

4. Щукин А.Н. Методика обучения речевому общению на иностранном языке [Текст]: Учебное пособие для преподавателей и студентов языковых вузов. – М.: Икар, 2017. – 454 с.

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**THE ACTIVITY OF AMYLOLYTIC AND ANTIOXIDANT ENZYMES (CATALASES, PEROXIDASES) DURING BARLEY MALTING DEPENDING ON THE GRAIN SIZE AND THE PHYTOREGULATORS APPLIED**

*Regina Rafikovna Islamgulova, PhD student, Department of Agronomic, Biological Chemistry and Radiology, Russian State Agrarian University – Moscow Timiryazev Agricultural Academy, 17regin@mail.ru*

*Fomina Tatiana Nikolaevna, english advisor, senior lecturer, Department of Foreign and Russian Languages, Russian State Agrarian University – Moscow Timiryazev Agricultural Academy, tfomina67@mail.ru*

*Seregina Inga Ivanovna, scientific advisor, Doctor of Biology, D., Prof., Department of Agronomic, Biological Chemistry and Radiology, Russian State Agrarian University – Moscow Timiryazev Agricultural Academy, seregina.i@inbox.ru*

**Abstract:** *Malting is rather important in brewing production due to the process in which the germinating barley grain significantly increases the activity of various enzymes. It has been found that phytohormones activate germination processes and enzyme activity. A kernel size can also impact the activity of enzymes in the process of malting.*

**Keywords:** *malting, barley kernels, chemical composition of grain, activity of amylases, catalases, peroxidases in germinating grain.*

Brewing production highly depends on the malting process when under standard conditions barley grains germinate forming an active complex of enzymes amylases, proteases, cytases, oxidoreductases that dissolve endosperm cells and convert spare substances into soluble compounds.

An increase in the moisture content of the germinating grains results in hydrolytic enzymes activation in the embryo shield and then in the cells of the aleurone layer, initiating their penetration into the endosperm where starch is converted into soluble carbohydrates under the action of amylases, moreover, spare proteins are hydrolyzed to amino acids under the action of proteolytic enzymes. Cytases hydrolyze structural polysaccharides of cell walls and thus enhance the penetration of amylases and proteases into endosperm cells [1, 2].

During malting, the activity of proteolytic enzymes in germinating barley kernels increases significantly. Spare proteins are broken down to amino acids needed for yeast nutrition during fermentation. The highest activity of these enzymes is observed on the 5th-7th days of grain germination [3].

The purpose of our research was to study the activity of the enzyme complex of barley kernels in the process of malting, depending on the kernel size. and the following phytohormones - epin-extra, zircon and siliplant – were applied.

The object of the research was brewing barley grains of the Nadezhniy cultivar harvested in 2017, grown on the leveled agrophone at the field experimental station of the Moscow Research Institute "Nemchinovka". The soil of the experimental site was sod-podzolic medium loam. Grain fractionation was carried out by the grain thickness using a set of sieves. The chemical composition of grains was evaluated by the near-infrared spectroscopy (NIR) analysis method.

The research has shown that the activity of enzymes in the process of malting depends on the size of grains and can be increased with the use of phytohormones. Activation of germination and increased activity of amylases, proteases, and antioxidant enzymes in the germinating grains were observed when barley kernels were soaked in solutions of epin-extra, novosil, quartzine, crezacin, aprotinin A, etc. [4, 5].

The purpose of our research was to find out the effect of kernel sizes on the chemical composition of barley and the ability of barley grains of the Nadezhniy cultivar to malt. These features were evaluated by the activity of amylases and enzymes of antioxidant action – catalases and peroxidases. Due to the important role of grain peroxidases in the activation of malting and protection against peroxide oxidation of cell membranes, the possibility of enhancing the action of these enzymes with the use of phytohormones has also been studied.

The activity of amylolytic enzymes, catalases and peroxidases was determined. The catalytic activity of the isoforms of these enzymes at pH = 5.5, 7.0, 8.0 was detected using a phosphate buffer system (1/15 M phosphate buffer). The activity of enzymes in the sprouted grain was determined after the removal of sprouts and roots. The effect of phytohormones on the malting process of barley grains was evaluated after 1-hour soaking of grains in siliplant, epin-extra and zircon solutions, regulatory preparations manufactured by INPO "NEST M". The rate of drug consumption was 0.1 ml/ liter of desalinated water.

The experiments on the fractionation of malting barley kernels, depending on the grain thickness demonstrated that the water-soluble proteins content was higher in dormant grains with a smaller grain thickness fraction (2.2-2.5 mm). Moreover, and the activity of acidic, neutral and alkaline amylases in the seedlings of this fraction was high as well. At the same time, high activity of acidic  $\beta$ -amylases and catalases, as well as acidic, neutral and alkaline peroxidases, was found in the germinated grains of the largest grain thickness fraction (>3 mm). The revealed features of these grain fractions improved the brewing properties of grain. Studying the action of enzymes in acidic (pH= 5.5), neutral (pH=7) and alkaline (pH=8) environments, it was found that acidic isoenzymes  $\alpha$ - and  $\beta$ -amylases, as well as neutral and alkaline isoenzymes catalases and peroxidase were very productive. Due to the influence of phytohormone caliper, the activity of acidic, neutral and alkaline forms of peroxidases in the kernels of 7-day-old barley seedlings increased by 43-81%, and the action of epin-extra resulted in the increase by 28-60%.

Statistical evaluation of the experimental data was carried out by the method of variance analysis using the computer program "Straz" (version 2.1 of the Information and Computing Center of the Russian State Agrarian University-Moscow Timiryazev Agricultural Academy, 1989-1991).

The data obtained indicate that these phytohormones have activated the grain germination process and thus can accelerate malting of barley, as well as the seedling development provided barley is grown for seeds.

However, over time, new generation of phytohormones appear [6]. Accordingly, the technologies of barley production for malting should be improved with their inclusion in order to obtain the highest yields of a particular cultivar and the best indicators of the product quality. Therefore, it is necessary to study the effectiveness of the new generation phytohormones application.

### References

1. Gamzaeva, R.S. Dynamics of the activity of amylolytic enzymes in germinating kernels of spring barley grown on increasing doses of nitrogen fertilizers // Coll. tr. scientific. conf. "Scientific support for the development of the agro-industrial complex in the context of import substitution." – St. Petersburg, 2018. – P. 9-11. (in Russian)
2. Kisileva T.F. Technique and technology of food production / T.F. Kiseleva, Yu. Yu. Miller, Yu.V. Grebennikova et al. // Technics and technology of food production. – 2016. – No. 1. – P. 11-17.
3. Novikov, N.N., Solovieva N.E. Influence of diet and phytohormones (novosil, epin) on grain quality and protein composition of malting barley when grown on sod-podzolic soil // Izvestiya TSKhA. – 2019. – No. 3. – P. 5-18. (in Russian)
4. Vitol, I.S., Karpilenko G.P. Protein-proteinase complex of barley grown on a different agricultural background with the use of drugs with regulatory action // Appl. biochemistry and microbiology. – 2007. – No. 3. – P. 356-364. (in Russian)
5. Steven E. Ullrich Barley: Production, Improvement, and Uses. – World Agriculture Series, John Wiley & Sons, 2010. – 656 p.
6. Novikov, N.N. A new method for determining the activity of peroxidases in plants // Izvestia TSKhA. – 2016. – No. 3. – P. 36–46. (in Russian)
7. Fomina T.N. English-Russian dictionary on Agronomy and Soil sciences: dictionary / T. N. Fomina. – Moscow: RSAU-MTAA, 2014. – 76 p.

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### **RADIOPROTECTIVE PROPERTIES OF THE LAMIACEAE FAMILY**

*Kuzmin Denis Dmitrievich*, post-graduate student, Department of Biotechnology, Federal State Budgetary Educational Institution of Higher Education Russian State Agrarian University-Moscow Timiryazev Agricultural Academy (RSAU-MTAA), *kuzmin.rabochiy@yandex.ru*