BREAD WHEAT GRANULAR MILLSTREAMS WITH A POTENTIAL FOR PASTA PRODUCTION
I. PHYSICAL AND ANALYTIC PROPERTIES[1]

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ABSTRACT

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The products from a bread wheat mill were examined for their potential to produce semolina-like material. Selected millstreams were collected from a pilot mill specifically flowed for producing bread flour. They were characterized and compared with a regular semolina and a commercial Brazilian farina normally used for pasta production. Varieties of hard red spring, hard red winter, and durum wheats from the crop years of 1974 and 1975 were investigated. The percentage of extraction varied greatly among the millstreams. Additional purification was necessary only for those streams of finer granulation. Streams of intermediate granulation appeared to be the best source of raw material for pasta production. Millstreams of coarser granulation generally had lower protein content, ash content, speck count, and starch damage, and had higher color score than those of finer granulation. Rheological measurements determined by the farinograph indicated that the coarser granulation had lower absorption and mixing tolerance index but longer peak time. The mixograph and the farinograph data were similar.

Although some countries, like the United States and Italy, basically use durum wheat for pasta production, other countries use different raw materials. LeClerc (1) observed that macaroni-like products also are made from rice, corn, and certain varieties of beans.

Irvine (2) stated that durum was the best type of wheat for macaroni processing, but that almost any type of wheat may be used for the purpose. In another paper (3), he considered only the natural yellow pigmentation as criterion of quality to distinguish durum from other classes of wheat as raw material for macaroni production.

According to Day (4), pasta products in Brazil are not made from durum wheat. Also, the farina sold to macaroni manufacturers may contain up to 10% cassava flour or other nonwheat starch material.

Regular commercial Brazilian farina, normally used for pasta production, has finer granulation than the traditional American semolina. Seyam *et al.* (5), however, showed that different particle size distribution of milled semolina did not appear to affect the quality of finished pasta. He concluded that the miller has some flexibility in the range of particle size of semolina he may wish to grind.

Wichser (6) said that the particle size range for similarly milled flours was

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nearly the same, regardless of the class of wheat; however, the distribution of particles according to size within this range varied greatly and was directly related to the class and to the vitreousness of wheat. Harris (7) found that environment was more influential than variety on flour particle size distribution.

We tested millstreams for pasta production from a pilot mill specifically flowed for producing bread flour. We evaluated the possibility of using, simultaneously, the same mill and the various mill products for different purposes. The millstreams were tested for various uses based on certain analytic, physical, and rheological criteria. Preliminary tests were conducted with samples from the 1974 crop year to establish particle size distribution of the millstreams as to coarse, intermediate, and fine. Mainly on the basis of percent extraction, a millstream of each granulation was selected.

MATERIALS AND METHODS

Samples

Wheats from the 1974 and 1975 crop years were tested. The wheat lots were the *Triticum durum* variety Rolette, and the *T. aestivums* hard red spring (HRS)

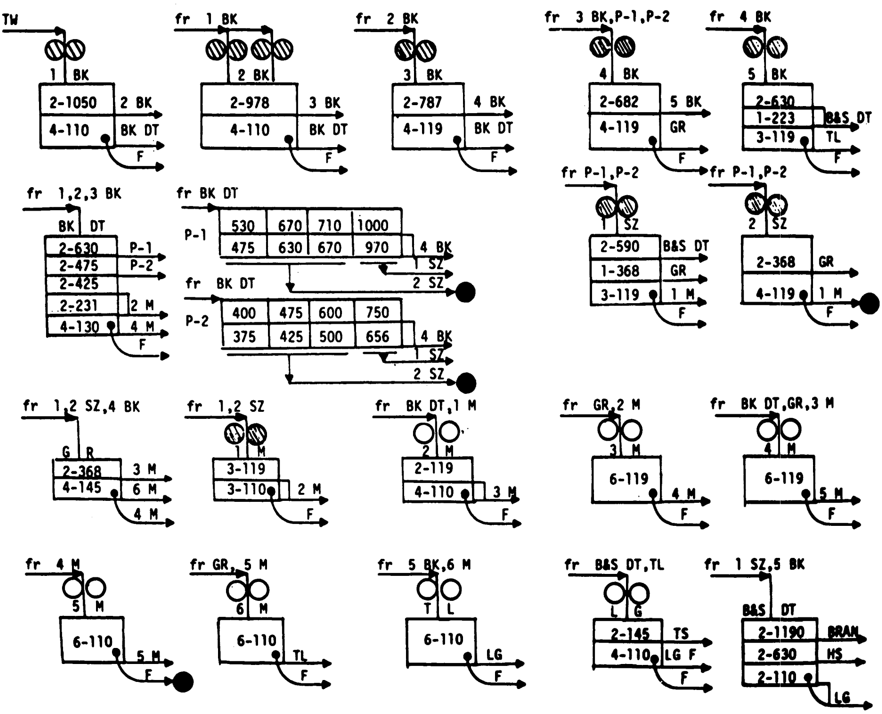

Fig. 1. Pilot mill flow diagram. Clothing size opening = microns, TW = tempered wheat, BK = break, SZ = sizing, M = midds, TL = tailings, LG = low grade, B&S = bran and shorts, DT = dust, GR = grader, P = purifier, HS = head shorts, TS = tail shorts, F = flour, fr = from, and • = position where selected millstreams were collected.

varieties Waldron and Era, commercial hard red winter (HRW), and a blend of the commercial HRW and Era (HRWE). Commercial Brazilian farina and semolina from a durum blend were used as the standards.

Milling and Purification

The millstreams were collected from a 55 cwt pilot mill (Buhler-Miag Co., Minneapolis, MN) described by Shuey (8). The flow diagram (Fig. 1) was especially designed for producing bread flour. After removal from the pilot mill, the streams were purified on a Miag laboratory purifier (Fig. 2), normally used for purifying semolina.

Millstreams

P1: coarse granulation millstream collected at Purifier I. It consisted of the throughs from sieves with openings of 475, 630, and 670 μ (Fig. 1).

S2: intermediate granulation millstream collected at Sizing II. It consisted of the throughs of the sieves with 368-μ openings and the overs of the sieves with 119-μ openings (Fig. 1).

4M: fine granulation millstream collected at fourth reduction. It consisted of the overs of the sieves with 119-μ openings (Fig. 1).

Physical Tests

Test weight, 1,000-kernel weight, and kernel size distribution were determined as described by Shuey (9).

Vitreousness was determined visually. The wheat kernels were cut and examined under a constant light source.

Number of speck per 10 in.^{2} was that material other than pure endosperm observed in a 1-in.^{2} area enclosed by a special glass and frame. Three separate counts are made, and an appropriate factor was used to convert observed count to speck per 10 in.^{2}

Yellowness, or dust color score, of the millstreams was determined as cited by Doty (10).

Particle size distribution of the millstreams was determined with a Ro-Tap testing shaker (W. S. Tyler Co., Cleveland, OH). The U.S. standard sieves 40, 60,

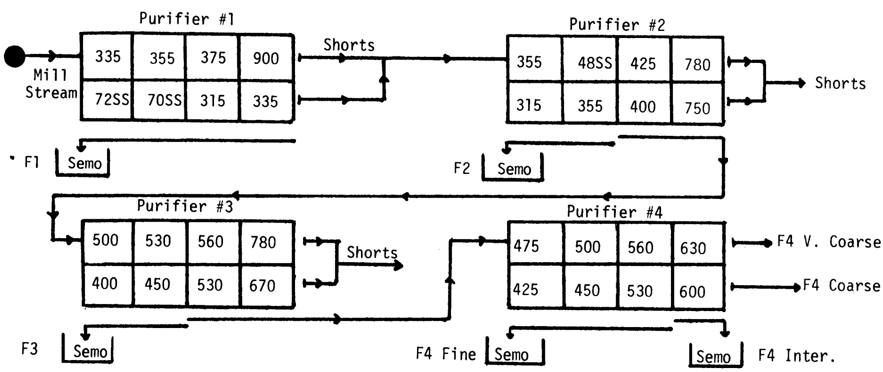

Fig. 2. Purifier flow diagram. Clothing size opening = microns.

80, and 100 were used. The sample (100 g) was sifted for 1 min. The percentage of each fraction was determined from the weight of the overs on each sieve.

Chemical Analysis

Moisture, ash, and protein were determined by AACC Approved Methods (11).

Starch damage was assayed colorimetrically according to Williams and Fegol (12). The results were expressed in Farrand equivalent units by the use of a regression equation.

Physical Dough Testing

Farinograms were obtained according to Irvine *et al.* (13). The millstreams were tested at a standard consistency of 500 BU. The measurements of the farinograms were made as defined by Shuey *et al.* (14).

Mixograms were obtained by using 25 g of sample (14.0% mb) and 12 cc of distilled water with the spring setting at 7. The millstreams were tested at a standard maximum peak height (MPH) of 6.5 cm. The measurement of the mixograms, similar to those described by Shuey (15), are listed below.

MPH was the height (centimeters) from the baseline to the center of the curve at the peak. Absorption was the amount of water required to produce a dough at an MPH of 6.5 cm. Peak distance was the distance (centimeters) from the start to the MPH. Tolerance was the height of the curve (centimeters) 10 cm from the start of mixing.

RESULTS AND DISCUSSION

Characterization of the Wheats

The physical and chemical characterization of the wheats tested are given in Table I. The durum variety Rolette yielded lower total flour extraction, probably because durum is harder than bread wheat varieties. Stenvert (16) also found that increasing hardness resulted in a marked drop in flour extraction.

Purification of the Millstreams

Table II shows the effect of purification on the streams collected from the pilot mill. The objective of the purification was to eliminate the bran particles extracted from the unpurified millstreams.

The percent of extraction and the percent of stream recovery after purification (SRAP) were quite variable for each millstream, variety, and crop year. The intermediate particle size millstreams for the varieties Waldron and Rolette gave the largest variations in SRAP between the crop years. The finer millstreams, located near the final stages of reduction, contained more ash before purification and were lower in SRAP.

During purification, the moisture decreased for all millstreams, but mainly for the coarser millstreams. The loss in moisture was due to aeration and distribution since the bran, which contains a higher amount of moisture, is removed.

The ash content decreased for the millstreams after purification mainly for those of finer granulation. The finer millstreams have less bran particles adhering to the endosperm and therefore can be more easily separated during purification than do the millstreams of coarser granulation. Seyam *et al.* (5) found that with

TABLE I
Wheat Kernel Physical and Chemical Characterization

Variety	Test Weight (lb/bu)	1000-Kernel Weight (g)	Kernel Size Large (%)	Kernel Size Medium (%)	Kernel Size Small (%)	Vitreousness (%)	Protein[a] (%)	Ash[a] (%)	Total Flour Extraction (%)
Crop 1974									
Rolette	58.60	44.4	63.0	35.0	2.0	87.5	16.3	1.543	68.3
Waldron	59.90	32.3	61.5	37.5	1.0	57.3	15.3	1.666	73.6
Era	62.00	30.0	42.0	56.0	2.0	67.8	12.7	1.525	76.7
Crop 1975									
Rolette	62.80	40.2	54.5	43.5	2.0	83.3	11.6	1.745	70.0
Waldron	61.30	32.3	54.5	44.5	1.0	78.6	14.3	1.639	76.1
Era	61.45	33.3	52.0	46.0	2.0	73.7	13.6	1.708	78.3
HRW	62.15	33.3	21.5	73.0	5.5	76.9	12.4	1.545	76.9
HRW-Era	62.20	32.3	37.0	58.5	4.5	80.0	12.4	1.602	76.6

[a]14.0% mb.

coarse semolina, the bran was attached to the endosperm chunks and was not readily separated during purification.

The protein content followed the same trend as the ash content. This would be expected, since larger endosperm chunks generally have bran attached. Ash and protein content in a wheat kernel are known to increase from the center portion of the kernel outward (17–19); therefore, their contents tend to increase together through the milling system (20).

Purification was necessary only for the millstreams of fine granulation and for the intermediate streams of the durum variety. Although the ash content of the intermediate millstreams of the bread wheat varieties was similar to the

TABLE II
Millstreams Before (BP) and After (AP) Purification

Variety,[a] Stream	Extraction			Moisture		Protein[c]		Ash[b]	
	BP (%)	AP (%)	SRAP[b] (%)	BP (%)	AP (%)	BP (%)	AP (%)	BP (%)	AP (%)
Crop 1974									
R-P1	8.9	7.6	85.2	15.2	14.0	14.3	14.3	0.596	0.577
R-S2	11.5	9.7	84.3	15.2	14.5	14.5	14.2	0.507	0.432
W-P1	8.4	7.3	86.8	15.0	14.3	12.3	12.3	0.337	0.321
W-S2	11.2	10.1	90.0	15.1	14.3	12.6	12.2	0.327	0.278
W-4M	15.8	11.0	70.0	15.2	14.3	13.9	13.2	0.659	0.378
E-P1	11.3	9.6	84.4	15.2	14.0	10.8	10.6	0.396	0.393
E-S2	13.8	12.9	93.6	15.2	14.5	10.8	10.7	0.375	0.352
E-4M	16.2	11.3	70.0	15.0	14.5	11.5	11.0	0.637	0.405
Crop 1975									
R-P1	10.9	9.5	87.2	15.4	11.5	10.6	10.4	0.572	0.564
R-S2	14.0	8.4	60.0	14.9	13.0	10.6	10.2	0.487	0.388
R-4M	29.0	19.1	65.8	14.3	12.8	11.9	11.1	0.821	0.523
W-P1	11.3	10.0	88.4	15.4	11.4	12.0	11.8	0.344	0.343
W-S2	13.7	7.5	54.8	15.4	13.7	12.1	11.7	0.330	0.266
W-4M	14.6	10.2	70.2	14.8	13.6	13.5	12.2	0.688	0.385
E-P1	12.4	11.3	91.4	14.5	12.4	11.1	10.6	0.402	0.402
E-S2	14.0	12.6	90.1	14.3	13.2	11.0	10.4	0.318	0.297
E-4M	14.1	10.7	75.8	13.5	12.9	12.2	11.0	0.696	0.412
HRW-P1	11.5	10.4	90.4	13.9	12.1	10.4	9.9	0.420	0.411
HRW-S2	13.2	11.6	87.3	13.7	12.9	10.4	9.8	0.309	0.296
HRW-4M	13.4	9.5	75.1	12.8	12.5	11.4	10.2	0.764	0.393
HRWE-P1	11.3	9.9	87.5	14.9	12.3	10.1	10.0	0.389	0.358
HRWE-S2	13.5	10.2	75.2	14.7	13.5	10.1	9.8	0.313	0.283
HRWE-4M	12.3	9.2	75.1	14.3	13.5	11.1	10.5	0.699	0.418

[a]R = Rolette, W = Waldron, E = Era, HRW = hard red winter, HRWE = blend of commercial hard red winter and Era.
[b]SRAP = stream recovery after purification.
[c]14.0% mb.

commercial Brazilian farina prior to purification, the percent of ash decreased noticeably after purification. In addition, the percentage of SRAP was variable for each year.

Particle Size Distribution of the Purified Millstreams

The particle size distribution of the millstreams selected is shown in Table III. Analysis of variance showed that year, variety, stream, and their interactions all

TABLE III
Millstreams Particle Size (PS) Distribution[a]

Variety,[b] Stream	PS > 420 (%)	250–420 (%)	177–250 (%)	149–177 (%)	PS < 149 (%)
Crop 1974					
R-P1	91.7	7.9	0.2	0.1	0.1
R-S2	...	7.7	47.5	23.9	20.9
W-P1	92.9	6.5	0.4	0.1	0.1
W-S2	...	5.2	37.4	29.2	28.2
W-4M	...	0.2	3.6	22.3	73.9
E-P1	91.7	7.3	0.5	0.3	0.2
E-S2	...	5.8	40.1	27.9	26.2
E-4M	...	0.2	3.7	35.1	61.0
Crop 1975					
R-P1	92.1	7.6	0.2	0.1	...
R-S2	...	16.0	53.5	21.0	9.5
R-4M	...	0.9	16.2	42.9	40.0
W-P1	93.1	6.7	0.1	0.1	...
W-S2	...	4.6	44.9	32.0	18.5
W-4M	...	0.1	5.8	30.9	63.2
E-P1	92.2	7.0	0.4	0.2	0.2
E-S2	...	5.5	40.5	29.2	24.8
E-4M	...	0.1	3.4	22.2	74.3
HRW-P1	93.1	6.2	0.1	0.1	0.1
HRW-S2	...	7.0	43.6	28.8	20.6
HRW-4M	...	0.1	3.0	21.9	75.0
HRWE-P1	94.2	5.3	0.3	0.1	0.1
HRWE-S2	...	7.1	49.1	27.7	16.1
HRWE-4M	...	0.2	5.0	30.2	64.6
Standards[c]					
Durum	9.8	62.1	17.6	6.2	4.3
Brazil	...	8.3	42.9	27.3	21.5

[a]Measured in microns.
[b]R = Rolette, W = Waldron, E = Era, HRW = hard red winter, HRWE = blend of commercial hard red winter and Era.
[c]Commercial Brazilian farina and semolina from milling and pasta standard durum wheat blend.

influenced the particle size distribution of the millstreams. This finding agrees with the findings of Wichser (6) and Harris (7).

In general, the intermediate millstreams of the bread wheat varieties from both 1974 and 1975 crop years had a particle size distribution most like that of the regular commercial Brazilian farina.

Physical and Chemical Characterization of the Purified Millstreams

The physical and chemical tests of the purified millstreams selected are shown in Table IV.

TABLE IV
Physical and Chemical Characterization of Millstreams After Purification

Variety,[a] Stream	Specks/ 10 in.^{2}	Color Score[b]	Starch Damage[c]
Crop 1974			
R-P1	60	13.0	3.84
R-S2	270	9.5	14.03
W-P1	37	8.5	2.27
W-S2	23	5.5	8.26
W-4M	316	5.0	17.64
E-P1	43	8.5	2.56
E-S2	37	5.5	10.33
E-4M	403	5.0	24.93
Crop 1975			
R-P1	7	14.5	4.02
R-S2	13	11.5	15.94
R-4M	77	10.0	39.84
W-P1	27	8.5	3.16
W-S2	10	6.0	8.49
W-4M	177	5.5	19.84
E-P1	33	8.5	4.06
E-S2	17	6.0	11.05
E-4M	173	5.5	25.45
HRW-P1	53	9.0	3.19
HRW-S2	17	7.0	9.56
HRW-4M	186	6.0	22.17
HRWE-P1	40	9.0	3.19
HRWE-S2	17	6.5	11.38
HRWE-4M	200	6.0	25.92
Standards			
Durum	63	12.5	5.67
Brazil	173	6.0	9.74

[a]R = Rolette, W = Waldron, E = Era, HRW = hard red winter, HRWE = blend of commercial hard red winter and Era.
[b]Method and units described in reference 9.
[c]Farrand equivalent units expressed on a dry basis.

Traditionally in the United States, the number of semolina specks is considered critical and should be as low as possible. In countries that produce pasta with farina from bread wheat varieties, however, the number of specks, although important, can be higher. Since artificial colorings or other ingredients or both are sometimes added to pastas made from farina to give a specific color, the presence of the specks may be masked. According to Winston (21), higher semolina ash means more bran has been included during the milling process. He added that high bran content in semolina or farina is undesirable, because bran has poor processing and cooking properties and produces a brown product.

The speck and ash contents were definitely higher for the streams with fine granulation, even after purification, although the process appeared to be effective because of the large drop in ash after purification. The higher ash levels are believed due to the position of the millstreams in the milling process. The fine millstreams are located in the reduction stage of the milling near the end of the process where the bran particles are small and similar to the millstream stock. Although the coarse millstreams, collected directly from the purifier section, had a high ash content, the number of specks was low, because the large bran particles are attached to the endosperm chunks at this stage in the milling process. The intermediate millstreams, collected from the sizing stage of milling, contained low ash content and speck count, because the streams originate from the purifiers. The correlation coefficients in Table V indicated that particle size of the millstreams and speck number were inversely related.

According to Murthy and Dietz (22), the main sources of color in flour are carotenoid pigments and outer layers of the wheat kernel. Moss (23) stated that the color of flour depends on both the amount of bran and the color of the bran layers. In our study, as expected, the millstreams of the durum variety were more yellow than were those of the bread wheat varieties. Consequently, the bread wheats gave lower color scores than did the durum variety. The coarse millstreams of all samples had the highest color scores due mainly to the effect of the granulation. As can be seen in Table V, the smaller particles of the millstreams were negatively correlated and the larger particles positively

TABLE V
Correlation Coefficients Between the Particle Size (PS) Distribution Data and the Millstreams Data[a]

Particle Size	Protein (%)	Ash (%)	Speck Count	Color Score	Starch Damage
>420 μ	NS[b]	NS	−0.358*[c]	0.585**[d]	−0.606**
250−420 μ	NS	NS	−0.324*	0.388**	−0.449**
177−250 μ	NS	−0.429**	NS	NS	NS
149−177 μ	NS	NS	NS	−0.575**	0.605**
<149 μ	NS	NS	0.716**	−0.640**	0.835**
Color score	NS	0.354*	−0.447**	...	−0.356*

[a]44 Observations.
[b]NS = Not statistically significant.
[c] * = Significant at 5.0% level of confidence.
[d]** = Significant at 1.0% level of confidence.

correlated to color score at the 1.0% confidence level. Ash content and speck count were also significantly correlated to color score. These results agree with those obtained by Skarsaune and Shuey (24), who found that particle size had a more consistent effect on flour color than did extraction level.

Starch damage was variable among the wheat varieties and classes. The higher damage in the durum variety than in the bread wheat varieties probably reflects the hardness of durum as a class of wheat. The starch damage was higher for the

TABLE VI
Rheology Data of Purified Millstreams

Variety,[a] Stream	Farinograph at 500 BU			Mixograph at MPH[b] = 6.5 cm		
	Absorption (%)	Peak Time (sec)	MTI[c] (BU)	Absorption (%)	Peak Distance (cm)	Tolerance (cm)
Crop 1974						
R-P1	32.8	195	92	36.1	6.5	5.4
R-S2	40.4	75	260	53.4	3.8	5.1
W-P1	35.4	255	50	59.2	9.1	6.0
W-S2	38.4	120	140	68.5	6.9	5.8
W-4M	40.1	105	150	69.9	5.4	5.8
E-P1	34.6	255	40	54.8	9.7	6.4
E-S2	37.8	105	120	61.5	7.6	5.8
E-4M	38.1	135	100	62.8	8.0	6.1
Crop 1975						
R-P1	31.0	270	0	34.1	7.5	6.2
R-S2	36.2	105	210	39.9	3.6	5.6
R-4M	39.4	90	250	47.4	3.5	5.7
W-P1	35.0	255	40	58.5	8.7	6.1
W-S2	38.4	105	100	62.4	6.3	5.6
W-4M	40.2	105	150	63.2	5.5	5.7
E-P1	33.8	270	30	49.3	6.6	5.9
E-S2	37.6	105	130	55.8	4.7	5.9
E-4M	38.7	105	150	59.6	5.2	5.7
HRW-P1	32.3	450	0	52.3	9.0	5.5
HRW-S2	35.2	180	60	56.3	7.2	5.4
HRW-4M	35.4	180	70	57.1	4.0	5.8
HRWE-P1	33.0	270	30	51.2	8.7	6.2
HRWE-S2	36.2	150	90	54.6	7.7	5.8
HRWE-4M	37.4	150	100	60.2	5.2	5.9
Standards						
Durum	37.2	105	190	42.5	4.1	6.1
Brazil	35.9	195	70	59.9	6.7	6.1

[a]R = Rolette, W = Waldron, E = Era, HRW = hard red winter, HRWE = blend of commercial hard red winter and Era.
[b]MPH = maximum peak height.
[c]MTI = mixing tolerance index.

millstreams with fine granulation than for those with coarse granulation. Table V indicates that larger particles had lower starch damage than did smaller particles, as may be expected since they had not been so finely ground.

Protein, ash, speck count, color, and starch damage of the millstreams varied between the two crop years.

The data indicated that the intermediate-size granular streams from the bread wheat varieties were the most promising as possible sources of granular material for pasta production. They contained low ash; the color score, protein content, and starch damage were similar to those of the commercial Brazilian farina; and the speck count was much lower than that of the farina.

Rheological Properties of the Purified Millstreams

The rheological properties of the purified millstreams are presented in Table VI. The farinograph data indicated that the millstreams of coarse granulation yielded lower absorption, longer peak time, and lower mixing tolerance index (MTI) than did those of the intermediate or finer granulations at the same consistency; the intermediate granulation showed slightly lower absorption than did the fine granulation. The fine granulation tended to be weaker, but the data indicated that the range in granulation is more tolerant toward finer particle size. The mixograph data agreed with the farinograph data.

The dough absorption, which is one of the most important factors in pasta processing (25), showed that the streams with intermediate granulation had absorptions similar to the commercial Brazilian farina. Generally, the durum variety gave lower absorptions than did the bread wheat varieties. Of the HRS varieties, Waldron had higher absorptions than did Era, and both had higher absorptions than did the HRW or the blend, HRWE. Differences in absorption may be due, in part, to protein quality as well as quantity. Correlation coefficients of −0.822** and −0.498* were obtained for all varieties studied

TABLE VII
Correlation Coefficients Between the Rheology Data and the Millstreams Data[a]

	Farinigraph			Mixograph		
	Absorption	Peak Time	MTI[b]	Absorption	Peak Distance	Tolerance
Moisture	0.524**[c]	−0.571**	0.469**	0.392**	NS[d]	NS
Protein	0.428**	−0.361*[e]	0.500**	NS	NS	NS
Ash	NS	NS	0.314*	NS	NS	NS
Starch damage	0.585**	−0.438**	0.466**	NS	−0.471**	NS
Particle size						
>420 μ	−0.739**	0.776**	−0.590**	−0.375**	0.543**	0.356*
250–420 μ	NS	NS	NS	NS	NS	0.296*
177–250 μ	NS	−0.468**	0.373*	NS	−0.369*	−0.512**
149–177 μ	0.633**	−0.605**	0.391**	0.326*	−0.400**	−0.351*
<149 μ	0.626**	−0.385**	NS	0.477**	NS	NS

[a]44 Observations.
[b]MTI = mixing tolerance index.
[c]** = Significant at 1.0% level of confidence.
[d]NS = Not statistically significant.
[e] * = Significant at 5.0% level of confidence.

between average particle size (P1, S2, and 4M), and farinograph and mixograph absorptions, respectively. Correlation coefficients of 0.373 and 0.110 were found between protein content and farinograph and mixograph absorptions, respectively. For just the *T. aestivum* cultivars, however, the correlation coefficients for average size versus farinograph and mixograph absorptions were −0.805** and −0.615**, respectively; and the correlation coefficients for the protein content versus farinograph and mixograph absorptions were 0.616** and 0.782**, respectively. Removal of the *T. durum* cultivar data markedly increased the correlation coefficients between protein content and absorptions, but only slightly changed the correlations between average particle size and absorptions. These results also indicate the protein quality differences between the two wheat classes.

Table VII shows that the initial moisture content, protein content, starch damage, and the largest and smallest particles of the millstreams were significantly correlated to absorption, peak time, and MTI of the farinograph. Mixograph absorptions were significantly correlated to initial moisture content and the largest and smallest particle size fractions of the millstreams. Peak distance was best correlated with the largest particle size fraction, and tolerance was significantly correlated to all but the smallest particle size fraction of the millstreams.

Although the rheological properties of the millstreams as expressed by the farinograph and mixograph data were similar, the correlation coefficients in Table VII show that different factors affected the rheological measurements obtained from these instruments.

CONCLUSIONS

From this study, two general conclusions were obtained: a) The intermediate-size granular millstreams appear to be the most promising for pasta production from bread wheat varieties on the basis that their physical, analytic, and rheological data are similar to those of granular material of known pasta production capabilities, and b) the selection of millstreams from a pilot mill specifically flowed for producing bread flour appeared to afford a wide range of farina types which may possibly be used for pasta production. Additional studies will be reported on the quality of pasta that can be made from the selected granular millstreams.

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