Fermentation of kvass wort by thermotolerant strains of microorganisms

Lesia Sandig-Predzymirska[1], Oksana Orobchuk[2], Liliya Shevchuk[2], Khrystyna Frys[2]

1. Institut für Nichteisen-Metallurgie und Reinststoffe, TU Bergakademie Freiberg, GERMANY, Freiberg, Leipziger Str. 34, 09599, E-mail: lesichkaplm@gmail.com
2. Department, of Technology of Organic Products, Lviv Polytechnic National University, UKRAINE, Lviv, S. Bandery street 12, E-mail: oksana.m.orobchuk@lpnu.ua

Abstract – For effective fermentation of fermented wort, a culture of thermotolerant yeast MP-10 and complexes of lactic acid bacteria in the form of starters "Kefir," "Yogurt," "Symbiotic," "Bifivit" were used. The dynamics of changes in the concentration of dry substances content and the acidity of fermented wort were studied. The optimal amount of yeast and lactic acid bacteria was established (4.0 % suspension of yeast and lactic acid bacteria with a mass ratio of yeast : lactic acid bacteria - 4:1).

Keywords – kvass, kvass wort, thermotolerant yeast, lactic acid bacteria, bacterial leavens.

Introduction

Kvass is a drink with preventive and healing properties, a sweet-sour taste, with a characteristic aroma of rye bread. Kvass has a balanced chemical composition. The drink is made from grain raw materials. Soluble substances are extracted from raw materials into wort: carbohydrates (mainly maltose, maltotriose, glucose, and fructose), vitamins, dietary fibers, mineral components, and proteins [1, 2]. Carbohydrates of wort are fermented by yeast and lactic acid bacteria (LAB). In the process of fermentation of kvass, biologically active compounds accumulate in the wort: amino acids, vitamins, and aromatic substances [3-5].

Using effective fermentation agents of kvass wort (strains of yeast and lactic acid bacteria) under optimal conditions makes it possible to achieve high organoleptic indicators and curative and preventive properties of kvass. The use of available commercial strains of fermentation agents will allow organizing the production of kvass at existing facilities, in particular craft breweries [1, 5, 6].

For the production of kvass, pure yeast cultures of races 131-K, C-2, and race M, baker's yeast with an optimal fermentation temperature of 26-30 °C, pH 4.5-5.5 is used [4]. Races ferment glucose and sucrose well, maltose and raffinose are worse. Therefore, using thermotolerant yeast strains of breweries makes it possible to increase the temperature range of fermentation.

In order to maintain high physiological activity, it is proposed to use thermotolerant yeast strains (fermentation temperature from 30 to 40 °C) MP-10 [8]. In addition, these yeast strains can provide excellent flavor and aroma properties to kvass.

Lactic acid bacteria are heterofermentative, fermenting glucose, sucrose, and maltose. During lactic acid fermentation, bacteria produce both lactic acid and acetic acid, ethanol, and aromatic compounds [4, 7, 8]. The optimal temperature for the reproduction of lactic acid bacteria is 30 °C.

During joint cultivation, two types of microorganisms are in symbiosis. Lactic acid bacteria increase the acidity of the environment, which is optimal for yeast, and yeast releases amino acids and vitamins necessary for bacteria into the environment [9]. At the same time, with unregulated reproduction, bacteria compete for nutrients. With a decrease in the concentration of dry substance content (DS content) and increased acidity, better living conditions are created for lactic acid bacteria. The too-high acidity in the environment inhibits the activity of yeast and lactic acid bacteria. The development of foreign microorganisms in the wort is also possible [6].

In the production of kvass, lactic acid bacteria Betabacterium [8], which have low fermentation activity, and individual strains of Lactobacillus and Bifidobacterium are used [8, 9]. For research, it is proposed to use dry preparations of lactic acid bacteria in the form of starters, which are easy to use in craft production conditions. The use of leavens based on lactic acid bacteria will make it possible to improve the quality of kvass, to obtain drinks with various taste and aroma profiles.

The tasks of the research are the justification of the use of microorganisms for the fermentation of sour wort based on dry concentrate; creation of optimal conditions for wort fermentation using thermotolerant strains of microorganisms.

Results

The following were used for research: dry kvass semi-finished product (rye bread crumbs, fermented rye malt, barley malt). The moisture content of dry kvass is not more than 10%, the extractability in terms of DS content is more than 49%, the acidity is not more than 60 cm^3 of a 1 N NaOH/100 g of extract, the color is not less than 10 cm^3 of a 0.1 N I_2/100 g.

Drinking water is used for the preparation of kvass wort by infusion. DSTU 7525:2014 Drinking water. Requirements and methods of quality control.

Ready commercial leavens based on lactic acid bacteria were used as lactic acid fermentation agents: "Yogurt", "Bifivit", "Symbiotic", "Kefir". Thermotolerant yeast of the MP-10 race was used as the causative agent of alcoholic fermentation.

Sour wort was prepared by the infusion method, filtered, and sugar syrup was added.

The wort was analyzed by determining the content of dry substances SR (refractometry), titrated (titrimetry, using an automatic titrator Easy Pro Mettler Toledo), and active (potentiometrically, using an automatic pH meter Mettler Toledo SevenCompact S220-Kit) acidity. Fermentation was carried out at a temperature of 35 °C and with different proportions of yeast and lactic acid bacteria. The total mass of the dry starter remained unchanged and was 0.05% of the mass of wort. The initial acidity of the wort is 0.143 ml of 0.1 N NaOH/100 ml of wort, the DS content is 3.2%, and the pH is 4.83.

Four samples of starter cultures with different microbiological compositions and thermotolerant yeast MP-10 were used for the study.

Sample 1 – MP-10 + kefir

Sample 2 – MP-10 + yogurt

Sample 3 – MP-10 + symbiotic

Sample 4 – MP-10 + bifivit

Fermentation of wort from dry concentrate was carried out at a temperature of 35°C (75% yeast and 25% LAB; 80% yeast and 20% LAB, fig. 1).

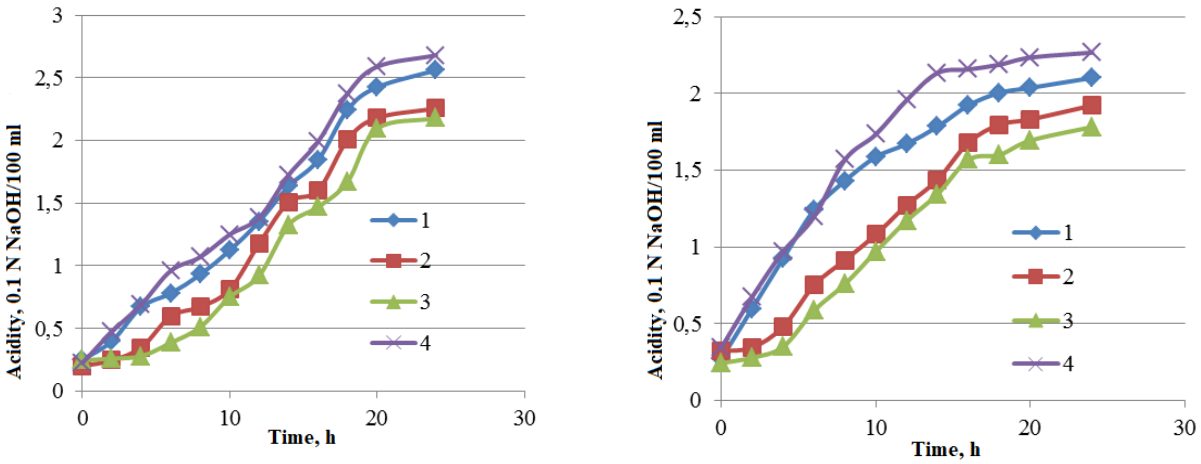

Fig. 1. The dynamics of changes in the titrated acidity of the wort during the fermentation process (temperature 35 °C) with the percentage of yeast and LAB in the starter: a – 75% and 25%, respectively; b – 80% and 20%, respectively.

After analyzing the graphs (Fig. 1), we can see that the wort reached the required level of acidity in 17-19 hours (when using 75% yeast) and 12-18 hours (when using 80% yeast). At a lower concentration of yeast, the increase in acidity occurred gradually, at a higher concentration - it was faster. The fastest process occurred during the fermentation of sample No. 4 using the "Symbiotic" complex of lactic acid bacteria.

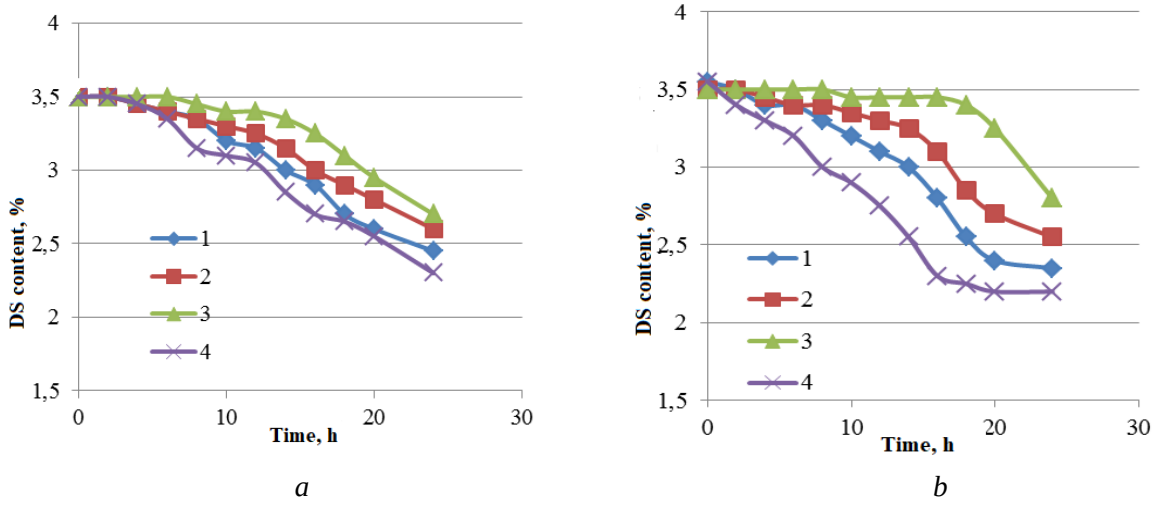

Fig. 2. The dynamics of changes in the content of dry substances in the wort during the fermentation process (temperature 35 °C) with the percentage of yeast and LAB in the starter: a – 75% and 25%, respectively; b – 80% and 20%, respectively.

The change in the content of dry substances occurred similarly to the change in acidity (at a lower concentration - gradually, at a higher concentration - faster). The fastest process occurred in the 4th (14 h), and 2nd (18 h) samples, provided 80% of yeast was used (Fig. 2).

The best results are also observed when using 80% yeast and 20% lactic acid bacteria. Therefore, a temperature of 35°C and the use of yeast and lactic acid bacteria in a ratio of 4:1 are optimal conditions for the fermentation of wort from dry concentrate.

Conclusions

A study was carried out to determine the composition of the leaven of yeast and lactic acid bacteria at the fermentation temperature of fermented wort. The course of fermentation of kvass is influenced by the composition and ratio of microorganisms in the sourdough starter. At 35 °C, fermentation takes place quite intensively. The optimal amounts of yeast and lactic acid bacteria were established, namely, a 4.0 % suspension of MP-10 yeast (80%) and LAB "Symbiotic" (20%).

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