## Short Communication

# Association between the HMW-glutenin Subunits and Gluten Strength Characteristics in Khorassan Wheat Lines

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**Abstract**: Khorassan wheat (*Triticum turgidum* ssp. *turanicum* Jakubz em. A. Löve & D. Löve) is an ancient tetraploid wheat that was grown in the Mediterranean region and Near East. Sixteen lines differing in the composition of high-molecular-weight glutenin subunits (HMWGs) were evaluated for SDS-sedimentation volume and quality index (QI). The data suggested that the two subunit combinations detected in the examined materials at the *Glu-B1* locus showed differences in both characteristics (relatively higher levels at the presence of the subunit combination 7+15 compared to 6+8). Weak gluten is in general characteristic of this wheat species. It could be used in a better way for other baking applications than for the pasta industry.

**Keywords**: bread-making quality; electrophoresis; seed storage proteins; *Triticum turgidum*

Khorassan wheat (*Triticum turgidum* ssp. *turanicum* Jakubz em. A. Löve & D. Löve; $2n = 4x = 28$, AABB) is a tetraploid wheat that was grown in Spain during the 19th century. During the 20th century its cultivation rapidly declined. Nowadays, samples of this wheat, grown earlier in Spain, can be found only in germplasm banks. The species was grown also in other parts of the Mediterranean region and in the Near East (Magness *et al.* 1971).

The endosperm storage proteins were identified as excellent markers of the gluten strength in durum and common wheat. These proteins are divided into two main groups (gliadins and glutenins) according to their molecular characteristics (Payne 1987). Glutenins are also divided into high-molecular-weight (HMWGs) and low-molecular-weight (LMWGs) subunits (Singh & Shepherd 1988; Pogna *et al.* 1990). Among these proteins, the HMWGs coded at the *Glu-1* loci located on the long arm of group-1 homoeologous chromosomes (Payne 1987) are characterized in the best way; the LMWGs are coded for the *Glu-3* loci on the short arm of the same homoeologous group.

Although durum wheat appears to be associated with making traditional breads in many regions of the world (Faridi & Faubion 1995; Harlan 1995), the bread baking properties of this wheat have been considered as poor in comparison with those of common wheat (Boyacioglu & D'Appolonia 1994). This is mainly associated with the HMWGs encoded at the *Glu-D1* locus (derived from *Aegilops tauschii* Coss.). The role of the other two loci (*Glu-A1* and *Glu-B1*) in bread-making quality

has scarcely been studied in durum wheat (Kovacs *et al*. 1993; Peña *et al*. 1994), mainly because this wheat is generally used for the pasta industry, where the variation in the LMWGs is most important. Nevertheless, the effect of these proteins on the baking quality of durum wheat could be undervalued due to the low variability at these loci in modern durum wheat cultivars. In fact, most cultivars contain only one or two HMWGs that are both encoded by chromosome 1B, mainly subunits 6+8 or 7+8, due to the high presence (more than 80%) of the *null* allele at the *Glu-A1* locus (Branlard *et al*. 1989). Consequently, the increase in the variability of these proteins could open new possibilities of using this wheat in the baking industry.

The main goal of the present paper was the evaluation of the important gluten strength characteristics in khorassan wheat lines differing in HMWGs at the *Glu-B1* locus.

Sixteen lines of khorassan wheat obtained from the National Small Grain Collections (Aberdeen, USA) were included in this study (Table 1). The materials were grown in 2007/08 in a trial with three replications in two locations in Spain (CIFA "Alameda del Obispo" in Córdoba, and CIFA "Finca Tomejil" in Carmona) using standard agronomic practices for the region (175 kg/ha N, 90 kg/ha P, and 90 kg/ha K). Two durum wheat cultivars (Soissons and Carmona) were included in the trial to evaluate the life cycle of these lines. The storage protein composition of these lines was analysed according to Alvarez *et al*. (2001).

Table 1. The origin of 16 khorassan wheat lines included in this study

| Line | Accession | Origin |
|---|---|---|
| T-tn 94 | CItr 8581 | Azerbaijan |
| T-tn 95 | CItr 11390 | USA |
| T-tn 96 | PI 166450 | Turkey |
| T-tn 97 | PI 190973 | Spain |
| T-tn 98 | PI 192641 | Morocco |
| T-tn 100 | PI 272602 | Hungary |
| T-tn 101 | PI 278350 | Italy |
| T-tn 102 | PI 306665 | France |
| T-tn 103 | PI 317495 | Afghanistan |
| T-tn 104 | PI 330552 | England |
| T-tn 105 | PI 349055 | Russia |
| T-tn 106 | PI 576854 | Turkey |
| T-tn 107 | PI 623629 | Iran |
| T-tn 108 | PI 623656 | Iran |
| T-tn 109 | PI 624207 | Iran |
| T-tn 110 | PI 625401 | Iran |

After harvest, each replication was separately milled using a cyclone mill fitted with a 0.5 mm sieve. Protein content was determined by the Kjeldahl method (% N × 5.7, dry matter). Gluten strength was estimated by SDS-lactic sedimentation volume (SDSs) according to Peña *et al*. (1990). The SDS volume was corrected by the quality index (QI), which represents the volume of sedimentation per unit of protein (ml/g protein). QI was calculated according to Halverson and Zeleny (1988). All determinations were performed in duplicate. Comparisons between the *Glu-B1* allelic variants were made for each character using the LSD method.

The lines included in this study were previously analysed for the HMWG composition. Eight lines showed the combination *null*, 7+15, whereas the other eight lines were *null*, 6+8.

Protein content was high for both locations, being on average 16.49% in Cordoba (ranging between 10.70 and 20.73%) and 17.91% in Carmona (ranging between 15.70 and 21.05%). Both means were higher than those observed in durum wheat (Dowell *et al*. 2006; Crosbie *et al*. 2007; Tahir 2008), but they were similar to those detected by Sissons and Hare (2002) in khorassan wheat. These high values could be connected with long life cycles of these materials. The grain filling period often becomes substantially shortened under the high temperatures in the south of Spain (higher than 30°C in June). At this respect, Harvelson and Zeleny (1988) suggested that the SDS volume could be corrected by the protein content, obtaining a "specific sedimentation value" that could be used as an index of gluten quality (QI).

The data presented in Table 2 showed that a significantly higher SDS volume and QI were obtained at the presence of the subunit combination 7+15 than with the subunits 6+8. Liu and Rathjen (1994) and Tahir (2008) also indicated that the *Glu-B1d* allele (subunits 6+8) should be considered as an allele of low bread-making quality. The values of SDS volume were low and similar to those observed in emmer wheat by Peña *et al*. (1993) (5.9 ml) or in the Spanish emmer wheat lines (Caballero *et al*. 2008) (4.8 ml).

Table 2. SDS sedimentation volume and QI (index of gluten quality) in khorassan wheat lines differing in the HMWGs at the *Glu-B1* locus

| Location | HMWGs at *Glu-B1* | SDS volume (ml) | QI |
|---|---|---|---|
| Córdoba | 6+8 | 5.92 b | 0.34 b |
| | 7+15 | 6.78 a | 0.42 a |
| Carmona | 6+8 | 5.72 b | 0.34 b |
| | 7+15 | 7.54 a | 0.40 a |

The means in columns followed by the same letter are not significantly different from each other at $P = 0.05$ of LSD test

In conclusion, although this research is only at a preliminary stage and the ever-narrowing quality specifications of modern industries should not be overestimated when evaluating the potential of traditional and non-breeding materials, these data suggest that the SDS sedimentation volume is likely to be low in this species, but some differences associated with the composition of certain HMWGs can be detected. These low values suggest that these materials are not suitable for the pasta industry, but they could be used for other baking applications where weak gluten is desirable.

***Acknowledgements.*** This research was supported by Grant AGL2007-65685-C02-02 from the Spanish Ministry of Science and Innovation and the European Regional Development Fund (FEDER) from the European Union. The first author thanks to the Spanish Ministry of Science and Innovation (FPI programme) and the European Social Fund for a predoctoral fellowship.

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Received for publication May 22, 2009
Accepted after corrections October 12, 2009

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