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Variability for glutenin proteins in Spanish durum wheat landraces

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SUMMARY - The diversity for high and low molecular weight glutenin subunits (HMW and LMW) of 201 Spanish landraces of durum wheat was investigated using SDS-PAGE and two step one dimensional (2S-1D) SDS-PAGE. A great variability in HMW and several patterns for LMW glutenin subunits of type 1 and type 2 were found. The chromosomal location of the genes responsible for some B-LMW was studied. The glutenin frequencies in landraces were compared to those of the cultivars grown in Spain.

Key words: Durum wheat, pasta quality, glutenin proteins, Spanish landraces, germplasm.

RESUME *- "La variabilité des protéines de gluténine chez les espèces autochtones espagnoles de blé dur". La diversité des sous-unités de gluténine à haut et faible poids moléculaire (HMW et LMW) de 201 espèces autochtones espagnoles de blé dur a fait l'objet de recherches à l'aide du SDS-PAGE et du SDS-PAGE à deux phases unidimensionnel (2S-1D). On a trouvé une grande variabilité chez les sous-unités de gluténine à haut poids moléculaire (HMW) ainsi que plusieurs modèles chez les sous-unités de gluténine à faible poids moléculaire (LMW) de type 1 et 2. La localisation chromosomique des gènes responsables de certaines des B-LMW a été étudiée. Les fréquences de la gluténine chez les espèces autochtones ont été comparées à celles des cultivars utilisés en Espagne.*

Mots-clés : *Blé dur, qualité des pâtes, protéines de gluténine, espèces autochtones espagnoles, germoplasme.*

Introduction

Pasta cooking quality has been showed to depend on two main parameters: rheological characteristics related to gluten elasticity or strength, and surface conditions, especially absence of deteriorations as stickiness and mushiness. It has been demonstrated that those two parameters are independent (Autran *et al.*, 1986).

The surface state of cooked pasta has been correlated positively with the amount of -SH plus S-S group in glutenin of various durum wheat cultivars (Alary and Kobrehel, 1987). Viscoelasticity of cooked pasta correlates to the prolamin composition. Damidaux *et al.* (1978) first reported the association between γ-gliadins 42 and 45 and gluten weakness and strength, respectively. Payne *et al.* (1984) suggested that the low-molecular weight (LMW) glutenin subunits closely linked to the γ-gliadins were responsible for determining gluten viscoelasticity differences in durum wheat, and that γ-gliadins 42 and 45 were only genetic markers. Pogna *et al.* (1990) established that the LMW glutenin subunits are responsible for the quantitative differences in quality.

In previous studies of durum wheat cultivars (Carrillo *et al.*, 1990a) and of Spanish landraces (Carrillo *et al.*, 1990b) several patterns of B-LMW glutenins were described showing different associations with gluten strength. The LMW glutenin patterns were more discriminant as markers for selecting lines of good quality than γ-gliadins, because the same γ-gliadin can be associated with two or more patterns of LMW glutenin with significantly different mean value in gluten strength, and besides that in some lines the γ-gliadins 45, 42 or 44 were absent.

We analyzed the seed storage protein composition of several durum wheat Spanish landraces

studying with accuracy the LMW glutenin patterns in order to have a criterion for selecting germplasm for quality.

Material and methods

Total seed proteins of 201 Spanish landraces were extracted from eight grains of each landrace into a buffered solvent containing 4% (w/v) sodium dodecyl sulphate (SDS) and 5% (v/v) 2-mercaptoethanol. The extracted proteins were fractionated by SDS-PAGE using 12% gels, following the method described by Payne *et al.* (1980). The HMW band numbers were according to those of Payne and Lawrence (1983). LMW glutenins were examined using the two step-one dimensional (2S-1D) system described by Singh and Shepherd (1988).

Results and discussion

In the 201 landraces studied, a great variability for B-LMW glutenin patterns was found. In Fig. 1 the patterns and frequencies of the main types are shown. They were grouped in LMW type 2 and LMW type 1 depending on the presence or absence of the widest and slowest band in the diagram. The chromosome control of the more frequent patterns was investigated (Fig. 2), showing their dependence on chromosome 1A or 1B at the locus *Glu-A3* or *Glu-B3*.

The composition of high-molecular weight (HMW) glutenin subunits is indicated in Table 1. The more frequent allele in *Glu-A1* is the Null allele, and in the *Glu-B1* are the bands 6+8 and 20.

Our data (Ruiz and Carrillo, 1994) showed that the slowest and widest band of patterns type 2, controlled by chromosome 1B at the locus *Glu-B3* was the most important determinant influencing positively the strength of gluten. In high molecular weight glutenins, band 20 (locus *Glu-B1*) showed a very negative influence on quality, and the presence of band 1 (locus *Glu-A1*) was positively correlated with some mixing properties of the gluten.

Comparing the frequencies of glutenin subunits (Table 2) found in Spanish landraces with those found in varieties grown in Spain (Carrillo *et al.*, 1990a), there is a more higher percentage of type 2 and HMW 1 (better quality), and HMW 20 (worse quality) in landraces than in the cultivars. The reason of these differences could be that the Spanish origin of the varieties currently grown in Spain is limited to a small group of varieties.

In the Spanish durum wheat germplasm analyzed there is a great variability in patterns of glutenins. This variation could be useful for improving quality.

Acknowledgments

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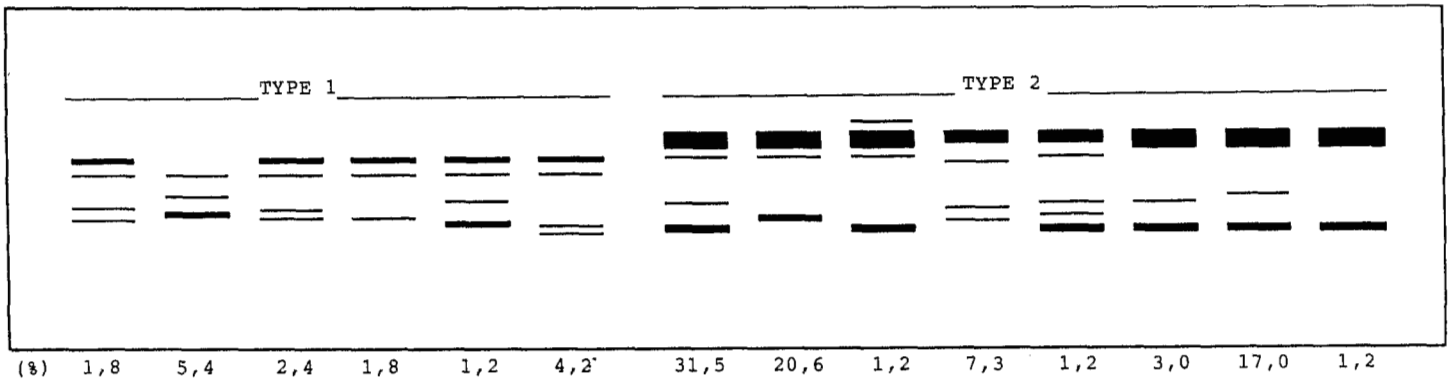

Fig. 1. Patterns and frequencies of main types of B-LMW glutenins subunits found in Spanish landraces of *Triticum turgidum*.

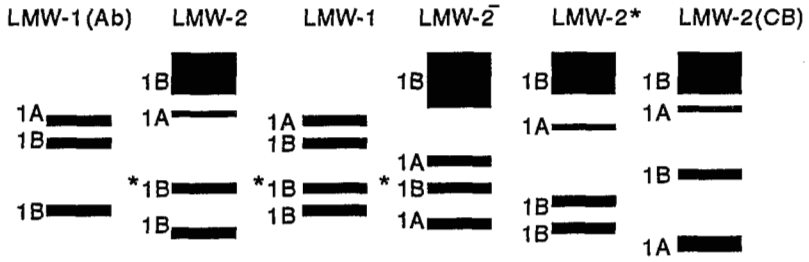

Fig. 2. Chromosome control of the B subunits of LMW glutenins patterns from different Spanish durum wheat landraces. * band coded by locus *Gli-B3* (Ruiz and Carrillo, 1993).

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Table 1. Allele frequencies of HMW glutenin subunits in Spanish durum wheat landraces

Locus	HMW	%
Glu-A1	1	15.1
	2*	15.6
	Null	69.3
Glu-B1	7	1.1
	7+8	3.3
	6+8	52.5
	20	34.1
	13+16	4.5
	20+8	1.7
	32+33	1.1
	Others	1.7

Table 2. Comparisons of glutenin subunits frequencies between Spanish durum wheat cultivars and landraces

	% in cultivars	% in landraces
HMW		
Null	95.0	69.3
1	5.0	15.1
2*	-	15.6
6+8	45.0	52.5
7+8	32.5	3.3
20	17.5	34.1
13+16	2.5	4.5
LMW		
Type 2	60	83
Type 1	40	17

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