

Swelling Index of Glutenin Test for Prediction of Durum Wheat Quality¹

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ABSTRACT

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The swelling index of glutenin (SIG) was assessed for suitability as a screening procedure for durum wheat gluten strength. Five sets of samples with a wide range of gluten strength values were collected according to gluten strength parameters and characterized for SIG. Statistical analysis revealed that the SIG and SDS sedimentation tests were both able to satisfactorily account for variations in gluten strength in all sets of samples. However, for most samples, the SIG test was more reliable than the SDS sedimentation test for predicting gluten strength. Furthermore, the SIG test can differentiate samples with glutenin swelling properties that could not be accounted for by intercultivar variation of SDS sedimentation volumes. The percentage of insoluble glutenin in protein is usually a better

predictor for gluten strength than the percentage of insoluble glutenin in flour. Similarly, when the SIG values were divided by the protein content of the samples, the resulting proportions were better predictors of gluten strength than the absolute values. Analysis of protein fractions revealed that the insoluble glutenin was the protein fraction most responsible for the SIG value and gluten strength. Extensibility of dough was significantly related to the soluble glutenin content, while the alveograph *G* index was related to monomeric protein content. The results suggest that screening based on the SIG test would be valuable for comparing durum wheat lines and cultivars for gluten strength and pasta-making quality.

Durum wheat is an important crop because it is used for the production of high quality pasta. The suitability of semolina from durum wheat is due to the biochemical characteristics of gluten proteins that form a network in dough and give pasta its viscoelastic properties. In durum wheat semolina, the stronger the gluten, the better the quality (firmness) of the cooked spaghetti (Matsuo and Irvine 1970). A high glutenin but low gliadin content was associated with spaghetti firmness (Walsh and Gilles 1971) and superior cooking quality (Wasik and Bushuk 1975). The residue protein (insoluble in acetic acid solution) was responsible for variations in gluten strength and cooking quality of spaghetti (Wasik 1978; Dexter and Matsuo 1980; Matsuo et al 1982; Sgrulletta and De Stefanis 1989), while gliadin and glutenin soluble in acetic acid solution were negatively related to gluten strength (Dexter and Matsuo 1980).

In durum wheat breeding programs, only small volumes of grain are available for testing in early generations. The SDS sedimentation test has been a popular predictor of end-use quality in such materials because it has a small sample size requirement and can be conducted in a relatively short time. The sediment in the SDSLA solution theoretically results from swelling of the glutenin strands (Eckert et al 1993). High SDS sedimentation volumes (SDSV) have been associated with stronger gluten and superior pasta-making quality (Dexter et al 1980). Cultivars with different protein quality, expressed as gluten characteristics, should be differentiated by the SDS sedimentation test.

Recently, the swelling index of glutenin test (SIG), originally developed in our laboratory for monitoring common wheat quality, has been found more reliable for predicting insoluble glutenin content and dough strength parameters than sedimentation tests (Wang and Kovacs 2002a,b). Our study found that the SIG test promotes strong swelling of glutenin and yields better results because it is based totally on insoluble glutenin content; all soluble protein was completely removed. On the other hand, the sedimentation test develops after only mild swelling caused by the presence of residual soluble glutenin.

To date, most studies on the swelling properties of glutenin from durum wheat have been based on the SDS sedimentation test. Our goal was to adapt the SIG test so that it could be used to measure durum wheat quality in the early generations of breeding programs.

Specifically, our objectives were to examine the effects of test conditions and protein composition on the glutenin swelling capacity to compare the SIG test with the SDS sedimentation test as predictors of durum gluten strength and pasta-making quality and to determine the variation from protein composition in the SIG and SDS sedimentation tests.

MATERIALS AND METHODS

Samples and Quality Data

Method evaluation samples, harvested in 1990, included 12 cultivars with a wide range of quality. These quality parameters and values were published earlier (Kovacs et al 1997). In addition, three years of durum co-op samples (95 DURC, 96 DURC, and 98 DURC) were used in this study for comparison of the SIG test with the SDS sedimentation test and gluten strength. Quality parameters (mixograph dough development time [MDT], alveograph *W* index, gluten index [GI], SDS sedimentation volume [SDSV], and protein content), were obtained from reports of the Prairie Registration Recommending Committee for Grain (PRRCG) with the permission of B. Marchylo (Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB, Canada). Quality parameters were described in detail in PRRCG reports (Marchylo et al 1996, 1997, 1999). Breeding lines (105) were provided by J. M. Clarke (Agriculture and Agri-Food Canada, Swift Current, SK, Canada), along with GI and SDS sedimentation values. Samples were collected as seed or semolina; 10 g of sample (seed or semolina) were ground in a Udy cyclone grinder with a 1.0-mm screen for the SIG test.

SIG Test and Protein Fractionation

The swelling index of glutenin in SDS solvent (SIG-SDS) and the swelling index of glutenin in SDSLA were performed according to the procedure of Wang and Kovacs (2002a). Whole meal or ground semolina (40 mg) was hydrated with 0.6 mL of distilled water for 20 min in a 1.5-mL plastic microcentrifuge tube. After the hydration, 0.6 mL of SDSLA stock solution or 1.5% SDS was added. After 20 min of swelling in the standard SIG test or different swelling time in the swelling curve test with intermittent vortexing, the suspended samples were centrifuged at $300 \times g$ for 5 min (Micromax model, International Equipment Co., Needham Height, MA). Residues were weighed after removing supernatant, and SIG was calculated as the weight of the swollen precipitate divided by original sample weight.

Protein fractions (monomeric protein, soluble glutenin, and insoluble glutenin) were determined by turbidity measurement after a sequential extraction procedure (Wang and Kovacs 2002a). All determinations were the average of two measurements.

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Statistical Analysis

Statistical analyses were performed using the data analysis tools of Microsoft Excel 97.

RESULTS AND DISCUSSION

Influence of Test Conditions on SIG Test

Results from three cultivars, DT 369 (strong, 162 alveograph *W* index), Arcola (medium, 102 *W*), and Cando (weak, 76 *W*) showed that test conditions influenced the SIG value in a manner similar to that for common wheat (Wang and Kovacs 2002a). High mixing intensity (with vortexing), long swelling time, or high temperature were required to completely dissolve soluble glutenin and achieve a maximum swelling value for insoluble glutenin. The curve of SIG versus swelling time was divided into three stages: swelling, swollen and breakdown (Fig. 1), as for common wheat (Wang and Kovacs 2002a). In addition, an increase of hydration time from 0 to 40 min increased SIG values (results not shown). This was consistent with the effect of hydration time on the swelling capacity of glutenin for common wheat (Wang and Kovacs 2002a).

The SIG test was affected by the ratio of solvent to flour, where an increase in the ratio corresponded to an increase in the SIG value (Fig. 2). Unlike common wheat (Wang and Kovacs 2002a), the high

swelling capacity in a low solvent ratio was not found in durum wheat, which is difficult to explain. When the ratio was changed from 30 to 40 (mL/g), the SIG value remained relatively constant, allowing the use of convenient sample weights (35–45 mg).

Three types of samples were used in this study: semolina, ground semolina, and whole meal. The SIG value from ground semolina was higher than that from semolina, probably because the large particle size (150–500 μm) affected the rate of solvent penetration. Furthermore, SIG values from semolina were higher than those from whole meal, because whole meal contains bran, which does not swell effectively in SDS solvent. SIG values from 98 DURC semolina showed strong correlations with SIG values of whole meal and ground semolina ($r = 0.94$, $r = 0.96$, respectively, $P < 0.001$). This indicated that the SIG test could apply to all three samples. Testing whole meal is more desirable than testing flour or semolina due to ease of preparation.

Two different solvents (aqueous SDS and SDSLA) were tested for the ability to cause swelling of glutenin. The SDSLA solvent was identical to the solvent used in the SDS sedimentation test (AACC 2000), while the 1.5% SDS solvent was the same as that used in a gel protein test (Graveland et al 1979). Glutenin was able to swell well in both solvents, but the swelling capacity of glutenin was

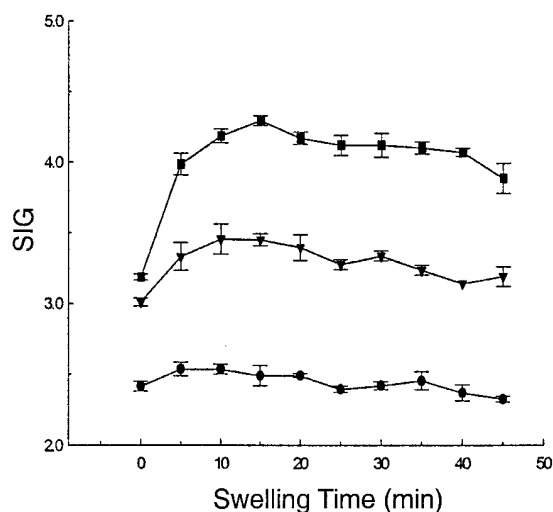


Fig. 1. Effect of swelling time on swelling index of glutenin (SIG) test for three cultivars: DT 367 (■); Arcola (▼); Cando (●). Error bars indicate standard deviations ($n = 2$).

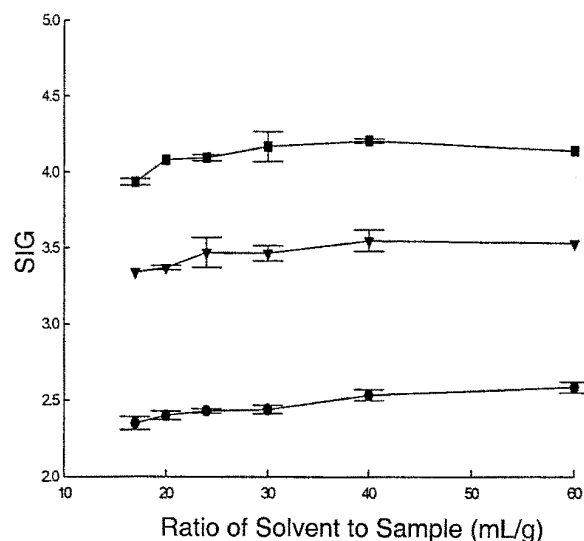


Fig. 2. Effect of solvent-to-flour ratio on swelling index of glutenin (SIG) test for three cultivars using method evaluation samples: DT 367 (■); Arcola (▼); Cando (●). Error bars indicate standard deviations ($n = 2$).

TABLE I
Reproducibility of Swelling Index of Glutenin (SIG) Tests on Three Durum Wheats from Method Evaluation Samples^a

	SIG			SIG-SDS		
	DT 369	Arcola	Cando	DT 369	Arcola	Cando
Mean	4.18	3.42	2.54	4.60	3.68	2.67
Standard deviation.	0.090	0.077	0.046	0.085	0.067	0.059
Relative standard deviation (%)	2.15	2.26	1.80	1.86	1.82	2.20

^a SIG test in SDS and lactic acid solution for three cultivars with high, medium and low SIG values measured in 24 replicates.

TABLE II
Correlation Coefficients Between Swelling Index of Glutenin (SIG) Tests, SDS Sedimentation Tests, and Gluten Strength Parameters^{a,b}

	95 DURC ($n = 25$)		96 DURC ($n = 25$)		98 DURC ($n = 20$)		MES ($n = 12$)		Breeding Lines ($n = 105$)	
	SIG	SDSV	SIG	SDSV	SIG	SDSV	SIG	SDSV	SIG	SDSV
MDT	0.51**	0.39*	0.75***	0.63**	0.70***	0.51*	0.76**	0.71**		
W	0.81***	0.68***	0.85***	0.87***	0.81***	0.81***	0.90***	0.85***		
GI	0.85***	0.63**	0.79***	0.88***	0.86***	0.85***	0.91***	0.89***	0.81***	0.70***
SIG	1.00	0.71***	1.00	0.85***	1.00	0.85***	1.00	0.97***	1.00	0.85***

^a Three years of durum co-op samples (95 DURC, 96 DURC, and 98 DURC); method evaluation samples (MES); SIG test in SDS and lactic acid solution; SDS sedimentation volume (SDSV); mixograph dough developing time (MDT); gluten index (GI); alveograph *W* index.

^b *, **, *** = significant at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

higher in the aqueous SDS solvent than in SDSLA. As in the SIG test for common wheat, the swollen glutenin in aqueous SDS solution was too watery to be separated from the supernatant, so centrifugation at $1,000 \times g$ instead of $300 \times g$ was used.

The reproducibility of the optimized procedures for SIG and SIG-SDS was determined using three cultivars with high, medium and low SIG values measured in 24 replicates (Table I). The coefficients of variation (CV %) were 1.80–2.26 in SIG and 1.82–2.20 in SIG-SDS, indicating that the SIG tests in both SDS and SDSLA solutions had good reproducibility.

Relationships Between Small-Scale Tests and Gluten Strength

SIG values were significantly correlated with SDS sedimentation volumes (SDSV) in all sets of samples (Table II), which was in agreement with the result for common wheat (Wang and Kovacs 2002a). In addition, SIG and SDS sedimentation tests were compared with gluten strength parameters for the five sets of samples. The SDSV was strongly and positively related to gluten strength in all sets of samples, supporting previous reports (Dexter et al 1980; Kovacs 1985; Autran et al 1986; D'Egidio et al 1990; Cubadda et al 1992; Kovacs et al 1997), which found that SDSV gave a good prediction of gluten strength. The results showed that the SIG test, similar to the SDS sedimentation test, strongly correlated to mixo-

graph dough development time (MDT), gluten index (GI), and alveograph *W* index. However, the SIG test appears to be superior to the SDS sedimentation test in relation to MDT. SIG values were better than or equal to SDSV for prediction of GI and alveograph *W* in 95 and 98 DURC and method evaluation samples but not in 96 DURC samples. The results showed that the SIG test was better than the SDS sedimentation test for predicting gluten strength for most sets of samples.

Comparison of SIG with SDS Sedimentation Tests

The swelling curves of SIG value versus swelling time for the 12 method evaluation samples were similar as swelling time increased (results not shown). As indicated in Fig. 1, the SIG values of the weak cultivar Cando changed little with an increase in swelling time. The swelling ability of the strong cultivar (DT 369) increased sharply from 0 to 5 min and then remained relatively constant. Because the swelling curves among the 12 method evaluation samples were similar, the correlation coefficient of SIG with SDSV was highly significant ($r = 0.97, P < 0.001$). These results suggested that the glutenin swelling properties in the method evaluation samples were

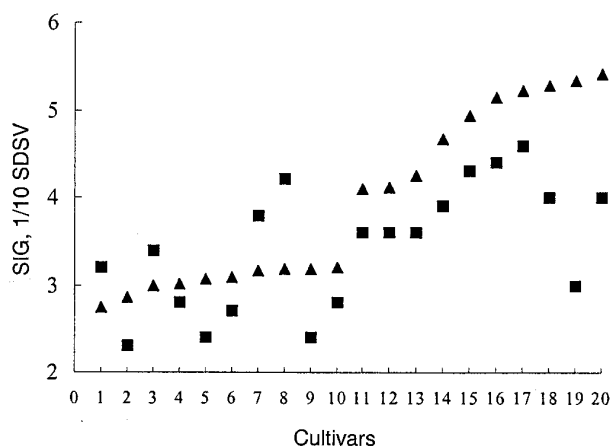


Fig. 3. Swelling index of glutenin (SIG) value (▲) compared with 1/10 SDS sedimentation volume (SDSV) (■) for 20 breeding line samples.

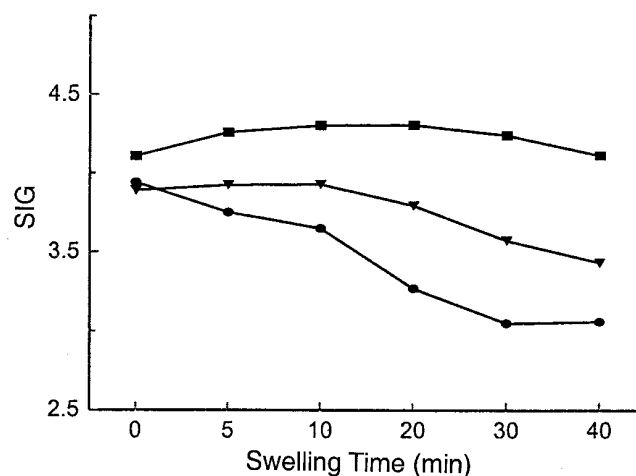


Fig. 4. Three representative swelling curves: total (●); swelling index of glutenin (SIG) > 1/10 SDS sedimentation volume (SDSV) (■); SIG < 1/10 SDSV (▼).

TABLE III
Correlation Coefficients of Swelling Index of Glutenin (SIG) Tests with Different Swelling Times, SDS Sedimentation Volume (SDSV), Insoluble Glutenin Content in Flour (% IG/F), Soluble Glutenin Content in Flour (% SG/F), and Gluten Index (GI) from 20 Breeding Line Samples^{a,b}

Swelling Time (min)	SDSV	IG/F	SG/F	GI
0	0.71***	0.89***	0.41	0.86***
5	0.69***	0.93***	0.37	0.89***
10	0.66**	0.93***	0.39	0.89***
20	0.67**	0.94***	0.36	0.87***
30	0.68***	0.95***	0.37	0.85***
40	0.69***	0.95***	0.38	0.83***
SDSV	1.00	0.58**	0.20	0.55*

^a Vortexing for 5 sec at beginning and end of swelling period, and vortexing for 5 sec at intervals of 10 min.

^b *, **, *** = significant at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

TABLE IV
Relationships Between SDS Sedimentation Volume (SDSV), Swelling Index of Glutenin (SIG) Tests, and Gluten Index (GI) for Common and Unusual Breeding Line Samples^{a,b}

Attributes	Total Samples ($n = 24$)					SIG > 1/10 SDSV ($n = 12$)					SIG < 1/10 SDSV ($n = 12$)				
	SDSV	SIG	MP/F	SG/F	IG/F	SDSV	SIG	MP/F	SG/F	IG/F	SDSV	SIG	MP/F	SG/F	IG/F
SDSV	1.00	0.75***	-0.37	0.16	0.64**	1.00	0.92***	-0.57*	0.32	0.87***	1.00	0.64*	-0.38	-0.11	0.45
SIG	0.75***	1.00	-0.44*	0.42*	0.94***	0.92***	1.00	-0.51	0.28	0.96***	0.64*	1.00	-0.36	0.61*	0.91***
GI	0.58**	0.78***	-0.45*	0.31	0.74***	0.87***	0.80**	-0.63*	0.12	0.69*	0.28	0.78**	-0.10	0.70*	0.87***

^a SIG test in SDS and lactic acid solution; monomeric protein in flour (% MP/F); soluble glutenin in flour (% SG/F); insoluble glutenin in flour (% IG/F).

^b *, **, *** = significant at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

similar in spite of cultivar diversity in gluten strength and pasta-making quality. Therefore, the glutenin content can be used to account for the variation in quality differences. This is not consistent with the results obtained from common wheat, in which the swelling curves of glutenin from weak and strong cultivars were obviously different (Wang and Kovacs 2002a). To further investigate the swelling properties of glutenin in durum wheat, 20 samples from breeders lines were selected according to a comparison of the SIG value and the value of 1/10 of SDS sedimentation volume (Fig. 3). Usually, the SIG value is larger than 1/10 of SDS sedimentation volume. In Fig. 3, the SIG values for 16 samples were larger than the 1/10 of SDSV, while four samples showed the opposite relationship. The former samples had swelling curves with a long swollen stage and showed a small decrease of SIG value in the breakdown stage. Those with the higher 1/10 of SDSV showed swelling curves with a sharp drop after short swelling and swollen stages or gave a sharp decrease in the SIG value after initial swelling (Fig. 4). Because SDSV obtained from a gentle mixing corresponded to a short swelling time in the SIG test (Wang and Kovacs 2002a), the sharp decrease of the SIG value after initial swelling is probably the reason that the SIG value was lower than the 1/10 of SDSV. Three types of swelling curves reflected different glutenin swelling properties in these samples. The correlation coefficient of SIG with SDSV in the selected samples was low compared with that in the breeding lines (Tables II, and III). In addition, the SIG value gave a higher correlation coefficient with GI than with SDSV (Table III). As swelling time increased, the correlations of SIG with GI increased little; the highest value occurred at 5–10 min of swelling time. A stronger correlation of SDSV with SIG with 0 min of swelling time, compared with SIG with 5 min of swelling time, occurred in common wheat ($r = 0.90^{***}$ at 0 min to 0.78^{***} at 5 min) (Wang and Kovacs 2002a) but did not occur in this set of durum samples, even though the coefficient between SDSV and SIG at 0 min was the highest.

To explain the difference in mechanism between the SIG and SDS sedimentation tests, protein fractions were determined for the method evaluation samples and selected samples. Similar to the correlation between SIG and SDS sedimentation tests, SDSV results from method evaluation samples were strongly related to the percentage of insoluble glutenin content in flour (IG/F) ($r = 0.95$, $P < 0.001$). This indicated that SDSV results can be explained by insoluble glutenin content because cultivars possessed the same glutenin swelling properties and glutenin quality had a similar effect on glutenin swelling capacity. On the other hand, the SDS sedimentation test showed a weaker association with IG/F in the selected samples (Table III). As discussed above, the selected samples contained cultivars with different glutenin swelling properties that influenced SDSV. As the swelling time increased, the correlation coefficients of SIG with IG/F increased (Table III), suggesting that the SIG test, which facilitates strong swelling, yields results based on

the contribution of insoluble glutenin. Unlike the results from common wheat (Wang and Kovacs 2002a), the percentage of soluble glutenin in flour (SG/F) had no significant correlation with SIG at different swelling times, but the highest coefficient occurred at 0 min of swelling time.

In breeding line samples, most SIG values were larger than the 1/10 of SDSV; however, with 12 samples the reverse was true. These 12 unusual samples were compared with 12 common samples that were randomly chosen from breeding line samples after removing unusual samples (Table IV). The SIG value was strongly related to SDSV in these 24 samples, but the SIG value gave a higher correlation coefficient with GI than with SDSV. In the common samples, the SIG had a very strong correlation with SDSV, similar to the result from the method evaluation samples. Here, both SIG and SDSV were good predictors for GI, indicating the common samples had similar glutenin swelling properties. In the unusual samples, a weak correlation between SIG and SDSV results was observed, while the correlation coefficient of GI with SIG was significant, that of GI with SDSV was not. Because the unusual samples exhibited uncharacteristic glutenin swelling characteristics, it was presumed that glutenin swelling properties had a larger effect on SDSV results, making SDSV a poor predictor of gluten strength as measured by GI. The stronger swelling conditions in the SIG test (due to elimination of the effect of soluble glutenin) may explain why SIG was still significantly related to GI in the unusual samples. Coefficients of IG/F with SDSV and SIG strongly support the idea that insoluble glutenin is the main contributor of GI and the difference between SDSV and SIG is due to SIG being strongly related to IG/F (Table IV). In addition, the other two protein fractions appear to have different effects on the swelling properties and gluten strength in the two sets of samples. The percentage of monomeric protein in flour (MP/F) was negatively correlated to SDSV and GI in the common samples, while the percentage of soluble glutenin (SG/F) had no significant relation to SDSV and GI. However, there were significant correlations of SG/F with SIG and GI in the unusual samples, while the MP/F had no significant correlation with them. This indicates that soluble glutenin influences the swelling properties in the unusual samples, inducing the differences of glutenin swelling properties.

Our results have shown that SDSV was a satisfactory predictor for gluten strength when samples have similar glutenin swelling properties. SIG is better for samples with different glutenin swelling properties.

Relationships of Protein Fractions and Small-Scale Tests with Durum Quality

To investigate the contribution of protein fractions to gluten properties and pasta-making quality, protein fractions from method evaluation samples were analyzed, and the correlation coefficients

TABLE V
Correlation Coefficients Between Protein Fractions, Small-Scale Tests, and Dough Quality Parameters for 12 Method Evaluation Samples^{a,b}

	Protein	MP/F	SG/F	IG/F	MPP/P	SG/P	IG/P	SDSV	SDSV/P	SIG	SIG/P
TEG	0.41	-0.34	0.69*	0.63*	-0.50	0.56	0.47	0.60	0.48	0.58*	0.41
MDT	-0.43	-0.78**	-0.35	0.69*	-0.76**	-0.16	0.81**	0.71**	0.76**	0.76**	0.83***
W	-0.35	-0.88***	-0.09	0.83***	-0.89***	0.09	0.92**	0.85***	0.87***	0.90***	0.94***
G	-0.13	0.63*	-0.33	-0.77**	0.74**	-0.30	-0.71**	-0.77**	-0.72**	-0.77**	-0.68*
R _{max}	-0.25	-0.88***	0.06	0.94***	-0.93***	0.20	0.98***	0.96***	0.97***	0.97***	0.97***
EXT	0.20	-0.30	0.67*	0.40	-0.39	0.63*	0.32	0.45	0.39	0.38	0.29
GI	-0.42	-0.89***	-0.08	0.84***	-0.89***	0.14	0.95***	0.89***	0.93***	0.91***	0.97***
CGVS	-0.32	-0.92***	-0.03	0.93***	-0.95***	0.14	0.99***	0.95***	0.97***	0.96***	0.99***
PDV	0.02	-0.77**	0.33	0.94***	-0.87***	0.36	0.90***	0.91***	0.86***	0.90***	0.82**

^a Protein content of semolina; monomeric protein in flour (% MP/F); monomeric protein in protein (% MPP/P); soluble glutenin in flour (% SG/F); soluble glutenin in protein (% SG/P); insoluble glutenin in flour (% IG/F); insoluble glutenin in total flour protein (% IG/P); SDS sedimentation volume (SDSV); SDSV divided by protein content (SDSV/P); swelling index of glutenin (SIG); SIG value divided by protein content (SIG/P); mixograph dough development time (MDT); mixograph total energy (TEG); alveograph G index; alveograph W index; extensigraph maximum resistance (R_{max}); extensigraph extensibility (EXT); gluten index (GI); cooked gluten viscoelasticity (CGVS); pasta disk viscoelasticity (PAV).

^b *, **, *** = significant at $P < 0.05$, $P < 0.01$, and $P < 0.001$, respectively.

between protein fractions and quality parameters were calculated (Table V). Monomeric protein content, expressed both as the percentage of monomeric protein content in flour (MP/F) and in protein (MP/P), was negatively correlated with gluten strength parameters MDT, extensigraph maximum resistance (R_{max}), and GI, pasta disk viscoelasticity (PDV), and cooked gluten viscoelasticity (CGVS). It is not possible to tell whether monomeric protein directly weakens gluten strength or if the result is due only to the highly negative correlation with insoluble glutenin content ($r = -0.96$, $P < 0.001$). The alveograph G value, which is used as a parameter for dough extensibility, positively correlated with monomeric protein content (MP/F). The soluble glutenin had no significant correlation with gluten strength but did correlate with mixograph total energy (TEG). This is not in agreement with a previous report (Dexter and Matsuo 1980) where, using a modified Osborne procedure, a negative correlation was found between soluble glutenin (extracted with acetic acid solution after sequential extractions of salt and ethanol solutions) and gluten strength. The contrasting results may be due to the different protein fractionation procedures and different sets of samples. In addition, the extensigraph extensibility was only significantly correlated with soluble glutenin content (SG/F), while monomeric protein and insoluble glutenin did not appear to contribute to this parameter. Monomeric protein and soluble glutenin are both believed to contribute to dough viscosity (Orth and Bushuk 1972; Huebner and Wall 1976). The results shown here suggest that the roles of the two fractions are not identical.

It has been demonstrated that insoluble glutenin present in bread wheat flour is largely responsible for bread wheat mixing properties and baking quality (Pomeranz 1965; Orth and Bushuk 1972; Orth and O'Brien 1976; Gupta et al 1993; Preston et al 1992; Bean et al 1998; Sapirstein and Fu 1998). Results from the current study also revealed that insoluble glutenin was the fraction mostly responsible for determining durum wheat functional properties (Table V). Insoluble glutenin was the main contributor to durum gluten strength because strong positive coefficients were found between insoluble glutenin content and strength parameters (MDT, GI, W , and R_{max}), which supported previous research (Wasik 1978; Dexter and Matsuo 1980; Matsuo et al 1982; Sgrulletta and De Stefanis 1989). The absolute content of insoluble glutenin (IG/F) was best correlated with TEG and PDV, while the relative content of insoluble glutenin (IG/P) correlated best with most strength parameters. This indicated that the IG/P is the best predictor of durum gluten strength. Similarly, the SIG value and SDSV could be divided by protein content into SIG/P and SDSV/P parameters. Compared with SIG and SDSV, SIG/P and SDSV/P would be the best parameters for evaluating durum gluten strength. The same conclusion was obtained from the analysis of other sets of samples (data not shown).

CONCLUSIONS

Gluten strength is a fundamental quality of durum wheat and it is particularly important when the grain is to be used in pasta-making. The results of this study indicate that the SIG test is a reliable method for evaluating gluten strength either in whole meal or in semolina. The SIG test satisfies nearly all the requirements of breeders. It is rapid, simple, and only a small sample (35–45 mg) of whole meal or semolina is needed for analysis.

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