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REGULAR ARTICLE

CHARACTERIZATION OF DURUM WHEAT (*TRITICUM DURUM* DESF.) QUALITY FROM GLIADIN AND GLUTENIN PROTEIN COMPOSITION

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ABSTRACT

The aim of this study was the electrophoretic characterization of gliadin and glutenin proteins in kernels of *Triticum durum*Desf. and their evaluation in relation to technological quality. All 108 accessions originating from different geographical areas of world were evaluated for high molecular weight glutenin subunit (HMW-GS) and low molecular weight glutenin subunit (LMW-GS) composition using SDS-PAGE and A-PAGE. The data indicated the prevalence of the null allele (91%), allele 1 (8%) and allele 2* (1%) at the *Glu-A1* and five alleles, namely 7+8 (35%), 6+8 (33%), 13+16 (10%), 20 (18%) and 17+18 (4%) represented at the *Glu-1B*. Protein subunit *Glu-1A* was correlated positively with improved dough strength as compared to subunit null. On the chromosome *Glu-B1* subunit 6+8 was associated with slightly stronger gluten type than 7+8 and 13+16, whereas subunit 20 was associated with weak gluten properties. On the basis of electrophoretic separation of gliadin fraction it was found that 86 genotypes contained γ-45, 3 genotype γ-42 and 19 genotypes another one. Cultivars having the low molecular weight (LMW) glutenin allele LMW-2 (or gliadin band *γ*-45) generally gave stronger gluten than lines with allele LMW-1(or gliadin band *γ*-42).

Keywords: durum wheat, HMW-GS, LMW-1, LMW-2, technological quality

INTRODUCTION

A *Triticum durum* Desf. is a tetraploid species with two diploid genomes AA and BB. Each of these genomes has 7 pairs of chromosomes (n=14 and 2n=28 chromosomes). It is regarded as an ancestral relation to modern day bread wheat (*Triticumaestivum*L.) and is characterized by possessing kernels showing a high degree of vitreousness, relatively high endosperm hardness and being amber in colour **(El-Khayat*et al*., 2003)**. The significance of durum wheat has increased worldwide due to shortages of good material to be utilised in the food industry, and food shortages occurring in many developing countries **(Korkut*et al*., 2007)**. It is the most appropriate cereal for the production of high quality pasta products **(Vansteelandt and Delcour, 1999)**. Pasta, bread and related products made of this cereal are associated with medium to high protein contents and compositions **(Dukić*et al*., 2008)**. The unique properties of wheat flour primarily depend on seed storage proteins which are the most important source of protein for human beings **(Qi et al., 2006)**.Wheat gluten proteins are classified into two broad groups on the basis of their aggregation and functional properties. These are the gliadins which are present as monomers which interact by mono-covalent forces and the glutenins which form polymers stabilized by interchain disulphide bonds. Gluteninsare divided into two basic classes according to the molecular weight of their subunits: HMW (High Molecular Weight) and LMW (Low Molecular Weight) glutenin subunits (GS) **(Motalebi*et al*., 2007)**. Gliadins are coded by the complex loci *Gli-1* (γ and ω) and *Gli-2* (α and β), located on the short arm of homoeologus chromosomes 1 and 6, respectively. HMW-GS are coded by complex loci *Glu-1*, located on the long arm of homoeologous chromosomes 1, whereas most of the LMW-GS are coded by complex loci *Glu-3*, closely linked to *Gli-1***(Porcedduet *al*., 1998)**. Two different LMW glutenin patterns, LMW-1 and LMW-2, linked to γ-42 and γ-45 respectively, were described by **Payne *et al.* (1984)**. In accordance with the presence of the particular allelic forms at *Gli-B1*/*Glu-B3* loci durum wheats are usually grouped into two main types (LMW-1 and LMW-2 type). The latter is responsible for endowing semolina with better properties **(Porcedduet *al*., 1998)**.The aim of the present investigation was to analyze the protein composition of 108 durum wheat (*Triticum durum*Desf.) originating from different geographical areas of the world. Suitable accessions can be used for the crossing programs to improve technological quality of durum wheat.

MATERIAL AND METHODS

In this study we analyzed seed storage proteins extracted from durum wheat (*Triticum durum*Desf.) grain. All samples were obtained from the collection of genetic wheat sources of The Gene Bank of the SlovakRepublic in Piešťany and from the work wheat collection. Seed storage proteins were isolated from the endosperm of intact, dry and mature single seeds. Seed homogenization was carried out by grinding. Glutenins were extracted by standard referee method ISTA **(Wrigley, 1992)**. Gliadins were obtained using standard referee method ISTA in the presence of acid solution **(Draper, 1987)**. The glutenin separation was performed by discontinuous PAGE based on ISTA methodology (Wrigley, 1992) and using the electroseparatic unit Protean II (Biorad). The electrophoretic separation of gliadins was followed by referee method ISTA **(Draper, 1987)** using mixture of glycine and acetic acid as electrolyte at pH 3.2. They were separated in continuous polyacrylamide gels at acid environment **(Draper, 1987)**. Protein fractions were stained by Coomassie Brilliant Blue R-250. Besides the analyzed samples, extract of gliadins of cultivars Basa, Leukurum and Wascana (LMW-2 type) and Soldur (LMW-1 type) were used as universal standards. The separate gluten subunits were identified by the nomenclature of **Payne and Lawrence (1983)**. According to the specific protein profile of the HMW alleles in each cultivar its quality score (Glu-score) was calculated by **Payne et al. (1987)**.

RESULTS AND DISCUSSION

One hundred and eight durum wheat accessions originating from different geographical areas of the world were evaluated for high molecular weight glutenin subunit (HMW-GS) and low molecular weight glutenin subunit (LMW-GS) composition using SDS-PAGE and A-PAGE.Nine different patterns were identified for HMW glutenins with the combination of null and 6+8 being the most common. The data indicated the prevalence of the null allele (91%), allele 1 (8%) and allele 2* (1%) at the *Glu-A1*and five alleles, namely 7+8 (35%), 6+8 (33%), 13+16 (10%), 20 (18%) and 17+18 (4%) represented at the *Glu-B1*(Tab1).**Ram (2003) and Aghaei (1995)** showed that protein subunit 2* and 1 were found correlated positively with improved dough strength as compared to subunit null. On the chromosome *Glu-B1* subunit 6+8 was associated with slightly stronger gluten type than 7+8 and 13+16, whereas subunit 20 was associated with weak gluten properties **(Motalebi*et al.*, 2007)**.On the basis of electrophoretic separation of gliadin fraction it was found that 86

genotypes contained γ-45, 3 genotype γ-42 and 19 genotypes another one. Cultivars having the low molecular weight (LMW) glutenin allele LMW-2 (or gliadin band *γ*-45) generally gave stronger gluten than lines with allele LMW-1 (or gliadin band *γ*-42). The combination of better alleles at *Glu-B1* (coded bands 17+18, 13 + 16, 7 + 8) and *Glu-3* (patterns LMW-2) showed linear cumulative effects for dough strength.

Table 1 Complete review of frequency of specific electrophoretic protein profiles with related Glu-score within 108 analyzed durum wheat cultivars

Electrophoretic profile of storage proteins			**Glu-score**	**Frequency (%)**
HMW-GS composition		**LMW glutenin pattern**		
Locus				
Glu-1A	***Glu-1B***			
1	17+18	LMW-2	6	1%
1	7+8	LMW-1	6	1%
1	20	LMW-1	4	1%
0	6+8	LMW-1	2	1%
2*	7+8	another	6	1%
1	20	another	4	1%
1	17+18	another	6	1%
0	17+18	LMW-2	4	2%
0	20	another	2	3%
0	13+16	another	4	3%
1	7+8	LMW-2	6	4%
0	6+8	another	2	4%
0	7+8	another	4	5%
0	13+16	LMW-2	4	7%
0	20	LMW-2	2	13%
0	7+8	LMW-2	4	24%
0	6+8	LMW-2	2	28%

Considering the composition of HMW-GS and LMW-GSglutenin patterns in each cultivar there were found 17 different electrophoretic protein profiles among 108 tested cultivars. **Bechere*et al.* (2002)** have shown that in a breeding programme of durum wheat quality, it is safer to use LMW glutenin patterns, the real casual proteins, because the same HMW glutenins can be associated with two different patterns of LMW glutenins as it has been demonstrated in their study. In a breeding programme for quality, it would be useful to discard lines with LMW-1 and HMW-GS 20, and to combine electrophoretic analysis with SDS sedimentation test to develop cultivars of durum wheat with good viscoelasticity and

firmness of cooked pasta. Obtained results could provide more complete understanding of the studied collections diversity on high molecular subunits and it will be useful to breeders who now possess a tool to formulate crosses by choosing varieties with appropriate characters**.**

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