

Effect of heat treatment on brewer's yeast fermentation activity

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Abstract – The influence of temperature treatment of brewer's yeast strain Saflager W-34/70 at temperatures of -17, 20, 25, 30, 35, 40 °C on their fermentative activity was studied. It was established that the freezing of yeast leads to a decrease of fermentation activity in directly proportional to the duration way. Fermentative activity of yeast samples can be increased by 20-24% by heat treatment at 35 °C during 15-30 minutes.

Key words – high gravity brewing; brewing yeast; heat treatment.

I. Introduction

Development of new and improvement of existing technologies aimed at intensification of alcoholic fermentation, reducing losses of raw material, reduction of cost and thermal power resources are important tasks of the brewing industry.

New and promising technology is high gravity brewing which is fermentation of highly concentrated wort with it's subsequent conditioning. However, a high solids content in the wort leads to a decrease in the rate of alcohol fermentation.

To implement the above benefits, number of conditions of the production must be followed, particularly during the fermentation process. Fermentation and maturation of beer wort should not last longer than in traditional technology, because otherwise there will not be obtained the desired economic effect. And this can be achieved only if there is an optimal composition of the wort, optimal conditions of aeration and the availability of highly active viable yeasts [1].

In high gravity brewing fermentation of wort is usually occurs in cylinder-conical fermentation apparatuses. This process is accompanied by a hydrostatic pressure on cells and a high concentration of carbon dioxide, ethanol and other metabolites which are accumulated at the end of the main fermentation, that can reduce the final rate of wort fermentation.

Task of technologist - reverse the negative impact of the aforementioned factors [2]. One way of solving the problems of high gravity brewing technology is activation of yeasts. For this purpose, various factors influence may be used, in particular physical methods of influence on the metabolism of yeast cells, including pressure, temperature, treatment in a magnetic field UHF waves, laser, ultraviolet rays and ultrasound [3-5].

Temperature has a significant impact on the energy and constructive exchange of cells, specific growth rate of the yeast and generation length. The shock of heat occurs in yeast for short-term rise in temperature to 37 ... 40 °C. Thus, there is active synthesis of certain proteins, but in a few hours metabolism returns to normal [3].

It was established that the cells undergoing the effect of high temperatures, becoming not only heat resistance, but also alcohol and osmostolerant, which is especially important in high gravity brewing.

Previously, researchers reported on the stimulating effect of cooling the yeast to temperatures -17 °C on their maltase activity [6]. The purpose of the work was to study the influence of temperature treatment and its duration on the fermentation activity of brewer's yeast.

II. Methods and research objects

The object of research was lager yeast strain Saflager W-34/70, which are used in European and national breweries. Yeasts were cultured in unhopped wort of 10% solids concentration at 25 °C in three stages. Yeast biomass was separated by centrifugation at 4000 rpm for 10 min.

Yeast fermentation activity was determined by Express method (modified Warburg method) [4]. Yeast samples were placed in Dry-air thermostat with a temperature of 20, 25, 30, 35 and 40 °C and a refrigerator with a temperature of -17 °C for 5, 15, 30, 45 and 60 minutes. The future impact of temperature treatment on fermentation activity of yeast was studied in wort with 16% solids content at 15 °C. Wort was concentrated by evaporation.

III. Research results

Fermentative activity of yeast is an important technological feature that determines the length of the main fermentation, physical and chemical properties of beer, its biological stability. In terms of the brewing industry as the seeding yeasts sedimented yeast are used up to 10-12 generations, which, after removal of the apparatus and washing them with cold water are stored for two days under water with a temperature of 1-2 °C. Longer storage leads to a decrease in fermentation activity.

Brewers experience shows that yeast seeding without preparation into cold wort are accompanied by a releasing of amino acids and nucleotides into the culture medium. As a result, their reproduction slows down or even stops, indicating a yeast sensitivity to temperature hopping.

The results showed that treatment of yeast at temperatures of 20, 25, 30 and 35 °C for 15 min. leading to increasing their fermentation activity (Fig. 1). The temperature of 40 °C is unfavorable because there is a significant loss of enzyme activity of yeast. The highest activity of yeast was achieved after treatment at 35 °C, which can be considered as optimal.

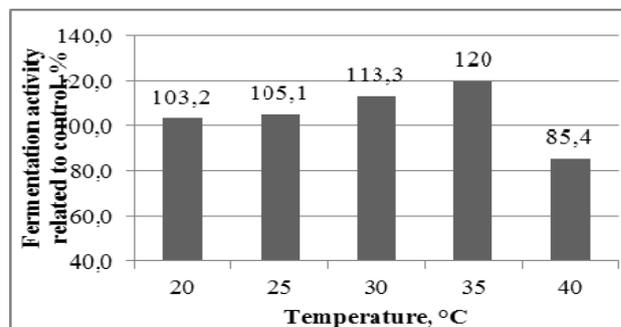


Fig. 1. Effect of treatment temperature on the fermentation activity of brewing yeast strain Saflager W-34/70

The effectiveness of heat treating of yeast depends not only on temperature but also on the duration of exposure. As a result, short-term increase in temperature of the yeast slurry to 35 °C caused the reduction of fermentation activity of the samples to 11% compared to control (Fig. 2), which correlated with previous studies. Instead, as a result of yeast holding at this temperature for 15 and 30 minutes fermentation activity of samples increased relative to control in 19.6 and 24% respectively. With further increase in the duration of heat treatment of yeast activity decreases, which can be explained by cells autolysis (Fig. 2).

However, cooling the yeast slurry at -17 °C temperature adversely influences on this yeast strain. Fermentative activity decreases in proportion to the duration of the heat treatment (Fig. 2). This negative effect can be explained by the formation of frozen water crystals inside the cells, and consequently, their destruction.

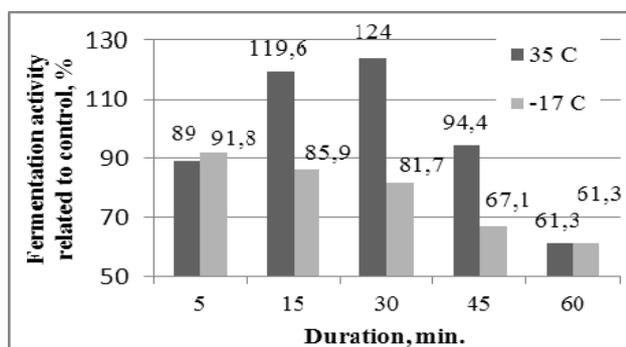


Fig. 2. Effect of heat treatment at 35 and -17 °C on the fermentation activity of brewing yeast strain Saflager W-34/70

Conclusion

Therefore, on the basis of the results it was found that treatment of yeast before fermentation at the optimum

temperature of 35 °C for 15-30 minutes allows to achieve increase of fermentation activity at 20-24% relative to control. Freezing yeast at -17 °C adversely affects their fermentative activity directly proportional to the duration of the temperature treatment.

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