

## CONTENT OF RAW PROTEINS IN OAT DEPENDING ON THE GROWING SYSTEM IN STRUMICA REGION, MACEDONIA

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### Abstract

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In the period 2005-2007 examinations were conducted with five populations of oat (*Krivogastani*, *Trebenista*, *Radolista*, population from Bulgaria and *Kuceviste*) and three oat varieties (*Rajac*, *Slavuj* and *Lovken*), which were set in conditions of organic and conventional production. The growing system showed increase in the content of proteins under the organic production system, absolutely by 0.18 %, or relatively by 1.39 % in comparison with the conventional production system. In the conditions of organic production the highest average content of proteins was found for the population *Trebenista* (13.74 %), and the smallest for the population *Kuceviste* and *Slavuj* variety (12.43 %), which was absolutely by 1.31 % or relatively by 10.54 % more. In the conditions of conventional production the highest average content of proteins was found for the population *Trebenista* (13.29 %), and the smallest (12.31 %) for the Bulgarian population.

**Key words:** oat, raw proteins, variety, population, organic production, conventional production

### Introduction

The oat (*Avena sativa* L.) is a culture grown mainly for the grain and the straw.

Today the oat is counted as the most important in the human nutrition with increased demand in the today culinary and the foodstuff industry.

Gradually the oat takes notably place in the human diet because it is the most nutritious cereal with high quantity of proteins in the grain. Besides the proteins the oat grain contains also soluble diet fibers as  $\beta$  glucans, whose content varies from 2.5 to 6.5 % (Przhulj et al., 1998). The content of  $\beta$ -glucans decreases the cholesterol in the blood, so today diet food

recommends food on the base of oat flakes (Welch, 1991 cit. Mlinar, 1996).

The average yield of oat in the world is 1781 kg/ha. In Macedonia the oat is grown on 2162 ha (Statistical review: Agriculture 5.4.7.01/564, July 2007) and the average yield is 1746 kg/ha.

Because the oats contain high concentration of well balanced proteins, it could satisfy request of the people whose diets are based on small quantities of proteins from animals (Peterson, 1989).

The raw proteins content in the oat grain varies from 9.6 to 12.6 % depending on the variety, soil and climatic conditions and used agrotechnical activities (Vasilevski, 2004).

The husk has fewer proteins, so the concentration of the proteins of the whole oat grains is about 25 % smaller than the concentration of the proteins in the peeled oat. The examinations made for 289 samples of peeled oat, grown under irrigation conditions in Aberdeen, Idaho, showed quantity of proteins that ranges from 12.4 up to 24.4% (Robbins et al., 1971 cit. Peterson, 1989).

Having this in forward, we appointed an aim, through field and laboratory several year comparable examinations of both types of oat production, to find positive and negative sides of the organic, compared with the conventional production, from agrotechnical point of view, as well as, to separate the best agrotechnical activities, oat varieties or populations for both types of production systems.

## Material and Methods

The examination started in 2005 and lasted until 2007. The field experiments were carried out in the field of Goce Delcev University in Stip, Faculty of agriculture, Strumica.

Five oat populations, of which four are home population and one is introduced from Bulgaria (*population Krivogastani, population Trebenista, population Radolista, population from Bulgaria and population Kuceviste*), and three oat varieties (*Rajac, Slavuj and Lovken*) introduced from Serbia were analyzed.

Two experiments were set, one in condition of organic and one in condition of conventional production, in which all oat genotypes were maintained. The experiments consisted of 8 variants in four repetitions, arranged by randomized block system, with dimension of the basic parcel of 5 m<sup>2</sup>. The distance between variants was 0.50 m, and between repetitions 1.0 m. The distance between lines at conventional production was 20 cm, and at organic production was 10 cm.

The seed range in both types of production was 550 grains/m<sup>2</sup>, in other words, 5 500 000 grains/ha. In all years of examination the soil was prepared in the same way. During the autumn the surface was

plowed in deepness of 3035 cm, than the surface was separated and fertilized by methodological principle, so the surface predicted for conventional production was fertilized with 300 kg/ha NPK fertilizer in combination of 15:15:15, while the surface predicted for organic production, 20 t/ha organic fertilizer was applied. After fertilizing the surface was additional cultivated and was leveled.

The seed in all years of examination was done in March on 17.03.2005, 28.03.2006 and 06.03.2007 when the sowing conditions were optimal. The sowing was made by hand in rows, at a dept of 5-6 cm.

During the field examinations two types of agrotechnics was used. In the conventional experiment the standard agrotechnics for field production of oat and needed measures for care were used: protection against pests, diseases and weeds, fertilizing with 150 kg/ha 27 % KAN in the tillering phase.

In the organic experiment allowed and regulated agrotechnics for field production of oat and needed measures for care was used.

The content of the proteins in the grain was determined by the method of Kjeldahl from the average samples of grains in the Laboratory for chemical analyses of grains in the PSI Institute for cattle breeding, Skopje.

The obtained results were elaborated by statistical analyses of variance and the differences were tested by LSD-test.

## Results and Discussion

The results obtained for the content of proteins in the grain from the examination in conditions of organic production of oat are showed in Table 1.

The highest average content of proteins in the grain in the organic production of oat for the three years of examination, independently from the varieties and populations, was obtained in the third year (2007) of examination (14.66%) that was absolutely by 3.11 % or relatively by 26.93 % more than that in the first year of examination, and absolutely by 1.63 % or relatively by 12.51 % more than the obtained content of proteins in the second (2006) year of examination.

**Table 1**  
**Content of raw proteins in % in the conditions of organic oat production**

Variety/ Population	Year			Average 2005/07
	2005	2006	2007	
Krivogastani	11.62	13.57	15.54	13.57
Trebenista	13.25*	12.79	15.19	13.74
Radolista	11.93	13.65	15.43	13.67
Bulgarian population	10.5	13.05	15.51	13.02
Kuceviste	11.5	12.45	13.36	12.43
Rajac	11.5	13.22	14.63	13.11
Slavuj	11.06	12.71	13.54	12.43
Lovken	11.06	12.81	14.08	12.65
Average	11.55	13.03	14.66	13.08
LSD				
0.05	1.5	n.s.	n.s.	
0.01	n.s.	n.s.	n.s.	

Factors that influenced on higher percent of proteins in the year 2007 were the optimal average monthly temperature during the formation period of the generative organs and flowering, compared with the temperature in 2005 and 2006, when they were lower.

The highest average content of proteins, independently of the year conditions, was found for the population *Trebenista* (13.74%), and the smallest for the

population *Kuceviste* and variety *Slavuj* (12.43%), that was absolutely by 1.31 % or relatively by 10.54 % more.

It could be concluded that the genetic characteristics of varieties and populations have bigger influence on the proteins content in the grain. For successful production of oat intended for human feeding, besides other factors, it should be made right choice of variety.

**Table 2**  
**Content of raw proteins in % in conditions of conventional oat production**

Variety/ Population	Year			Average 2005/07
	2005	2006	2007	
Krivogastani	10.43	14.68	14.62	13.24
Trebenista	11.5	14.08	14.29	13.29
Radolista	10.56	14.59	13.07	12.74
Bulgarian population	10	14.85	12.09	12.31
Kuceviste	11.06	14.25	12.5	12.6
Rajac	11.93*	13.91	13.8	13.21
Slavuj	10.12	14.59	13.97	12.9
Lovken	10.5	14.08	13.97	12.85
Average	10.76	14.37	13.53	12.9
LSD	1	n.s.	n.s.	
0.05	1	n.s.	n.s.	
0.01	n.s.	n.s.	n.s.	

According to literature, different varieties and localities affect the changes in the content of proteins in the oat grain. Thus according to Nikolic et al. (1989) the oat grains obtained from the Kragujevac locality were more qualitative than the oat grains obtained from the Ljubljana locality because the percent of proteins and lipids was higher at Kragujevac locality (14.13 %), whilst in Ljubljana was 12.07 %. The variety *Rajac* contained 14.71 % raw proteins in the Kragujevac locality.

The results obtained for the content of proteins in the grain from the examination in the conditions of conventional oat production are showed in Table 2.

Independently of the year conditions and genotypes, the common average content of proteins in oat grain in this type of production was 12.90 %.

In the conventional production of oat it could be also accepted that the highest average content of proteins, independently of the year conditions, was achieved for the population *Trebenista* (13.29 %), and the smallest (12.31 %) for the Bulgarian population, that was absolutely by 0.98 % or relatively by 7.96 % more.

The differences that appear between varieties and populations in the same growing conditions are due to the variety specificity, in other words, are due to the specificity of the genetic characteristics of the examined populations and varieties.

According to Mlinar et al. (1996) the content of proteins at different varieties is differently and ranges from 8.98 % for *Istra* to 10.20 % for *Kupa*. The variety *Istra* was with highest grain yield.

Comparing the content of proteins by years in both growing systems independently of the varieties and populations and dependently on the used agrotechnical measures it could be said that in the organic production the content of proteins was higher in two of the years of examinations than in the conventional production. Thus in 2005 the average content of proteins in the organic oat production was higher absolutely by 0.79 %, or relatively by 7.34 % than in the conventional production. In 2007 the content of proteins also was higher absolutely by 1.13 %, or relatively by 8.35 % in the organic production, and in 2006 the

average content of proteins in the organic oat production was smaller absolutely by 1.34 %, or relatively by 9.32 % than in the conventional production.

In the three year examinations of Georgieva (1995), although the insignificant differences, there was increase in the grain proteins content at  $N_6$  (14.70 %). Maximum nitrate combination ( $N_{18}$ ) brought to decrease in the proteins content (14.30 %).

The growing system showed minimal increase of the protein content in the organic production. The content of proteins was higher absolutely by 0.18 % or relatively by 1.39 % than the proteins content in the conventional production.

Independently of the year, soil and climatic conditions and growing system, i.e. the used agrotechnics, the best genotype among the examined varieties and populations for the highest percent of raw proteins obtaining was the population *Trebenista*, which in the organic production system reached average proteins content of 13.74 % and in the conventional production system 13.29 %. The common average content of raw proteins in our examinations was 12.99 %.

## Conclusions

According to the three year of the examinations (2005-2007) for the raw proteins content depending on the growing system it could be concluded:

- The organic growing system showed increase in the content of raw proteins in oat grain. The content of raw proteins at the organic production system was higher absolutely by 0.18 % or relatively by 1.39 % than that at the conventional production system.

- At the organic production system the highest average content of raw proteins was reached for the population *Trebenista* (13.74 %), and the smallest was found for the population *Kuceviste* and *Slavuj* variety (12.43 %) that was absolutely by 1.31 % or relatively by 10.54 % more.

- In the conventional oat production the highest average content of raw proteins was reached for the population *Trebenista* (13.29 %), and the smallest was found for the *Bulgarian* population (12.31 %).

- Independently of the year, soil and climatic con-

ditions and growing system, i.e. the used agrotechnics, the best genotype among the examined varieties and populations for obtaining highest content of raw proteins was the population *Trebenista*.

- The common average content of raw proteins in our examinations was 12.99 %.

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