to 25 min. The crust was air dried (45° C), ground, and read on the Agtron. Before grinding, the few dark brown spots due to Maillard reaction were removed.

TABLE V
Colors (Agtron Values)[a] of Flours from Five U.S. Wheat Varieties and a Western White Composite Used to Produce Iranian Flat Breads

	Breads[b]			
Wheat Variety	**Barbari**	**Lavash**	**Taftoon**	**Sangak**
Paha	57.0	48.0	45.0	35.5
Sprague	60.0	50.0	47.0	36.5
Twin	62.0	44.5	42.0	39.0
Western White	62.0	54.5	50.5	40.0
Nugaines	62.5	49.0	47.0	33.5
McCall	50.5	36.5	23.0	18.0

[a]Higher values indicate light colors.
[b]Flour extraction required: Barbari, 77%; Lavash, 82%; Taftoon, 84%; Sangak, 87%.

TABLE VI
Water Absorption (%) of Flours from Five U.S. Wheat Varieties and a Western White Composite Used to Produce Iranian Flat Breads

	Breads[a]			
Wheat Variety	**Barbari[b]**	**Lavash[c]**	**Taftoon[b]**	**Sangak[b]**
Paha	62.5	45.0	58.5	76.0
Sprague	65.0	45.0	60.0	79.5
Twin	65.0	45.0	60.0	79.5
Western White	65.0	45.0	60.0	80.0
Nugaines	66.5	47.0	61.0	84.0
McCall	73.0	50.0	67.0	87.0

[a]Flour extraction required: Barbari, 77%; Lavash, 82%; Taftoon, 84%; Sangak, 87%.
[b]Adjusted to 400, 580, and 220-BU lines, respectively.
[c]Estimated by dough feel.

RESULTS AND DISCUSSION

Flour Characteristics

Twin had the highest protein content, followed by McCall and Paha (Table III). Twin also had a higher ash content at all extraction levels, which is typical of soft white spring wheat. In baking tests, Twin breads were consistently darker in color than others made with the soft whites tested in this study.

Relative dough strength is indicated by the height and width of the curve from the peak to the mixogram end. Thus Paha had the weakest dough at all extractions, followed by Sprague, Twin, Western White, Nugaines, and McCall (Fig. 1). Relative strength depends on a number of factors, including protein quality and quantity. If the Twin composite used in this study had had about 10% protein instead of 12.2%, it would probably have replaced Paha and/or Sprague as the weakest in this study.

For each wheat variety tested, gassing power increased with

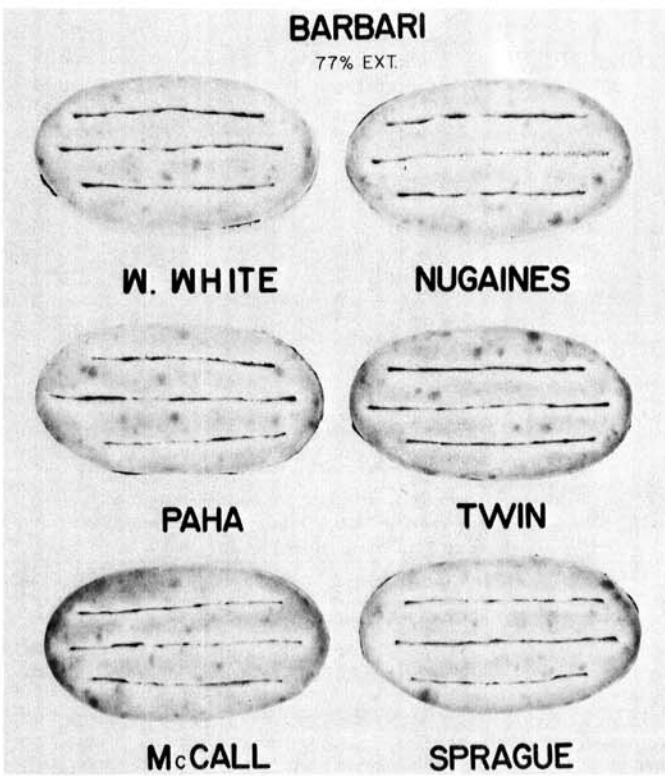

Fig. 2. Iranian Barbari breads produced from five U.S. wheat varieties and a western white composite.

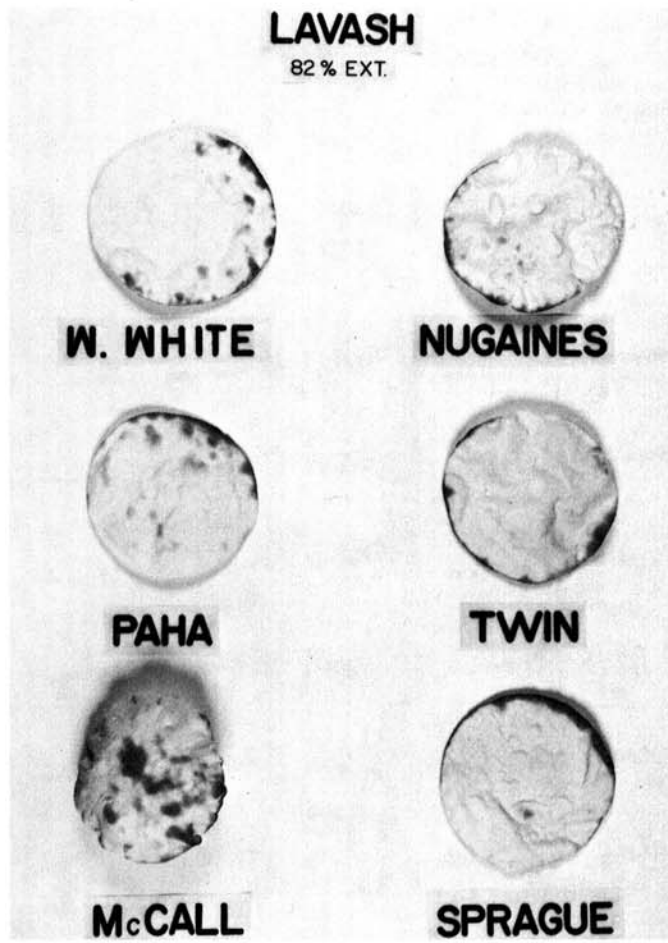

Fig. 3. Iranian Lavash breads produced from five U.S. wheat varieties and a western white composite.

increasing extraction rates (Table IV). Fermentation activity of the McCall was significantly highest, followed by Nugaines, Western White, Paha, Twin, and Sprague. Gas produced was related to flour texture and overall strength of the varieties, as shown in Fig. 1, and to the expected starch damage associated with the higher flour extractions. McCall was also significantly darker than the other wheat varieties, as shown by flour color tests (Table V). Iranian breads are made from high extraction flours; therefore the dark color imparted by the hard red wheat bran make red wheat flours less desirable.

The effect of various water absorption levels on bread quality was determined by experimental baking. The optimum dough consistencies for barbari, taftoon, and sangak were 400, 580, and 200 BU, respectively. Because of the extreme dryness of lavash dough, optimum absorption was determined solely by dough feel and bread properties (Table VI).

Baking Results

Barbari. The best flour for barbari bread production was a white wheat flour like Nugaines (Table VII). Paha produced poor quality bread. The dough was extremely weak and sensitive to excess fermentation. Sprague and Twin also failed to produce quality barbari bread. McCall was too strong; although the texture appeared excellent, the crust color was dark.

To improve the flour strength, different levels of ascorbic acid were added to Western White, Twin, Sprague, and Paha (Table VII). Ascorbic acid was effective in strengthening the weaker flours, and quality barbari bread was produced from all (Fig. 2).

Lavash. Flour of medium-to-low strength was optimum for quality lavash production (Table VII). High quality lavash is paper thin and has pronounced air cells on the surface (Faridi and Finney 1980). An undesirable characteristic is puffing (separation of upper and lower crust). Because of excess strength, McCall was unsatisfactory, both from the standpoint of dough handling and end product evaluation (Fig. 3). Nugaines showed a tendency to puff. Paha, Twin, Sprague, and Western White all were graded satisfactory, both in dough handling and end-product evaluation.

Taftoon. A medium-to-strong soft white flour was optimum for quality taftoon production (Table VII). Nugaines produced high quality bread and Western White and Sprague, satisfactory bread. Twin produced questionable bread because of excessive browning. Paha was too weak and McCall was too strong. Also, the McCall bread was too dark to be acceptable (Fig. 4).

Traditionally, taftoon dough is not proofed, but in Iranian mechanized bread production systems, it is proofed for a few minutes (Faridi and Finney 1980). We found that the proof time had a pronounced effect on color intensity of the finished product as measured by the Agtron. Darkness of the bread increased with increases in proof time (Table VIII).

Sangak. Medium-to-strong white flour was optimum for quality sangak production (Table VII). Nugaines, Western White, Sprague, and Twin all produced quality breads; however, because of the very peculiar method of dough preparation and baking, the stronger soft white wheats (such as Nugaines and Western White) were more favorable. Paha was not strong enough, and McCall was too strong and again too dark. Because sangak bread is made from 87% extracted flour, the darkness and redness of hard red winter wheat (McCall) were readily observable (Fig. 5A and B).

CONCLUSION

Soft white wheats were generally the most suitable for Iranian breads. The hard red winter wheat (McCall) was less suitable. Also, at higher extraction levels, the darkness of McCall flour made the bread too dark to be acceptable. Club wheat was weak, making the dough handling difficult and the bread texture porous.

Of the five different varieties and the white composite tested, the

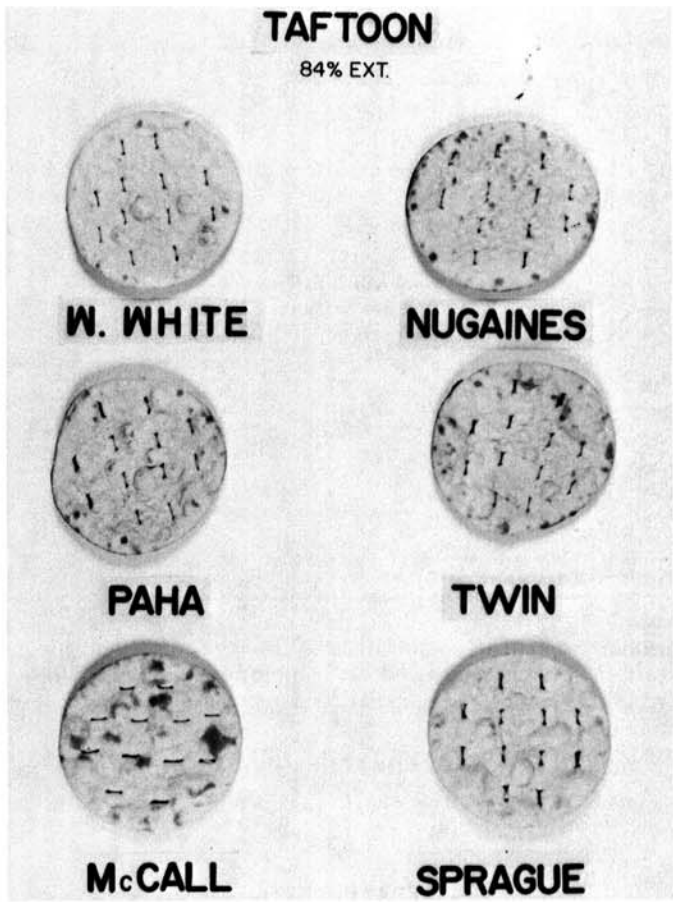

Fig. 4. Iranian Taftoon breads produced from five U.S. wheat varieties and a western white composite.

TABLE VII
Quality Evaluation[a] of Flours from Five U.S. Wheat Varieties and a Western White Composite Used to Produce Iranian Flat Breads

	Breads							
	Barbari							
	Conventional		With Ascorbic Acid[b]				Sangak	
Wheat Variety	Color	Texture	Color	Texture	Lavash[c]	Taftoon[c]	Color	Texture
Paha	Q-U	Q	S	S	S	U	Q-S	S
Sprague	Q	Q-S	S	S	S	S	S	S
Twin	Q	Q-S	S	S	S	Q-S	S	S
Western White	Q	Q-S	E	E	S	S	S	S
Nugaines	S	S	S	S	Q-S	E	S	S
McCall	Q-S	E	Q-S	E	U	U	U	U

[a] E = excellent, S = satisfactory, Q = questionable, U = unsatisfactory.
[b] Addition of 25, 75, 75, and 150 ppm ascorbic acid to Western White, Sprague, Twin, and Paha, respectively.
[c] Judged for overall acceptability.

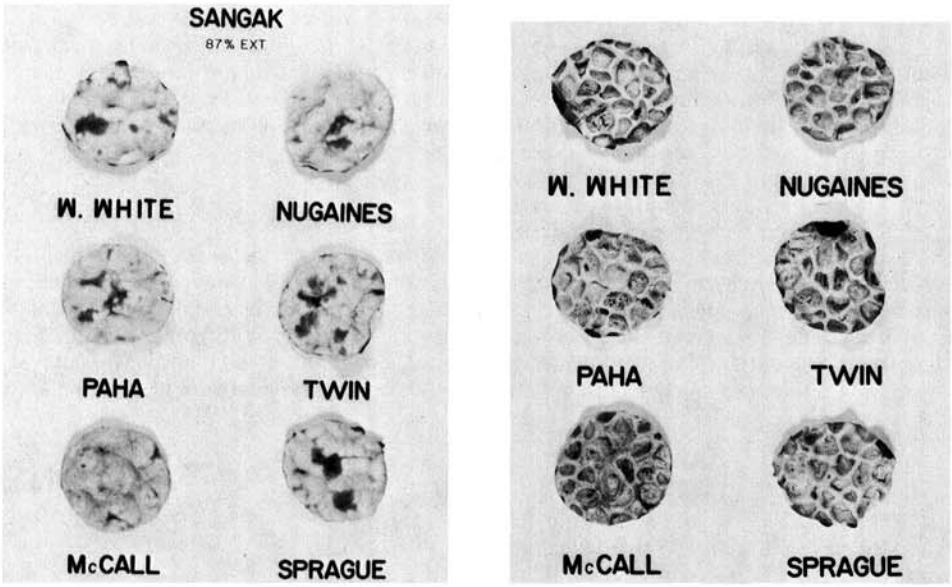

Fig. 5. Iranian Sangak breads produced from five U.S. wheat varieties and a western white composite. **Left,** top view; **right,** bottom view, showing indentions in bread.

TABLE VIII
Effect of Proof Time on Taftoon Bread Color[a]

Proof Time (min)	Agtron Value
0	90.0
2	80.5
5	75.5
10	70.5
15	68.5
20	62.0
25	55.0

[a]Higher values indicate light color.

medium-strength soft white wheat Nugaines and the composite, Western White, yielded the best all-purpose flours for use in preparing the four most popular Iranian breads.

ACKNOWLEDGMENT

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