NOTE

Rheological Properties and Baking Quality of Flour from a Landrace and Durum Wheat Cultivars Grown in Jordan

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ABSTRACT

Rheological and bread-making quality of a landrace (Horani-27) and nine durum wheat cultivars (ACSAD-65, Amra, Der Alla-6, Der Alla-2, Veery, Korifla, Lacesh, Rabi-S, and Sham-1) grown in Jordan were assessed by farinograph and extensigraph. Farinograph and extensigraph data showed significant differences between these cultivars. When the characteristics of bread loaves were compared, all the durum wheat cultivars produced desirable characteristics for breadmaking. Amra, Veery, and Lacesh were rated excellent. All others, including the landrace, were rated good.

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Bread is the daily staple of the Jordanian people and provides most of their calories and proteins. Production has not been sufficient to satisfy the domestic needs. In 1989, 54,519.8 meteric tons were produced on 562,116.8 hectares (Anonymous 1989).

Wheat yield improvement, through breeding programs and the introduction of high-yielding cultivars, has been a major effort of the Ministry of Agriculture in Jordan. The goals are to meet the increasing demand for bread and reverse declining production.

The rheological properties and baking quality of flour obtained from durum wheat cultivars have been investigated by many workers (Finney and Barmore 1948; Faridi et al 1982; Faridi and Rubenthaler 1983, 1984; Guy 1984; Pomeranz et al 1984; Khatchadourian et al 1985; Amr 1988; Huifen and Ponte 1988; Lai et al 1989; May et al 1989; Silaula et al 1989).

The objective of this study was to compare the rheological and baking quality of a landrace and nine durum wheat varieties grown in Jordan.

MATERIALS AND METHODS

Materials

Nine durum wheat cultivars used in this study were: ACSAD-65 (Syria 1988), Amra (Jordan 1988), Der Alla-6 (Jordan 1988), Der Alla-2 (Jordan 1988), Veery (Mexico, not released), Horani-27 (landrance), Korifla (Mexico 1988), Lacesh (Mexico 1988),

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Rabi-S (Syria, not released), and Sham-1 (Syria 1988). All were grown at Maru Agriculture Experimental Station (North Jordan) in a randomized complete block design with three replicates in 1987–1988. All wheat samples were tempered to 15.5% moisture content and milled on a Buhler experimental mill (model MLV-202) at the Western Wheat Quality Laboratory, Pullman, WA.

Rheological Analysis

For the determination of water absorption, arrival time, peak time, stability, mechanical tolerance, development time, and departure time of the wheat flours, a Brabender farinograph equipped with a 50-g bowl and the constant flour weight procedure (method 54-21, AACC 1983) were used. The farinograms were evaluated according to Shuey (1972).

The Brabender extensigraph was used to test the flours for resistance to extension and extensibility (AACC method 54-10). Dough-extension curves were obtained at rest periods of 45, 90, and 135 min. Only the final rest period was utilized for comparing flour properties. The ratio figure was computed as the ratio between resistance to extension and extensibility.

Bread-Baking Techniques

Pan bread loaves were prepared, according to Pomeranz (1987), with 100 g of flour (72% extraction), were mixed with 1.8 g of wet yeast, 1.8 g of NaCl, 7.5 mg of ascorbic acid, and 61 ml of water in a farinograph for 6 min. The dough was transferred to a pan and left to ferment at 30°C, 86% rh. It was punched after 105 and 155 min, molded after 180 min of fermentation, and baked at 218°C for 24 min. Loaves were weighed as they came out of the oven. Volume was determined by sesame seed displacement, and the specific volume (cm^3) was calculated. Loaves were allowed to cool for 1–2 hr and then evaluated.

Bread-Evaluation Techniques

Evaluation of bread was done according to Faridi and Rubenthaler (1984). Visual scoring of all breads was based on numerical values of 1–10 (10 = excellent). The average score for each quality factor of three repeated bakes for each replicate were converted to descriptive categories of excellent (9–10), satisfactory (7–8), questionable (5–6), and unsatisfactory (lower than 5).

Statistical Analysis

The collected data were statistically analyzed and the least significant difference among treatments was determined according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Farinograph Studies

Results of the rheological properties of the wheat flour samples obtained from the farinograph data are shown in Table I. The farinograph data showed high water-absorption values ranging from 59% (ACSAD-65, Amra, Veery and Sham-1) to 68.5% (Horani-27). All other wheat varieties were intermediate. The arrival time ranged from 1.5 min (Lacesh) to 4.5 min (Veery and Korifla). Peak time, as shown in Table I, ranged from 2 min (Amra and Lacesh) to 3.5 min (Sham-1). All other cultivars were intermediate. These results compare very well with rheological data presented on two major wheat varieties grown in Saudi Arabia (Khatchadourian et al 1985) and with rheological data presented on hard red spring wheat flour (Volpe and Zabik 1981). The peak time in this study compares well with data presented by Volpe and Zabik (1981), who reported a peak time range of 2–15 min for hard red winter wheat flour supplemented with single-cell yeast protein.

Stability data of the dough is also shown in Table I. The stability time ranged from 1.8 min (Lacesh) to 4 min (Rabi-S). All other cultivars were intermediate. Although the stability times were short for all the doughs, the mixing characteristics of all the doughs had sufficient structural support because of sufficient development of gluten protein.

The mechanical tolerance index data is also shown in Table I. It ranged from 10 Brabender units (BU) (ACSAD-65, Veery, and Horani-27) to 22 BU (Korifla). All other cultivars were intermediate. These results are in agreement with data reported on Saudi Arabian wheat cultivars presented by Khatchadourian et al (1985).

Extensigraph Studies

As indicated in Table I, the resistance to extension of dough made from the investigated wheat cultivars ranged from 400 BU (ACSAD-65), Lacesh and Sham-1) to 500 BU (Der Alla-2). All others were intermediates. These data compare very well with those reported by Khatchadourian et al (1985), Volpe and Zabik (1981), and Singh et al (1990). The extensigraph data indicated a medium (400–500 BU) resistance to extension and a slightly low extensibility, which ranged from 132 mm (Der Alla-2 and Horani-27) to 136 mm (Rabi-S). The values of extensibility are lower than those reported by Khatchadourian et al (1985) and El-Sayed et al (1978 a,b) for flour obtained from Saudi wheat and hard wheat, respectively, but they are in agreement with values reported by Yaseen et al (1991).

The ratio between extensibility and resistance to extension, as shown in Table I, are in conformity with values reported by Yaseen et al (1991) that are characteristic of medium strength flours.

Bread Study

The characteristics of bread loaves made from the wheat flours we investigated are shown in Table II. The weight of the loaves ranged from 150.1 g (Lacesh) to 162.8 g (Sham-1). Loaf volume ranged from 315 cm^3 (Sham-1) to 750 cm^3 (Veery). The specific volume ranged from 1.9 cm^3/g (Sham-1) to 5.0 cm^3/g (Veery).

TABLE I
Farinograph and Extensigraph Characteristics of Flour Obtained from Wheat Cultivars Grown in Jordan[a,b]

Wheat Cultivars	Farinograph Absorption (%)	Arrival Time (min)	Peak Time (min)	Stability (min)	Mechanical Tolerance Index (BU)	Development (min)	Departure (min)	Resistance to Extension (BU)	Extensibility (mm)	Ratio
ACSAD-65	59 c	2 d	3.1 b	2 b	10 d	2.5 e	4 g	400 l	134 bc	2.98 f
Amra	59.5 c	3 b	2 d	3 b	20 b	4 c	6 d	410 g	133 cd	3.08 e
Der Alla-6	61 b	3 b	2.4 c	2 d	15 c	3 d	5.4 e	436 e	136 a	3.21 cd
Der Alla-2	61.2 b	2 d	2.1 d	1.5 f	20 b	2 fg	4.1 g	500 b	132 d	3.79 b
Veery	59 c	4.5 a	3.2 b	2 d	10 d	5 a	7.7 b	448 c	137 a	3.27 c
Horani-27	68.5 a	2.5 c	2.1 d	2.5 c	10 d	2.5 e	5 f	542 a	132 d	4.11 a
Korifla	60.2 bc	4.5 a	3.3 ab	2.5 c	22 a	4.5 b	8.8 a	442 d	136 a	3.25 c
Lacesh	60 bc	1.5 e	2 d	1.8 e	15 c	1.8 g	3.3 h	400 h	134 bc	2.99 ef
Rabi-S	60 bc	2.5 c	2.5 c	4 a	15 c	3 d	6.5 c	428 f	136 a	3.15 d
Sham-1	59 c	2 d	3.5 a	2.1 d	15 c	2.3 ef	4 g	400 l	133 ab	3.01 f
LSD ($P \leq 0.05$)	1.43	0.27	0.27	0.16	0.13	0.30	0.26	5.31	1.79	0.06

[a] Average of three determinations.
[b] Means within columns with different letters are significantly different according to LSD at $P \leq 0.05$.

TABLE II
Characteristics of Bread Loaves Prepared from Durum Wheat Flour[a,b]

Wheat Cultivar	Loaf Weight (g)	Loaf Volume (cm^3)	Specific Volume (cm^3/g)	Visual Scoring[c]			Quality Estimate
				Crust Color	Crust Crispness	Loaf Integrity	
ACSAD-65	161.3 b	345 f	2.1 g	8 bc	7.5 c	9 a	Good
Amra	156.7 e	630 c	4.0 c	9 a	8.5 a	8.5 b	Excellent
Der Alla-6	159.7 c	345 f	2.2 f	8 bc	8 b	8.5 b	Good
Der Alla-2	154.5 f	335 g	2.2 f	8 bc	7.5 c	8 c	Good
Veery	150.4 g	750 a	5.0 a	8 bc	8 b	8.5 b	Excellent
Horani-27	157.2 de	330 h	2.1 g	9 a	8.5 a	9 a	Good
Korifla	160.8 b	370 e	2.3 e	7 d	7.5 c	7 e	Good
Lacesh	150.1 g	680 b	4.5 b	7.5 cd	7.5 c	7.5 d	Excellent
Rabi-S	157.6 d	570 d	3.6 d	7 d	7.5 c	7 e	Good
Sham-1	162.8 a	315 i	1.9 h	7.5 ed	8 b	7.5 d	Good
LSD ($P \leq 0.05$)	0.64	0.94	0.06	0.55	0.43	0.28	

[a] Average of three determinations.
[b] Means within columns with different letters are significantly different according to LSD at $P \leq 0.05$.
[c] Averages of numerical values 1–10 (10 = excellent).

All others had intermediate values. The loaf weight, loaf volume, and specific volume values presented in Table II are in agreement with those values presented by Faridi and Rubenthaler (1983) on 12 wheat varieties used to produce four North African breads. Our data is in agreement with values presented by Singh et al (1990) on 15 wheat cultivars.

Data on crust color, crispness, and loaf integrity are presented in Table II. Our wheat cultivars produced acceptable bread. Amra, Veery, and Lacesh were rated excellent. All others were rated good. Some slight differences were noted in crumb texture and crust color among the investigated varieties.

CONCLUSIONS

There are more than 20 improved and newly introduced wheat cultivars in Jordan. Durum wheat has been the most important grain crop in Jordan in terms of acreage and total gross value. These varieties were compared under varying environmental conditions for yield performance (Jaradat 1988).

The data showed Lacesh, Veery, and Amra cultivars were superior to other varieties in terms of bread volume, while ACSAD-65 and the landrace (Horani-27) were inferior.

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