

# Enzyme Complexes for Preparation of Spelt Wort in Alcohol Production

Liubov Palianytsia, Natalia Berezovska, Zorian Pikh

Department of Organic Products Technology, Lviv Polytechnic National University,  
UKRAINE, Lviv, S. Bandery street 12, E-mail: liubapal@ukr.net

**Abstract – The effective complex of enzyme preparations for the spelt wort production was proposed: Amylex 5T (source of  $\alpha$ -amylase), Diazyme SSF (source of glucoamylase), Laminex BG2 (source of cellulase) and Alphalase AFP (source of protease) for the hydrolysis of biopolymers spelt grains.**

Keywords – enzymes, spelta, wort, yeast, mash.

## Introduction

Starchy and sugar-based raw materials are used mainly for the production of food alcohol. Research on the selection of alternative raw materials is directed at those plants that contain starch and sugars. Spelt (*Triticum spelta* L.) is a kind of wheat that has a film grain and a scalene rod. Its cultivation does not require significant agronomic costs, since the cereal has drought and cold resistance and mature very quickly. Spelt is an environmentally friendly crop [1].

It is known [2] that the content of proteins in the spelt is 28% higher than in wheat, fats - in 1,6 times, and mineral substances - by 22%. According to the results of research [2], spelt grains contain more soluble fractions of food fibers, vitamins and minerals. Carbohydrate-based polymers (starch, cellulose) are used as carbon source during the microbiological formation of ethanol and the generation of biomass of yeast. But these carbohydrates can be used by microorganisms only after hydrolysis of them to mono- and disaccharides.

Proteins in the spelt after enzymatic hydrolysis to amino acids become a valuable source of not only nitrogen, but also carbon for the life of yeast. Given the presence of these acids in the wort for the formation of biomass yeast consumes less sugar, and more - for the production of alcohol. Hydrolysis of pectin substances is not important in the production of alcohol, but during the preparation stage, their hydrolysis is desirable due to the fact that it reduces the viscosity of the medium. Cellulose of raw materials under the influence of cellulolytic enzymes is partially hydrolyzed to glucose, which increases the yield of alcohol and reduce the viscosity of intermediate products of alcohol production. All these processes are carried out with the participation of hydrolytic enzymes that catalyze the hydrolysis of starch, cellulose, protein and pectin substances.

Consequently, the task of finding effective enzyme preparations complexes for the preparation of spelt wort with the properties necessary for the alcohol production is actual and of practical importance.

## Materials and Methods

The subjects of the research were: commercial enzymes («Danisco», Denmark), spelt wheat (*Triticum spelta* L.) of the variety «Zorya Ukrainy», were obtained from Ukrainian Scientific Institute of Plant Breeding (Kyiv) and dry alcoholic yeast Thermosacc DRY. The technological parameters of spelt grain are: humidity 10,5%, starch 44,0%, debris with grain impurities < 1,5% and garbage impurities – 1,0%, grinding size - 92% of the throughput through a sieve with a diameter of holes 1 mm. Fermentation of spelt wort was carried out in flasks at  $33 \pm 1^{\circ}\text{C}$  for 72 hours. In the work, the research methods adopted in the alcohol industry were used. Evolved CO<sub>2</sub> was controlled by gravimetric method. In fermented wash the content of ethanol was determined by distillation method.

## Результати досліджень та їх обговорення

The choice of enzyme preparations was due to peculiarities of grain raw materials and their chemical composition. The lower content of starch in grain grains of the special varieties "Zorya Ukraina" in comparison with wheat increases the content of non-starched polysaccharides. Therefore, in order to effectively transform starch, as well as other components of grain raw materials into digestible sugars and components for the nutrition of yeast, complexes of enzyme preparations based on  $\alpha$ -amylase, glucoamylase, cellulase and proteases were proposed. For the decomposition of non-starched polysaccharides contained in the filamentous part of the grain spelled, a proposed Laminex BG2 AF, capable of maintaining activity at 60 - 70<sup>0</sup>C and recommended by the manufacturer to make it during the preparation of dough. Alphasase AFP with a temperature optimum of 50<sup>0</sup>C is proposed for the decomposition of protein substances (table).

Thermo-enzymatic treatment of milled grain with water was carried out at a temperature of 76 ± 1<sup>0</sup>C for 2,5 hours, and saccharification - 30 min at 55-60 <sup>0</sup>C. The ratio of water to ground grain was 3 : 1. The efficiency of the enzyme complexes was determined depending on the rheological properties of the wort, such as the viscosity of the wort, indicating the efficacy of starch hydrolysis, the content of dry matter and the pH of the wort.

The results of studies on preparation of spelt wort using enzyme complexes (table) indicate that the introduction of cellulases and proteases leads to a decrease in viscosity of the wort and an increase in its concentration.

*Table*

Influence of complexes of enzyme preparations on indicators of spelt wort

Wort indicators	Complexes of enzyme preparations		
	Amylex 5T Diazyme SSF (control)	Amylex 5T Diazyme SSF Laminex BG2	Amylex 5T Diazyme SSF Alphasase AFP
Concentration of wort, %	16,2	16,7	16,5
Viscosity of the wort, Па·с	0,025	0,021	0,022
pH	5,9	5,9	5,7

Investigations of the spelt wort fermentation have shown that in the case of using amylolytic enzyme complexes with Laminex BG2 and Alphasase AFP, the mass of CO<sub>2</sub>, isolated during fermentation, increased by 2-4% compared with control. The content of alcohol in the bar, where the wort was received from Laminex BG2, was the maximum, and Alphasase AFP - the minimum.

## Висновки

Thus, among the investigated enzyme preparations for obtaining spelt wort in alcohol technology, the most effective was the complex on the basis of Amylex 5T, Diazyme SSF and Laminex BG2.

## Література

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