

## THE INVESTIGATION OF SOME QUALITY PARAMETERS OF WHEAT GRAIN IN DIFFERENT MATURITY STAGES

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**ABSTRACT.** The protein content and sedimentation volume in grain of different maturity stages (milk, early dough, full dough, and full physiological) in winter wheat varieties (KG-56, Srbijanka, Lepenica, Ljubičevka, Oplenka, Jugoslavija, Nizija, Slavonija, Zagrepčanka and Baranjka) were investigated. The obtained results have shown that grain quality depended of maturity stage and variety. The mean values for protein content and sedimentation volume of the varieties exhibited variability the cultivars under all the four maturity stages. The highest protein content was in grain of milky stage (11.56 %), but the lowest in grain of early dough stage (10.64 %). The sedimentation volume was the highest in grain of early dough stage (40.0 ml), and the lowest in grain of milky stage (32.5 ml). The analyzed varieties differed and depended of grain maturity stage. The highest grain protein content had Jugoslavija in milky stage (12.82 %), but the highest value of sedimentation were found at KG-56 at full physiological stage (46 ml) and Slavonija variety at full dough stage (46.0 ml). These results indicated that grain protein content of wheat was the highest at milky stage, but its quality was the best at dough stage.

### INTRODUCTION

The grain quality of wheat is mainly determined by the genetic base, but may also influenced by agroecological conditions and management techniques. Stage of maturity refers to a plant's stage of development at the time it is harvested. For realisation good quality of wheat grain it need harvest in the moment of favorable grain maturity stage (ŠARIĆ *et al.*, 1975; POPOVIĆ, 1976; RAFILOVIĆ, 1986). When the kernel water concentration has decreased to 13 to 14 percent the grain is ready for direct combining and storage. Harvesting after full physiological stage causes reduction of yield and quality of wheat (STOJANOVIĆ *et al.*, 1984; IVANOSKI *et al.*, 1991; ŠARIĆ *et al.*, 1998).

There are many ways of characterizing grain quality, but the main indicators of quality are protein content and sedimentation volume. This two quality traits of wheat are positively correlated with other quality parameters. Grain protein content and sedimentation volume are depended to mineral nutrition, especially to nitrogen nutrition. Wheat varieties with the best grain quality (enhancer) had the stable quality in different agroecological conditions (KUBUROVIĆ *et al.*, 1990; PAVLOVIĆ *et al.*, 1994; ŠARIĆ-KONC *et al.*, 2002).

The objective of this paper was to examine relationships between grain quality and grain maturity in different wheat varieties.

## MATERIAL AND METHODS

Winter wheat varieties (KG-56, Srbijanka, Lepenica, Ljubičevka, Oplenka, Jugoslavija, Nizija, Slavonija, Zagrepčanka and Baranjka) were examined in the experimental field at Small Grains Research Centre, Kragujevac. Spikes of these varieties were sampled at four grain maturity stages (milk, early dough, full dough, and full physiological). The stage of maturity determined with grain moisture content, color and grain consistency (PAVLIČIĆ, 1964). **Milk stage** - a white, milk-like fluid can be squeezed from the kernel. **Early dough** - during the dough stages, kernel water content continues to decrease as more and more dry matter is accumulated. **Full dough stage**- by the end of the hard dough stage, the kernel reaches physiological maturity. Reduction in yield after this stage result from harvest losses and/or environmental injuries such as sprouting and hail. **Physiological maturity**- the kernel dry, brittle and hard, it can no longer be dented with thumbnail and, if crushed, it splits into pieces.

The spike was hand-treshing and grains dried at room temperature to dry-air condition. The grain protein content was determined by *Kjeldahl* method, and sedimentation volume by *Zeleny* method (KALUĐERSKI & FILIPOVIĆ, 1998).

## RESULTS AND DISCUSSION

In the watery ripe and milk stages, the number of the cells in endosperm (the major starch and protein storage portion of the kernel) is established. Not much weight is accumulated during this phase. Than one to two weeks after pollination, the kernel begins accumulating starch and protein rapidly and its dry weight increases in a nearly linear manner. This is when most of the final weight of the kernel is accumulated. The kernel consistency is soft dough during this time. Finally, growth of the kernel declines about three weeks into grain filling and its weight approaches a maximum attained at physiological maturity. As the kernel approaches maturity, its consistency becomes hard dough.

The dry matter accumulation in wheat change with plant development stage. The protein synthesis in wheat grain happen gradually. In the time of grain form and milky stage are synthesis of albumine and globuline. Than become glutenin synthesis. The prolamin creation mostly perform at the end of milky stage and at dough stage (PAVLOV, 1984). That means that proteins gather very early in wheat grain. At the dough stage make normaly proportion between all grain ingredients, but at full maturity stage the kernel dry up and grain mass has decreased.

In this investigation grain protein content changed significantly and depended upon the grain maturity (Tab.1). In average for all varieties the highest protein content established in grain of milky stage (11.56 %), and the lowest in grain of early dough maturity (10.64 %). Grain protein content reduced from milky stage: for 23 % in grain of early dough stage; 3.9 % at grain of full dough stage and 5.2 % in grain of full physiological maturity. Higher grain percentage at milky stage than at other stages can be explain by low grain mass and higher part of germ which consist higher protein content than endosperm (ĐOKIĆ, 1988). The analyzed varieties differed and depended of grain maturity. Jugoslavija variety had the highest grain protein content in milky stage (12.82 %), and the lowest in early dough stage (9.74 %). In average to all analyzed varieties, the highest grain protein content established at Nizija variety (11.41 %), and the lowest at Jugoslavija variety (10.76 %).

Grain protein plays an important role for bread-making quality and for seedling vigor and grain yield in wheat. Storage proteins hydrolysis plays important role to supply energy for seedlings growth (EVANS & BHATT, 1977).

Table 1. Grain protein content of different growth stages in wheat (%)

Variety	Growth stages				Average
	Milk	Early dough	Full dough	Full physiological	
<b>KG-56</b>	11.85	10.71	11.51	10.31	11.10
<b>Srbijanka</b>	11.85	11.34	11.17	10.71	11.27
<b>Lepenica</b>	10.71	10.89	11.45	10.31	10.84
<b>Ljubičevka</b>	11.34	9.86	11.45	10.89	10.88
<b>Oplenka</b>	12.19	10.03	10.77	10.77	10.94
<b>Jugoslavija</b>	12.82	9.74	10.31	10.15	10.76
<b>Nizija</b>	12.19	10.38	11.05	12.03	11.41
<b>Slavonija</b>	11.28	11.85	10.43	11.29	11.21
<b>Zagrepčanka</b>	10.26	11.34	11.28	12.25	11.28
<b>Baranjka</b>	11.11	10.26	11.68	10.94	11.00
<b>Average</b>	11.56	10.64	11.11	10.96	11.07

The sedimentation volume is very important quality trait of wheat because of its positive correlation with bread-baking quality. Grain protein content and quality directly influenced on sedimentation volume. Among the grain proteins, the high molecular weight glutenin subunits appear to have the greatest effect on bread-making quality.

The results of sedimentation volume are displayed in Table 2. In this study sedimentation volume was changed and depended of maturity stage. Sedimentation volume increased from milky stage to dough stage. In average for all investigated varieties sedimentation volume was the highest in grain of early dough stage (40.1 ml), and the lowest in grain of milky stage (32.5 ml). In comparison of early dough stage, sedimentation was lower: in grain of milky stage for 18.95 %, in grain of full dough stage for 1.50 %, and for 3.20 % in grain of full physiological stage. Analyzed varieties had shown different values of sedimentation volume and depended of maturity stage. The highest value of sedimentation established at KG-56 (46 ml) in full maturity stage and Slavonija (46 ml) in full dough stage. Variety KG-56 is well-known as enchanser variety with high bread-making quality. Sedimentation volume in milky stage was the lower, may be because in this stage did not gather all gluten which directly influenced on sedimentation volume. This is in agreement with obtained results by JOVIĆ *et al.* (1998).

Table 2. Sedimentation volume of different growth stages in wheat (ml)

Variety	Growth stages				Average
	Milk	Early dough	Full dough	Full physiological	
<b>KG-56</b>	27	43	38	46	38.5
<b>Srbijanka</b>	42	39	36	37	38.5
<b>Lepenica</b>	30	45	38	36	37.2
<b>Ljubičevka</b>	34	40	39	44	39.2
<b>Oplenka</b>	34	43	42	40	39.8
<b>Jugoslavija</b>	21	34	35	36	31.5
<b>Nizija</b>	37	39	40	39	38.8
<b>Slavonija</b>	27	41	46	41	38.8
<b>Zagrepčanka</b>	31	37	39	33	35.0
<b>Baranjka</b>	42	40	42	36	40.0
<b>Average</b>	32.5	40.1	39.5	38.8	37.7

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