NOTE

The Chemical Composition and Rheological Properties of Flours Milled from Two Major Wheat Varieties Grown in Saudi Arabia

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ABSTRACT

The chemical composition, mineral contents, and rheological properties of flour samples obtained from two major wheat varieties grown in the Kingdom of Saudi Arabia, Yecora Rojo and Probred, were studied. Results of the chemical composition indicated that these flours contained relatively high levels of protein, when compared to other flours, but similar levels of crude fiber, ash, and fat. Probred was higher in protein (16.03%) than Yecora Rojo (14.19%). The other cultivar components such as crude fat, crude fiber, ash, and nitrogen-free extract were present in comparable amounts in the two flours. The mineral profiles of the two flours were comparable except for a slightly higher iron content in Probred. The sodium level in both flours was relatively high. Data on the rheological properties indicated desirable physical characteristics for breadmaking.

The Kingdom of Saudi Arabia is advancing rapidly in the field of wheat production. The agricultural goal of the Kingdom is to reach self-sufficiency in wheat production by the crop year 1985–1986. During 1977–1978 wheat production in Saudi Arabia was 119,000 tons (Anonymous 1982). From 1977–1978 to 1980–1981 it increased by 56%, whereas the increase from 1980–1981 to 1982–1983 was even more impressive at 252%.[3] It is anticipated that during 1983–1984, wheat production in Saudi Arabia will reach 1,300,000 tons.

The wheat varieties presently cultivated are the Yecora Rojo and Probred varieties, and during the 1982–1983 crop season they accounted for 95% of all the wheat produced in the country. The locally milled flour is enriched at the flour mills with essential vitamins and iron. It is further treated with bleaching and oxidizing agents, and fungal amylase is also added.

The objective of the present study was to evaluate the chemical composition and the rheological properties of the flours milled from the locally grown wheats, Yecora Rojo and Probred.

MATERIALS AND METHODS

Materials

Flour samples from two wheat varieties, Yecora Rojo and Probred, were obtained from the grain silos and flour mills organization in Riyadh, Saudi Arabia. These were taken at two different times representing two crop years (1982 and 1983). The wheat samples were milled at the quality control laboratory of the flour mills using a Bühler Laboratory mill. All flour samples were stored in polyethylene bags in a refrigerator at 5°C for further analyses.

Proximate Analysis

Moisture (method 44-15), protein (N × 5.7) (method 46-12), crude fat (method 30-25), and ash (method 30-25) were determined according to procedures outlined by the AACC (1982). Crude fiber was determined according to method 7.068 of the AOAC (1980).

Mineral Analysis

For determining the mineral contents (Na, K, Ca, Mg, P, Fe, Cu, Zn, and Mn), the ash was dissolved in 20% HCl. The final diluted solution for Ca and Mg contained 1% lanthanum to overcome interference, especially by phosphates. All minerals except Na, K, and P were determined by using an atomic absorption spectrophotometer (Perkin-Elmer, model 603). Sodium and K were determined with a flame photometer (Beckman, Klina Flame). Phosphorus was determined spectrophotometrically by the procedure of Watanabe and Olsen (1965).

Rheological Analysis

For the determination of water absorption, arrival time, mixing time, dough stability, departure time, and mixing tolerance index of the wheat flours, a Brabender farinograph equipped with the 50-g bowl and the constant flour weight procedure (AACC method 54-21, 1982) were used.

TABLE I
Chemical Composition (%) of Flours[a] of the Two Major Wheat Varieties

	Flour Sample		
	Yecora Rojo	Probred	Yecora Rojo (95%) + Probred[b] (5%)
Proximate composition			
Moisture	10.03	10.03	10.85
Protein (N × 5.7)[c]	14.19	16.03	14.02
Crude fat[c]	1.11	1.50	1.22
Crude fiber[c]	0.42	0.32	0.40
Ash[c]	0.67	0.66	0.57
Nitrogen-free extract[c]	83.61	81.49	83.79
Mineral composition[d]			
Ca	35	31	···
Mg	41	42	···
P	115	126	···
Na	58	62	···
K	126	129	···
Fe	1.15	1.67	···
Mn	0.67	0.49	···
Cu	0.23	0.19	···
Zn	0.68	0.79	···
Crop year	1982	1982	1983

[a] Results are based on triplicate determinations of two distinct flour samples from each wheat variety.
[b] Blend of two wheat varieties at the flour mills in November 1983.
[c] Dry basis.
[d] mg/100g dry basis.

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TABLE II
Farinograph and Extensigraph Data for the Flours of the Two Major Wheat Varieties

Flour Sample	Crop Year	Water[a,b] Absorption (%)	Arrival[b] Time (min)	Mixing[b] Time (min)	Stability (min)	Mixing[b] Tolerance Index (BU)	Resistance[b] to Extension (BU)	Extensibility[b] (mm)	Ratio[b]
Yecora Rojo	1982	65.9	2.0	8.8	17.5	20	410	175	2.34
Probred	1982	69.0	3.9	7.0	13.6	10	440	205	2.15
Yecora Rojo (95%) + Probred (5%)[c]	1983	64.1	2.1	8.5	17.8	18	...	...	...

[a] Absorption as is basis.
[b] Mean values for duplicate determinations.
[c] Blend of two wheat varieties at the flour mills in December 1983.

The Brabender extensigraph was used to evaluate the flours for resistance to extension and extensibility by method 54-10 (AACC 1982). Load-extension curves were recorded at 45-, 90-, and 135-min rest periods. However, only the final rest-period values were used for comparing flour properties. The ratio figure was calculated from the values of resistance to extension and extensibility.

RESULTS AND DISCUSSION

Chemical Composition

Proximate composition. The proximate composition of the flours of the two major wheat varieties and their blend (Yecora Rojo 95, Probred 5) are presented in Table I. The protein content of Probred (16.03%) was relatively higher than Yecora Rojo (14.19%), or the blend (14.02%). The protein content of the blend was slightly lower than the expected value. This could be due to different lots of the two parent wheat varieties used for blending which might have had different protein contents than indicated in the present study. The flour blend was obtained from the Riyadh flour mill. The protein contents of these flours were similar to those reported by Pellet and Shadarevian (1970) and Watt and Merril (1963) for patent, straight, and 80% extraction flours. The protein content of Probred flour compared well with those reported for hard flours (El-Sayed et al 1978a,b; Volpe and Zabik 1981; Chung et al 1979). As for the fat content of these flours, the results were comparable to those reported by Pellet and Shadarevian (1970) and Watt and Merril (1963).

The crude fiber and ash contents of these flours are within acceptable values and compare favorably with values reported by Watt and Merril (1963) for 80% extraction flour and patent bread flour. Because a Bühler mill was used for milling the wheat samples, a certain variation in ingredient values is to be expected, although the criterion of combining flour streams to obtain a uniform ash content of 0.55% was a fixed one.

The flour yield ranged from 64 to 66%. It is important, however, to note that during the 1983 crop year 95% of the wheat produced in the Kingdom was the Yecora Rojo variety.

Mineral elements. The mineral contents of the two major flour samples are presented in Table I. No major differences were observed in the mineral contents of the studied flour samples. The Na content of the flours was very high compared to data reported by Watt and Merril (1963) and Pomeranz (1978). The probable explanation for such a high Na content is the high salt content of irrigation water in Saudi Arabia. The Ca content of the two flours was also high compared with the values reported by Lorenz et al (1980). Such variation in mineral contents are usually a result of different agricultural practices and growing conditions (Ghanbari and Mameesh 1971). However, the Mg content compared well with the values reported by the same investigators. The P and K contents of these flours are close to values reported by Pellet and Shadarevian (1971) and Watt and Merril (1963) for baker's bread flour, straight hard winter, and 80% extraction flours. As for the micronutrient contents, Probred had a relatively higher Fe content than Yecora Rojo, but Mn, Cu, and Zn contents were generally comparable in the two flours. The values for Mn and Cu of these flours compared favorably with those reported by Pomeranz (1978).

Dough Rheology

Results of the rheological properties of the wheat flour samples are presented in Table II.

The farinograph data on the flours of the two major wheat varieties and their blend showed high water absorption (64.1–69.0%) values, highly acceptable mixing times (7.0–8.75 minutes), and long stability times (13.6–17.8 minutes). These results indicated that these flours could be used successfully for breadmaking and that they conform well to the classification criteria of wheats for breadmaking (Pomeranz 1978). These results also compared well with rheological data presented on hard red spring wheat flour (Volpe and Zabik 1981).

The extensigraph data for the flours of the two varieties indicated a medium (410–440 BU) resistance to extension and medium (175–205 mm) extensibility values (Pomeranz 1978). The values of resistance to extension of the flours are lower than those reported for hard flours by El-Sayed et al (1978) and Volpe and Zabik (1981). However, the extensibility values compared well with those reported by the same investigators. The ratio figures for the two flours are also in conformity with those that are characteristic of medium strength flours (Pomeranz 1978).

The data on the rheological properties indicated that the flours of the two major wheat varieties studied could be successfully used in breadmaking. In conclusion, the wheat grown in Saudi Arabia could yield flours of acceptable chemical and rheological properties suitable for making Arabic (flat) and European breads.

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