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Research Article

QUALITY ANALYSIS OF THE YEAST SACCHAROMYCES CEREVISIAE

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Abstract:

Yeast, as a part of the recipe mass, must have high fermentation activity, and also have the ability to expand under anaerobic conditions, and to adapt quickly to a changing nutrient medium, in order to obtain high-quality bakery products.

Preliminary activation of the pressed bakery yeast allows to shorten the duration of the technological process for the production of bakery products, and to reduce the cost of the final product.

The experiments on the preliminary activation of yeast were conducted to study the behavior of yeast Saccharomyces cerevisiae under different conditions, namely in various nutrient media. The obtained results indicate, that the more substances, necessary for the yeast cell, present in the nutrient medium (sugars, amino acids, vitamins, macro- and microelements), the higher fermentation activity it possesses.

Various products of plant raw materials processing were used as the components of the nutrient media. They allowed increasing the fermentation activity of yeast S. cerevisiae, in comparison with the yeast fermentation activity without preliminary activation.

Keywords: *preliminary activation, yeast S. cerevisiae, fermentation activity, nutrient medium.*

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INTRODUCTION:

The creation of products, performing preventive and dietary functions, which have excellent quality indicators and guaranteed safety, is becoming an important direction in the food industry.

Based on the data of the Institute of Nutrition of the Russian Academy of Medical Sciences, the health indicators of the Russian population have been reduced due to the lack in the daily diet of nutrients, such as vitamins, macro and microelements. As a result, the risk of cardiovascular and oncological diseases increases. In this regard, the important direction of improving the health indicators of Russians is the creation of functionally directed products. These include bread and bakery products, which have high nutritional value.

On the other hand, to reduce economic costs during the production of bakery goods, obtained in the process of fermentation of semi-finished bakery products with yeast *S. cerevisiae*, it is necessary to increase the fermentation activity of the latter. It is assumed, that fermentation activity largely depends on the chemical composition of the medium in the phase of baker's yeast activation.

In connection with the foregoing, the aim of the work was to study the preliminary activation of yeast *S. cerevisiae* on its fermentation activity, using various nutrient media, which were based on plant raw materials, rich in various micronutrients, necessary for the enhancing of yeast biotechnological properties, as well as for the enrichment of the final product.

MATERIALS AND METHODS:

In this article, the following raw materials were used to prepare nutrient media:

- Water extract of Siberian fir green, Abisib-P, STO 24633276-001-10;
- Baker's wheat flour of the premium quality, GOST R 52189-2003;
- spelt flour, STO 53548590-032-2014;
- Baker's whole meal wheat flour, GOST R 52189-2003;
- Oatmeal flour, STO 53548590-019-2013;
- Powder of forest berries, RST of the RSFSR 22-75.

The powder was obtained by grinding the dried berries in a mill and further dressing on a sieve with a mesh size of 0.56 mm.

Influence of nutrient media on yeast *S. cerevisiae* was established according to the following indices:

1. Lifting force;
2. CO₂ release in the process of fermentation;
3. Maltase activity.

Pressed bakery yeast "Lux extra" TU 9182-038-48975583-2011 was used for the research.

The fermentation activity of the bakery pressed yeast *S. cerevisiae* was defined using the accelerated method of determining the yeast lifting force, with respect to time, necessary for the ball of dough with the tested yeast (mixed with flour, salt solution and pressed yeast) to come to the top in the glass of water at a temperature of 35°C.

Also, the yeast fermentation activity was defined using a technique for determining the gassing power of the flour (GPF), with the help of device Yago-Ostrovsky. The number of milliliters of CO₂, released for 5 hours of fermentation at 30°C, from 100g of flour with a moisture content of 14%, 60ml of water and 10g of pressed baker's yeast is taken as the indicator of GPF.

The enzymatic (maltase) activity of yeast on the device of Yeletsky was determined. Maltase activity is expressed by the time, necessary for releasing of 10ml of CO₂, in the process of attenuation of 20ml of 5% -maltose solution with pressed yeast, taken in an amount of 2.5% of the medium volume. Maltase activity is essential in the process of fermentation of semi-finished bakery products.

RESULTS:

The process of activation of baking yeast lies in the use of certain activators, accelerating biochemical processes in the yeast cell [1]. At present, the use of plant extracts activators, containing biologically active substances, is advanced. We examined the water extract of Siberian fir green, Abisib-P, hereafter the extract. This extract contains vitamins, microelements, phytoncides, chlorophyll, flavonoids [2].

Phytoncides are biologically active substances of vegetable origin, which inhibit the growth and development of bacteria. Phytoncides kill the *Bordetella pertussis*. The bactericidal action against *K. pneumoniae* has been established. Phytoncides not only inhibit growth, but also stimulate the development of microorganisms - antagonists of pathogenic forms for a given plant [3]. Chlorophyll is a green pigment of plants; it produces energy in nature, and is also used in medicine as a biologically active substance. Recent studies have shown, that chlorophyll is a potent antioxidant [4, 5]. Flavonoids are the largest class of vegetable polyphenols. This extract contains the following flavonoids: rutin and quercetin. Rutin fights against allergies, cataracts and strengthens the walls of the capillaries. Quercetin, in turn, fights against asthma, is a support for immunity, lowers the level of cholesterol in the blood [6].

At the first stage, the change in fermentation activity of pressed baker's yeast was studied, by determining its lifting force. The test samples were the process data with the extract and soaking the yeast with it; the control samples were the process data without the extract. The following concentrations of the extract were used: 40%, 70%, 100%, 130% to the weight of yeast. The suspension was exposed during 15 minutes, then the determining of yeast lifting force was carried

out according to the procedure, taking into account the recalculation of the amount and concentration of the salt solution in the process of doughing the ball (the recalculation was carried out to avoid the increase in humidity of the ball, because it was the water extract, used in the process of activation). Data are presented in Figure 1, from which it follows, that the lifting force is increased by 4.5-9.1% compared to the control.

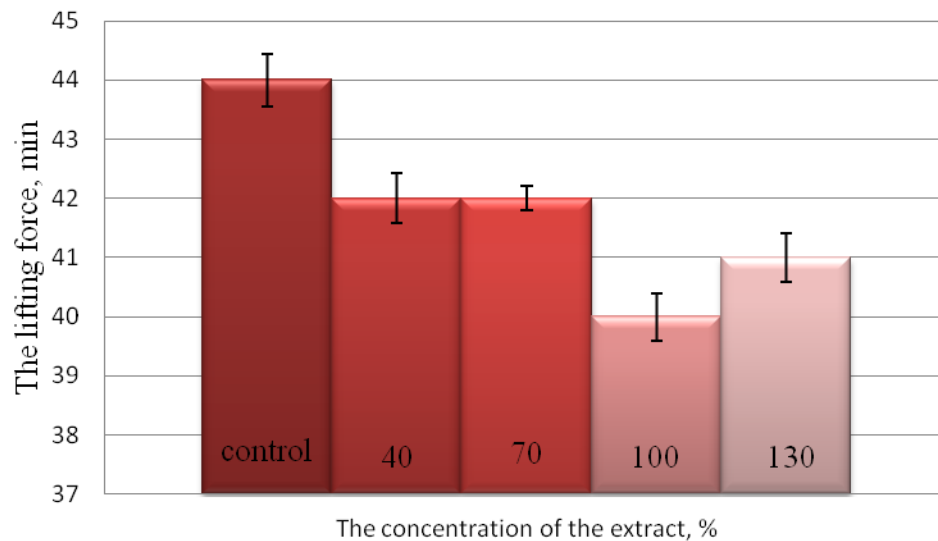


Fig 1: The impact of the extract concentration on the lifting force of yeast.

Further studies were aimed at determining the maltase activity of yeast with the following concentrations: 70%, 100%, 130% to the weight of the yeast. Data on the impact of the extract on the maltase activity of yeast is presented in Figure 2.

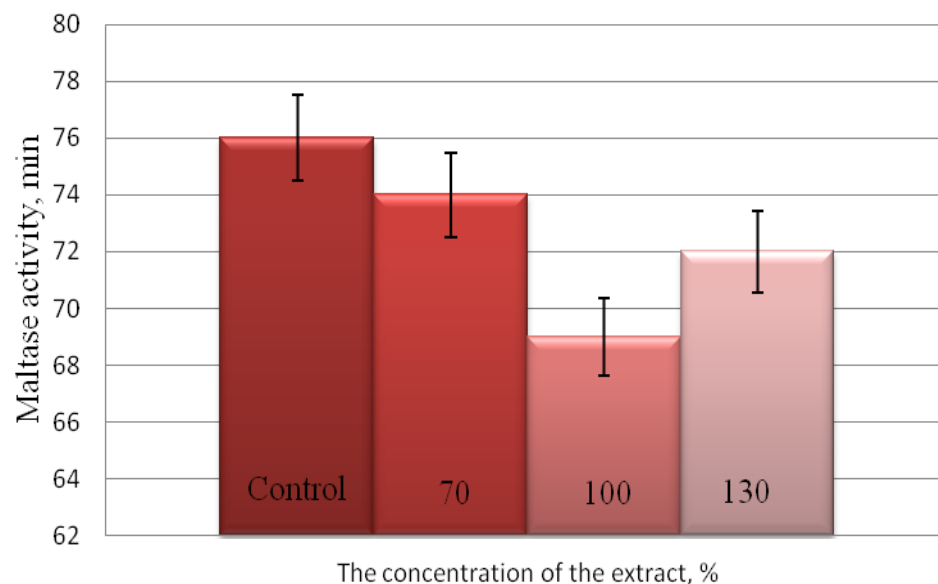


Fig 2: The impact of extract concentration on maltase activity of yeast

It follows from the data in Figure 2, that the maltase activity increases by 2.6-9.2%, compared to the control.

Thus, the optimum concentration of the extract, which gives the greatest effect for such parameters as the lifting force and the maltase activity of the yeast, is the concentration of 100% to the weight of the yeast. Improved fermentation activity is observed due to the presence in the extract of vitamins, macro- and microelements and other compounds of organic nature [2].

Then the study was aimed at determining the fermentation activity of pressed yeast in the process of its activation in a nutrient medium, consisting of wheat top-grade flour, extract, and water. This nutrient medium has been studied due to the fact, that the yeast is grown under aerobic conditions, and during the production of bakery semi-finished goods, it is under anaerobic conditions (in floury medium). To reorganize the yeast cell from the aerobic type of metabolism to anaerobic, it takes some time, so this transition is advisable to carry out in the process of yeast activation. During the research it was revealed, that the variation of flour within 25-75% and water in the range of 125-175% to the weight of yeast, did not lead to significant changes in the lifting force of the yeast. The nutrient medium composition was taken in the following ratio: flour: water: extract: yeast 1.5: 2.5: 2.0: 2.0; the time of exposure was 15 minutes. Data on the fermentation activity of activated yeast is presented in Table 1.

Table 1: Fermentation activity of yeast, activated in a nutrient medium.

The lifting force, min		Maltase activity, min	
Control	Test	Control	Test
46,5 ± 1,5	34,5 ± 2	70 ± 2	50 ± 2

From the data presented in Table 1 it follows, that the lifting force of yeast after activation in the nutrient medium increased by 25.8%, maltase activity increased by 28.6%, compared to the control parameters. A significant increase in lifting force and

maltase activity can be explained by the fact, that yeast enzyme complexes were reconstructed to obtain energy from the flour medium.

The next stage in the study of yeast activity was the use of complex additive and water as a nutrient medium. The complex additive consists of spelt flour, baker's whole meal wheat flour, oatmeal flour, powder of forest berries and the extract. At that, more than 50% of the additive is the spelt flour. The choice of the spelt flour as the main component of the complex additive is justified by its chemical composition (Table 2). As can be seen from Table 2, the spelt flour has an increased total sugar content of 5.82/100g, reducing sugar 3.02/100g - relative to the first grade wheat flour. This indicates its high sugar-forming capacity, necessary for feeding the yeast. Spelt flour has a higher content of such elements as magnesium, potassium, phosphorus. Magnesium stimulates the action of almost all the most important enzymes of the cell, and the energy metabolism of adenosine phosphoric acids can be carried out only in the presence of magnesium. Potassium stimulates the penetration of inorganic phosphorus into the cell, is the main cation of the cytoplasm and has a significant effect on biosynthesis, enzymatic activity and the preservation of yeast. Phosphorus is the main energy component of biosynthesis, which is a part of ATP nucleic acids, phospholipids, cell wall polymers, some enzymes and vitamins. It should be noted, that spelt flour has higher content of amino acids, including irreplaceable [7, 8]. It is known, that amino acids play an important role in the metabolism of yeast cells [9]. Bakery whole meal wheat flour is used as a source of ballast substances, thanks to which the yeast cells are evenly distributed in the nutrient medium. Oatmeal flour contains many antioxidant active compounds [10]. Forest berries are rich for vitamins and minerals. They contain carbohydrates, tanning substances, organic substances, pectins, essential oils, phytosterols, tannins.

Table 2: Chemical composition of spelt flour [7]

Indicator	First grade wheat flour	Spelt flour
Mass fraction of crude protein, %	10,80	13,60
Total sugar, %	3,40	5,82
Reducing sugar, %	0,80	3,02
Thiamine, mg	0,25	0,15
Riboflavin, mg	0,08	0,06
Pantothenic acid, mg	0,50	0,55
Folic acid, µg	35,50	43,00
Potassium, mg	176,00	179,00
Magnesium, mg	44,00	54,00
Phosphorus, mg	115,00	138,00

Table 3: The dependence of the lifting force of yeast on dilution of the nutrient medium.

Components ratio			Lifting force, min	
Yeast	Complex additive	Water	Control	Test
-	-	-	$41 \pm 1,0$	-
2	5	5	-	$26,3 \pm 0,5$
2	5	7,5	-	$26,3 \pm 0,5$
2	5	10	-	$26,3 \pm 0,5$
2	5	12,5	-	$25,4 \pm 0,5$

The nutrient medium was made from a complex additive and water. The dependence of the yeast lifting force on the decrease in nutrient concentration was studied by increasing the water content in the nutrient medium. In this case (Table 3), the following yeast ratio was used: complex additive: water 2: 5: (5-12.5). The mixture was exposed during 15 minutes and the lifting force was determined according to the procedure.

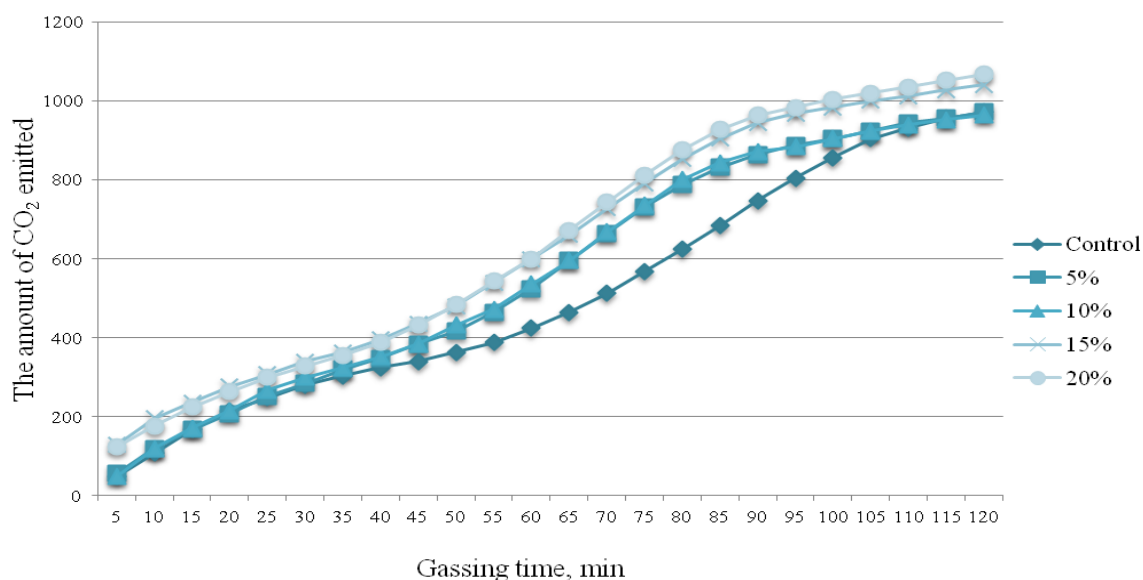
It follows from Table 3 that the lifting force practically does not change when the nutrient

medium is diluted within the specified limits. In this case, the activation of yeast with the help of complex additive gives an increase in the lifting force by an average of 36%, compared to the control sample.

Further, the dependence of the yeast lifting force on the increase in the concentration of the complex additive in the nutrient medium was investigated (Table 4). The following yeast ratio was used: complex additive: water - 2: (5-20): (5-20). The mixture was exposed during 15 minutes.

Table 4: The dependence of the lifting force of yeast on the concentration of the complex additive.

Components ratio			Lifting force, min	
Yeast	Complex additive	Water	Control	Test
-	-	-	$41 \pm 1,0$	-
2	5	5	-	$26,3 \pm 0,5$
2	10	10	-	$19,0 \pm 0,5$
2	15	15	-	$16,5 \pm 0,5$
2	20	20	-	$16,3 \pm 0,5$

**Fig 3: The impact of activated yeast on the rate of gassiness.**

From the data in Table 4, it can be seen, that there is a tendency to increase the lifting force with the increment of complex additive concentration in the nutrient medium, and then, starting with the ratio 2:15:15, with increasing the concentration of complex additive, the lifting force remains at the stationary level. The increase in lifting force with a component ratio 2:15:15 – is 60%, compared to the control sample.

The fermentation activity of activated yeast in a nutrient medium with a complex additive was also determined on the device of Yago-Ostrovsky, during 120 min. Figure 3 shows that the graphs, corresponding to the activated samples, are above the control sample graph. It indicates a higher rate of gassiness, consequently confirming the higher fermentation activity of the activated yeast.

DEDUCTIONS

Thus, the set the obtained results indicates, that the richer the nutrient medium with micronutrients, the more active is the pressed yeast *S. cerevisiae*, but a simple increase in the concentration of additives leads to the detection of the growth limit of the lifting force. This may mean, that the metabolic rate of the yeast cell does not depend only on the substances, contained in the nutrient medium.

CONCLUSION:

The obtained results allow to assess positively the prospects of using a nutrient medium on the basis of complex additive, when yeast is activated for the intensification of fermentation process and for enrichment of the final product.

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