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ТЕХНОЛОГІЯ БРОДІННЯ, БІОТЕХНОЛОГІЯ ТА ФАРМАЦІЯ

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SPELTA WHEAT AS A COMPONENT OF THE MEDIUM FOR YEAST GROWING

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This article demonstrates a new possibility to use spelt as a component of the medium for yeast growing and also furthers expands the market of alternative cereals The best experimental results of the study of the yeast growing in spelta worts compared to control common wheat wort were obtained. This is due to the chemical composition of the wort. These results suggest that the rate of yeast growth in spelta wort is greater than in common wheat wort. The biosynthetic activity of two strains of yeast in the spelta wort and wheat wort was investigated. Possibility of effective growing of yeast in spelta wort with the purpose of their using in alcohol technology was shown.
Key words: spelta, common wheat, wort, medium, enzymes, yeast, growing.

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СПЕЛЬТА ЯК КОМПОНЕНТ ПОЖИВНОГО СЕРЕДОВИЩА ДЛЯ ВИРОЩУВАННЯ ДРІЖДЖІВ

У статті запропоновано використання зерна спельти як компонента живильного середовища для вирощування дріжджів, що також розширює ринок альтернативних зернових культур. Одержано кращі експериментальні результати вирощування дріжджів у суслі зі спельти порівняно з пшеничним суслом. Це пов’язано з хімічним складом сусла. Результати роботи свідчать, що швидкість розмноження дріжджів у спельтовому суслі є вищою, ніж у пшеничному суслі. Досліджено біосинтетичну активність двох штамів дріжджів у спельтовому та пшеничному суслі. Показана можливість ефективного вирощування дріжджів у суслі зі спельти з метою їх використання в технології спирту.
Ключові слова: спельта, пшениця звичайна, сусло, середовище, ферменти, дріжджі, вирощування.

Introduction

The yeast cell is an important microorganism, without which fermentation products are not possible. It is an important microorganism which converts sweet wort into an enjoyable alcoholic beverage. Selection yeast strains, which are most prospective for practical use in biotechnology, allows to expand the raw material base for the preparation of the nutrient medium [1]. Different yeast strains impart subtle characteristics to the wort in which they are pitched. Although yeasts may be of the same species, *Saccharomyces cerevisiae*, they are different in the activity of propagation in the wort

[2, 3]. The propagation of active maintains yeast and its importance in alcohol technology was going on for a long time and is still an active research area. Therefore, the conditions used for propagating and maintaining yeast need not be identical to those used for fermenting grain wort.

Yeast is a facultative anaerobe which can survive and grow in the presence (aerobic) or absence (anaerobic) of oxygen. The presence of oxygen determines the metabolic fate of the cell [4].

The most important factors affecting the growing and maintaining of yeast are oxygen, pH, temperature, osmotic pressure and wort composition [5–6]. The medium (or wort composition) also determines yeast growth and fermentation performance and is important in maintaining and storing viable, stable yeast. In terms of fermentation, wheat wort contains most of the ingredients necessary for fermentation. Problems arise only if the nitrogen composition is low. A special role here belongs to amino acids. In terms of generation, the closer the starter medium is to the fermentation wort the better.

Wheat wort with higher concentrations works well for most fermentation and is recommended for use in most cases of alcohol production, but it does not contain enough nutrients to grow yeast [7]. Thus, the research has established that the generation of yeast on grain wheat (concentration 19 %) provides the best degree of carbohydrate conversion and biosynthesis of alcohol. The addition of yeast nutrients (amino acid/peptide and vitamin) and certain salts can also improve yeast growth and are a worthwhile addition to starters [8]. Thus starter worts should be supplemented with yeast nutrients so that nitrogen is not limiting.

Triticum spelta L is an alternative culture with undermanding growing requirements. Spelta shows a very good adaptability. Accoding to [9] it belongs to the ecological crops. There are many applications of spelt in the bakery industry [10, 11], but a few of them in the beverage industry, which makes new approaches in the process of malting and brewing for further research [12]. Also spelta is used in other branches of the food industry [13–14]. The use of spelta wheat can solve both the problem of growing yeast and the expansion of grain raw materials sources in the alcohol production. Spelta contains more protein, fats and vitamins than common wheat [13, 15]. Therefore, an important problem is the study of yeast growth in spelta wort. In this work, the growing yeast is proposed in the medium with spelt as an alternative cereal in the beverage industry.

Materials and Methods

In this study used yeast *Saccharomyces cerevisiae*, including commercial dry yeast preparations Quickferm Super (“SternEnzym”) and Thermosacc DRY (“Lallemand Biofluels”). The yeast was then rehydrated in aqueous solution before cultivation. The experimental materials comprised cultivars of common wheat (**Triticum aestivum**), and spelta wheat *(Triticum spelta L.)* were obtained from Ukrainian Scientific Institute of Plant Breeding. The grains were hammer milled in a mill fitted with 1 mm opening screen. In this work commercial enzymes (“Danisco”): Amylex 5T (alpha-amylase), Diazyme SSF (glucoamylase), Laminex BG2 (source of cellulase) were used. Wort was inoculates with 0.1 g/L of dry yeast slurry and this was estimated to give an initial yeast count of $18–20\cdot10^6$ viable cells/mL Yeast generations were carried out in flasks capped at the open and with cotton wool at 30 °C for 24 hours. The number of yeast cells was determined by Goryaev chamber using a microscope XS-5510 (MICROmed) and the physiological state of yeast – by the number of cells with buds.

Results and Discussion

Wort preparation modes for fermentation were selected according to the conditions of alcohol technology. The preparation of wort for fermentation was carried out in this way. In this work the spelta wort was obtained using enzymes Amylex 5T, Diazyme SSF and Laminex BG2 for the hydrolysis of not starch polysaccharides contained in the filmy part of the spelta grains. The thermo-enzymatic treatment conditions of spelta were established: the temperature of batch preparation 46±1 ºC, the duration of liquefaction 2,5 hours at a temperature of (79±1) ºC, saccharification – 30 min at (56±1) ºC. Common wheat wort (control) was obtained under similar conditions. Wort with a concentration of 18–20 % dry matter (w/w) works well for most fermentations and is recommended for use in most situations of alcohol production.

Two strains of dry yeast for research were used, such as: Quickferm Super and Thermosacc

DRY. Dehydration of yeast cells causes them to enter a state of anhydrobiosis in which their metabolism is temporarily and reversibly suspended. Dried yeast can be resuscitated by placing in liquid media. The yeast was then rehydrated (10 min, 20 °C) in an aqueous solution prior to inoculation in the wort.

Wheat wort produced by enzymatic hydrolysis of pretreated wheat grains at a high concentration of 18–20 % dry matter (w/w) was used for testing the effect of nutrients on their ability to improve fermentation performance of *Saccharomyces cerevisiae.* Yeast is inoculated into 40–50 ml of media and grown until it reaches the stationary phase of growth (24 hours). Initially there is a lag phase**.** This occurs during the first few hours after addition of the yeast. During this time there are no apparent signs of growth. The yeast are becoming acclimated to their new medium. The second phase is the exponential phase where yeast reproduction and metabolism is in high gear. During yeast propagation it is important to keep the yeast growing exponentially [4].

The dynamics of yeast cell count during the generation of Quickferm Super given on Fig. 1 It indicates that the largest yeast number is observed in wort obtained using spelta. Yeast content in spelta wort is higher as compared with the control (common wheat worts) sample on 13–16 %.

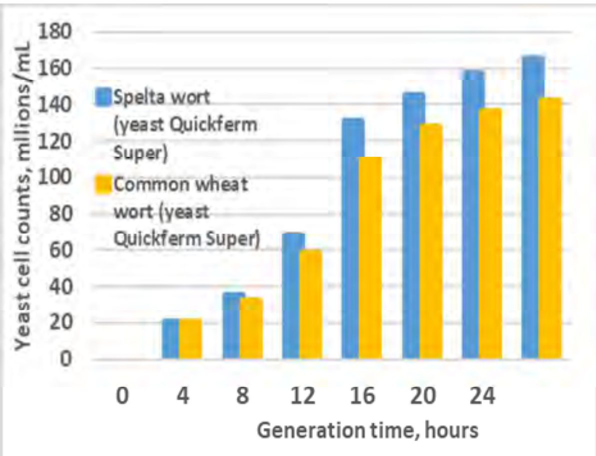

Fig. 1. Effect of spelt wort on yeast (Quickferm Super) cell number

The dynamics of yeast cell count during the generation of Thermosacc DRY given on Fig. 2.

It was found that the amount of accumulated yeasts in a spelta wort for 16 hours was higher on 23–25 % than in wheat wort. Yeast content in spelta wort is higher as compared with the control (common wheat worts) sample on 19–20 %.

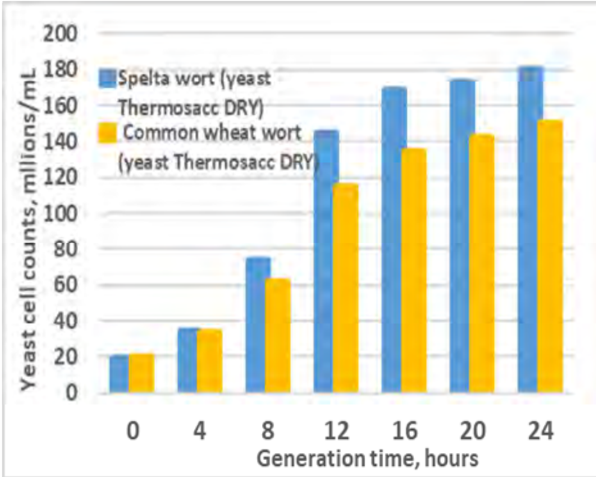

Fig. 2. Effect of spelt wort on yeast (Thermosacc DRY) cell number

Propagation conditions should be such that a maximal amount of yeast is produced which provides optimal fermentation performance once pitched. In terms of propagation, the closer the starter media is to the fermentation wort the better.

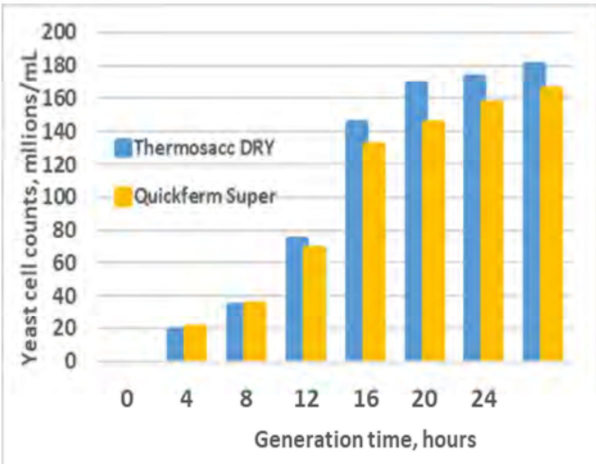

Fig. 3. The dynamics of yeast cell count

The main criteria for generation performance are based on the rate and extent of generation. Yeast growing in spelta wort showed a more rapid generation at the first hours (4–8 h) and then slow growth rate by 16 hours generation (Fig. 4). The growth rate of yeast at the beginning of the process (4–8 hours) increased by 20 % compared with control.

Saccharomyces cerevisiae has a round to ovoid shape and it reproduces by a budding mechanism. The physiological state of yeast cells (Thermosacc DRY and Quickferm Super) during their generation in spelta and wheat worts was studied. Generation of yeast in spelta wort and common wheat wort causes the largest number of cells with buds, which is by 15 and 21 % respectively. Also, the largest number of cells with buds for (14 % more than Quickferm Super) was in the yeast Thermosacc DRY. Thus, the physiological state of dry yeast preparations Thermosacc DRY is superior to yeast Quickferm Super.

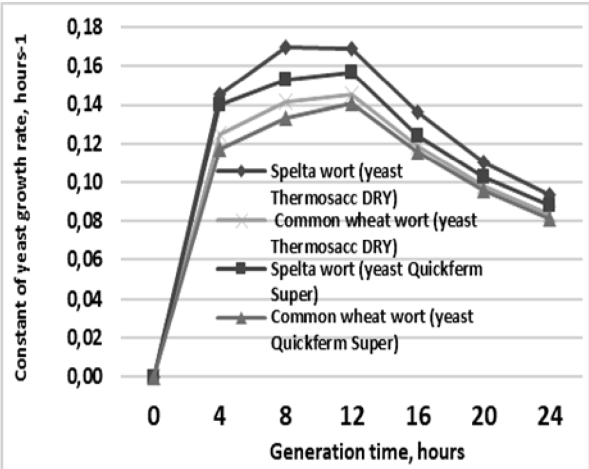

Fig. 4. Rate of yeast growth in worts

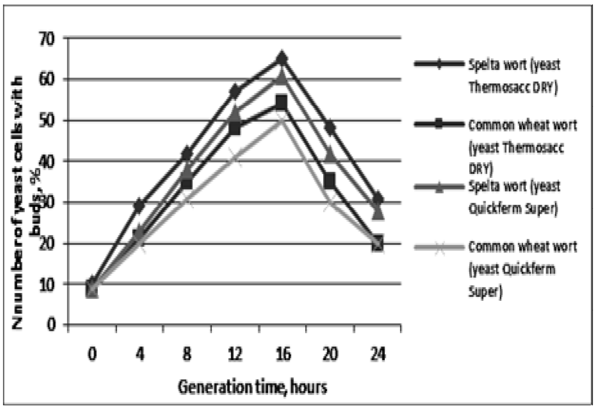

Fig. 5. Physiological state of yeast (Thermosacc DRY and Quickferm Super) during their generation

The best experimental results of the study of the yeast growing in spelta worts compared to control can be explained as follows: the nutritive value of spelta wheat is higher and contains all the basic components such as proteins, saccharides, lipids, vitamines and mineral. Lysine is contained in more quantities in the spelta than in common wheat. This amino acid was chosen because it is a Group A, meaning that it is among the first amino acids assimilated by yeast [15–16]. A mixture of different nitrogen sources was shown to enhance both growth and fermentation and suggest that the amino acid/peptide-based nutrients may be more appropriate than diammonium phosphate. Spelt grains were characterized by significantly higher concentration of oleic acid in comparison with common wheat. The highest total lipid content was reported in spelt which, in addition to common wheat, was also marked by the most favorable composition of essential PUFAs [15]. They are useful for preparing a nutrient medium for yeast growth.

Conclusion

In this paper, the results demonstrated a possibility of effective growing of yeast in spelta wort with the purpose of their using in technological processes. Thus, the use of spelta wort for the yeast generation at the expense of nutrients can increase the rate of yeast growth. Yeast content in spelta wort is higher as compared with common wheat worts sample on 13–25 %. The comparison of the physiological state of dry yeast during their generation in spelta and wheat worts was investigated.

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