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AGRONOMIC CHARACTERISTICS AND BAKING QUALITY OF TWELVE WHEAT VARIETIES GROWN IN IRAN[1]

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ABSTRACT

Twelve varieties of wheat commonly grown in Iran were studied for three consecutive years and their agronomic characteristics and baking quality were determined. The year-to-year variation was great for all characters except the 1000 kernel weight, protein content, sedimentation number and the volume of bread.

The results obtained indicated significant differences between varieties with respect to yield, protein content and volume of bread. However, no significant differences existed between varieties for the rate of extraction and water uptake. A negative correlation was found between yield and baking quality. The relationships between protein content, sedimentation value and bread volume for these 12 varieties were similar to those of German wheat varieties.

INTRODUCTION

Agronomic characteristics and baking quality for the common varieties of wheat grown in a region are the basic information required in any breeding, baking, import or export program. Wheat quality is closely related to the quality of its milled products, particularly flour. Baking quality of a wheat variety depends on many factors among which the extraction percentage, protein and ash contents and particle size of the flour are the most important ones (10).

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Grosskreutz (9) demonstrated the effect of protein quality of flour on its baking quality and Bungenburg de Jong (7) described the role of gluten in the strength of flour. Bolling and Springer (4) used a correlation between the sedimentation value and protein percentage in flours to predict the baking quality. Bolling (5) evaluated the mixing effect of different varieties of wheat. Seibel *et al.* (11) and Bolling and Zwingelberg (6), after thorough qualitative studies, formulated the best mixture of imported and German wheat varieties for obtaining flour of good quality.

Production of wheat in Iran varies between one to three million tons per year; however, the demand for wheat is greater than supply (2). Lack of enough information on the quality of local and introduced varieties to guide breeders and producers encouraged the initiation of this study.

MATERIALS AND METHODS

Seeds of the varieties used in this study were originally obtained from the Plant Breeding Institute of Iran (Karadj) and were increased under field conditions at the Bajgah Experiment Station of the College of Agriculture, Pahlavi University, Shiraz, Iran. Seed of each variety was planted in plots of 6 x 2.4 m in four replicates of a randomized complete block design. The experiment was repeated in three consecutive years. The soil type was a calcareous silty clay loam with a pH of 8.2. Before planting 100 kg superphosphate and 70 kg urea/ha were applied. Planting was done around mid-October and plots were harvested on mid-May with five irrigations in between. The average weather data for the period of this study are shown in Table 1. Data were taken on grain yield, 1000 kernel weight, length of spike and number of spikelets per spike after harvesting.

Seeds harvested from each plot were equilibrated to a moisture content of 16% and milled using a Buhler automatic laboratory mill (Type MKU 202, Uzwil, Switzerland). Sedimentation value, % protein and ash, falling number and bread volume by the Rapid Mix Test were then measured according to standard methods (1,3). Rheological properties of flour were determined by a Brabender Farinograph, Duisburg, Germany using the 500 line. Data were subjected to the analyses of variance and means of varieties were compared using Duncan's Multiple Range Test (8) at the 1% probability level.

Table 1. Mean weather data of Bajgah Aricultural Experiment Station during the experimental seasons of 1971-73.

Month	Temperature. C			Noon relative humidity, %	Rainfall, mm
	Minimum	Maximum	Mean		
October	0.6	27.0	13.8	21.2	0.0
November	-3.9	19.7	7.9	33.9	7.0
December	-6.3	13.3	3.5	46.3	30.1
January	-8.8	6.7	-1.1	72.3	104.1
February	-6.6	7.8	0.6	62.6	70.1
March	-3.3	12.5	4.6	31.1	17.1
April	5.1	17.5	11.3	37.6	27.3
May	4.1	24.5	14.3	27.5	0.0

RESULTS AND DISCUSSION

Analyses of variance for data of individual years and all three years combined showed significant differences with respect to varieties and years for many characters studied. However, varieties did not differ significanly from each other for spike length (7.7 cm), number of spikelets per spike (15.5), extraction percentage (73.01),ash content (0.642%), water uptake (56.01 ml/100g flour), falling number (415 sec) or bread yield (126.68g/100g flour).

The effect of year was statistically the same for 1000 kernel weight, protein content, sedimentation number and volume of bread whereas year had significant effects on other characters under study.

Yield, kernel weight, protein content, sedimentation number and volume of bread averaged over three years for different wheat varieties are reported in Table 2. Yield of grain from different varieties varied from of 4.03 tons/ha for Koohrang to 1.62 tons/ha for Siano. In general, introduced wheat varieties had lower yields than the varieties developed in Iran. This might be one of the basic reasons for lower wheat acreage of foreign wheat varieties in Iran.

The varieties differed with respect to the kernel weight; Derakhshan having the heaviest and Deihim the lightest kernels. The differences between varieties for the protein content and sedimentation value were also significant. In general, the foreign varieties had higher protein content and sedimentation value than the local Iranian varieties. The variety Siano had the highest amount of protein in the grain (13.4%) and sedimentation number (27.67 ml).

Bread volume was obtained according to the Rapid Mix Test (3) and estimates of the volume of bread for each variety were also obtained by interpolation of the protein and sedimentation value on the charts produced by Bolling and Springer (4). By both methods, the variation between different varieties were great for bread volume. The predicted values were reasonably close to the actual values and the differences never exceeded 11.1%. On the everage, the deviation between the actual and predicted bread volumes was about 5.4%. Although Bolling and Springer (4) devised their charts for German wheat variaties, this study clearly shows that these charts are quite adequate for estimating the bread volume from protein content and sedimentation number of flour of other wheat

Table 2. Mean of different varieties for various characters under study.

Varieties	Yield, tons/ ha	1000 kernel weight, g	Protein, %	Sedimentation No., ml	Volume of bread		
					Rapid Mix Test	Estimated	Difference
Koohrang	4.03 a *	38.7ab	10.1b	9b	520 b	517 c	+3
Ommid	3.70 ab	38.8ab	10.0b	14ab	564 ab	510 c	+54
Navid	3.51 ab	32.9b	11.0ab	17ab	609 ab	570 b	+39
Jolgeh	3.47 ab	41.1a	10.9ab	12ab	524 ab	547 bc	-23
Deihim	3.27 abc	32.4b	12.0ab	15 ab	533 ab	558 bc	-25
Roshan	3.15 abc	41.6a	11.6ab	15 ab	545 ab	527 c	+18
Derakhshan	3.00 abc	43.4a	11.6ab	17 ab	545 ab	545 bc	0
Penjamo	2.77 abc	36.6ab	12.2 ab	19 ab	580 ab	588 b	-8
Tobari	2.74 abc	36.0ab	11.8ab	23 ab	611 ab	567 b	+44
Inia	2.06 bc	40.7a	12.3ab	22 ab	649 a	577 b	+72
Akowa	2.02 bc	35.2ab	12.9ab	21 ab	598 ab	643 a	-45
Siano	1.62 c	36.1ab	13.4a	28 a	628 ab	575 b	+53

* Means in each column followed by same letter are not significantly different at 1% level of probability.

variaties or in screening tests where a large number of strains are involved.

All possible simple correlation coefficients between character pairs across all varieties and years were calculated and are reported in Table 3. Highly significant negative correlations were found between yield of varieties and their protein content, sedimentation value and water uptake. Kernel weight was not significantly correlated with any other character studied. Protein content, on the other hand, was related with sedimentation number, water uptake, bread yield and volume. Other significant correlations were between water uptake and bread volume; between extraction percentage and bread volume and between ash content and water uptake.

The point worth mentioning is that according to Table 3, the varieties that had higher yield were actually of poorer baking quality as shown by lower protein content, sedimentation value and water uptake. This calls for extensive breeding programs to develop wheat strains which could have good performance with respect to both yield and baking quality. Table 3 also shows that the three primary characters which determine quality (protein content, sedimentation value and water uptake) are fortunately positively interrelated so that, through breeding programs, the improvement in any one of the three characters would cause the other two to improve as well.

Table 4 and Fig. 1 demonstrate the actual baking characteristics of each variety of wheat. Table 4 shows that although the color of crumb of some of the varieties such as Ommid, Jolgeh, Penjamo, Tobari, Inia and Akowa was yellowish, the texture and flavor of bread made out of their flour were satisfactory.

Taking the volume of bread into consideration (Table 2), the varieties Penjamo, Tobari, Inia and Akowa had particulary a good baking quality. Fig. 1 shows that, with the exception of Navid, Deihim, Penjamo, Siano and Inia, the varieties studied can be used in the baking of European type bread of good quality while others need to be mixed with either stronger or weaker quality varieties. Other studies are under way to determine the relationships between agronomic characteristics and baking quality of these varieties for use in flat types of bread common in the Middle East.

Table 3. Simple correlation coefficients between character pairs across all varieties and years.

Factors of quality	Yield	KW	P	SN	EX	Ash	WU	BV
1000 Kernel weight (KW)	.10							
Protein % (P)	-.94**	-.25						
Sedimentation No. (SN)	-.91**	-.23	.83**					
Extraction % (EX)	.41	.26	.17					
Ash % (Ash)	.31	.15	.01	.23	-.12			
Water uptake % (WU)	-.37*	.01	.64**	.53**	.09	.39*		
Bread yield (BY)	-.19	-.27	.43*	.12	.13	-.22	.34	
Bread volume (BV)	-.30	-.26	.59**	.69**	.42*	.11	.27	-.06

*,** Correlation coefficient greater than that required for significance at 5 and 1% probability levels, respectively.

Table 4. Baking characteristics of wheat varieties according to the Rapid Mix Test.

Variety	Dough yield	Dough appearance	Bread texture	Bread flavor	Color of crumb
Koohrang	160	Plastic-short	Good to fair	Like biscuit	Yellow
Ommid	161	Normal-moist	Good	No off-flavor	Normal
Navid	161	Plastic-short	Small but satis-factary	Like biscuit	Somewhat yellow
Jolgeh	162	Somewhat short	Large but satis-factary	No off-flavor	Yellow
Deihim	162	Moist	Objectionable	No off-flavor	Normal
Roshan	162	Moist	Objectionable	No off-flavor	Normal
Darakhshan	163	Moist	Objectionable	No off-flavor	Normal
Penjamo	162	somewhat tough	Good, somewhat open	No off-flavor	Normal
Tobari	162	Normal to short	Very good	No off-flavor	Somewhat yellow
Inia	163	Moist	Small but satis-factory	No off-flavor	Normal
Akowa	164	Moist	Small but satis-factory	No off-flavor	Somewhat yellow
Siano	163	Somewhat vel-vety and moist	Objectionable	No off-flavor	Normal

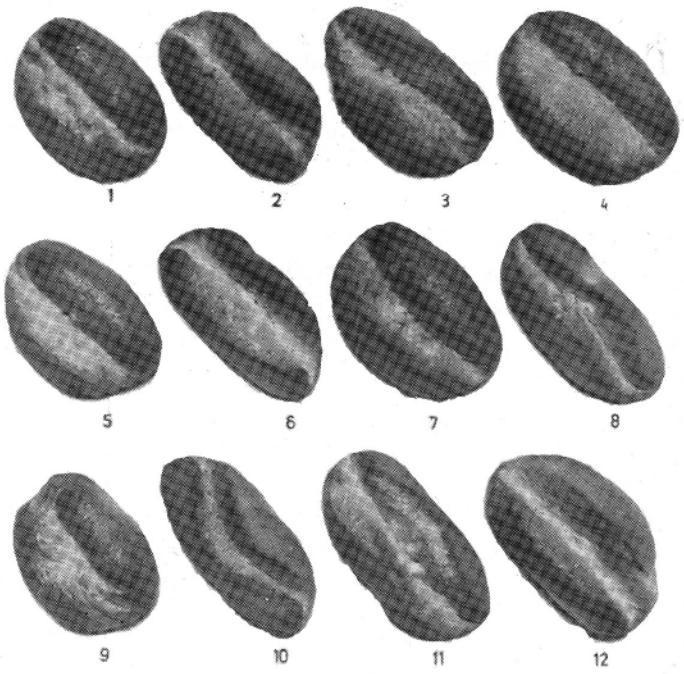

Fig. 1. Appearance of bread baked from flour of Koohrang (1), Navid (2), Jolgeh (3) Ommid (4), Derakhshan (5), Deihim (6), Roshan (7), Penjamo (8), Tobari (9), Siano (10), Inia (11) and Akowa (12).

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