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STUDY OF COMPLEX ADDITIVE USE POSSIBILITY TO IMPROVE YEAST AND WHEAT BREAD QUALITY

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Abstract:
In this work, they study the effect of a complex additive on the ferment activity of pressed baker yeast Saccharomyces cerevisiae, the effect of activated yeast on the fermentation process of the dough semi-finished product and the quality of wheat bread.

The yeast fermentation activity was studied by yeast lifting force determination. The effect of activated yeast on the fermentation process was determined by the volume of dough semi-finished product increase and the dynamics of acid accumulation. The quality of wheat bread was estimated by organoleptic and physicochemical indicators (moisture, acidity, porosity, specific volume).

It has been established that when the concentration of the complex additive increases, the yeast lift force also increases, and the accumulation of acidity is accelerated in the dough semifinished products. The physicochemical parameters of a finished product are improved at 10% concentration of the complex additive to the flour weight. The organoleptic evaluation showed that they recommend to introduce complex additive during the activation of yeast at the level of 10% without the deterioration of bread taste characteristics in comparison with the control sample.

Keywords: *baking yeast, complex additive, preliminary activation, fermentation activity, wheat bread.*

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1. INTRODUCTION:

During the production of bakery pressed yeast to accelerate the growth of biomass, the yeast Saccharomyces cerevisiae are cultivated under aerobic conditions. At bakery enterprises the yeasts get into conditions close to anaerobic ones after dough kneading. A certain amount of time is required in order to reorganize the yeast enzyme systems from aerobic to anaerobic energy production process. It is economically and technologically more feasible to create the conditions for the reorganization of enzyme systems by yeast pre-activation [1].

The process of baker yeast activation is represented by the use of certain activators that accelerate biochemical processes in a yeast cell [2]. At present, the use of plant extract activators (RF patents No. 2486754, No. 2392308), the powders from seeds and fruit and vegetable products (RF patents No. 2348684, No. 2257407, No. 2388227, No. 2333647, No. 2208631), as well as the flour from the crops non-traditional for bakery (patent of Russian Federation No. 2180913), containing biologically active substances, is the most prospective one.

The composition of the complex additive under study contains the extract of the green fir Siberian Abisib-P. This extract contains vitamins, microelements, phytoncides, chlorophyll and flavonoids [3]. Phytoncides are biologically active substances of vegetable origin, which inhibit bacteria growth and development [4]. Chlorophyll is used in medicine as a biologically active substance. Recent studies have shown that chlorophyll is a potent antioxidant [5,6]. Flavonoids are the largest class of vegetable polyphenols. This extract contains the following flavonoids: rutin and quercetin. Rutin struggles with allergies, cataracts, strengthens capillary walls. Quercetin, in its turn, fights against asthma, acts as the support for immunity, lowers cholesterol in blood [7].

Other components that make up the complex supplement are: eincorn flour, wheat flour, bread flour, oatmeal flour and cranberry powder. In this case, the bulk of the additive is represented by eincorn flour. Eincorn flour has an increased total sugar content of 5.82/100 g, reducing sugars 3.02/100 g relative to wheat flour of the first grade, and all this indicates its high sugar-forming capacity necessary for yeast feeding. Eincorn flour also has a higher content of such elements as magnesium, potassium, and phosphorus.

Magnesium stimulates the action of almost all most important enzymes of a 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 a cell, acts as the main cation of the cytoplasm and has a significant influence on biosynthesis, enzymatic activity and the preservation of yeast. Phosphorus is the main energy component of biosynthesis, which makes the part of the nucleic acids ATP, phospholipids, cell wall polymers, certain enzymes and vitamins. It is worth noting that eincorn flour has a higher content of amino acids, including irreplaceable ones [8,9]. It is known that amino acids play an important role in the metabolism of yeast cells [10]. Wheat bakery flour is used as a source of ballast substances, due to which the yeast cells are evenly distributed in the nutrient medium. Oatmeal flour contains many compounds that exhibit antioxidant activity [11]. Cranberries are rich in vitamins and minerals. They contain carbohydrates, tannins, organic substances, pectins, essential oils and phytosterols [12].

The aim of this work is to study the preliminary activation of pressed baking yeast on their fermenting activity, using a complex additive consisting of traditional and non-traditional vegetable raw materials for bakery industry, rich in vitamins, macro- and microelements, biologically active substances, and also the study of activated yeast on dough semi-finished product and finished product quality.

2. MATERIALS AND METHODS:

In this work, in order to obtain the nutrient medium that was used to activate the pressed baking yeast, a complex additive was applied comprising the following feedstock (in % to the total weight of the additive):
- (60%) eincorn flour, STO 53548590-032-2014;
- (15%) wheat bread-baking flour, GOST R 52189-2003;
- (15%) oat flour, STO 53548590-019-2013;
- (5%) cranberry powder, PCT RSFSR 22-75;
- (5%) water extract of the green fir Siberian Abisib-P STO 24633276-001-10.

The powder was obtained by dried cranberries grinding in a mill and their further sieving on a sieve.
The effect of preliminary activation on the fermenting activity of baked pressed yeast was determined by the lifting force factor.
They used bakery pressed yeast "Lux extra" TU 9182-038-48975583-2011 for the study.

The preliminary activation of yeast was carried out in the following way: the nutrient medium was prepared from the complex additive (CA) and water, then the amount of yeasts required by the procedure (recipe) was kept in a nutrient medium at the temperature of 30 °C for 15 minutes. The following component ratio was used: yeast: CA: water: 2:5:5; 2:10:10; 2:15:15; 2:20:20. When dough samples were kneaded, the wheat flour was replaced with the amount of the complex additive that was used during pre-activation.

The lifting force was determined by the express method. Under the lifting force the time interval is conventionally understood as the time interval in minutes from the moment when a ball of dough (the mix of flour, table salt solution and pressed yeast) was dropped into a glass of water at the temperature of 35 °C, until it floated to the surface [13].

The effect of activated pressed yeast on the maturation process of dough semi-finished products was established according to the following indices:

1. dough volume;
2. dough acidity.

The measurement of dough volume during fermentation. Glass measuring cylinders of 100 ml were used as the containers to measure the dough volume. Before mixing, the yeasts were pre-activated using a complex additive, after which the dough samples were kneaded. The dough was kneaded according to the recipe, according to GOST 27842-88 for wheat bread. The measuring cylinders with dough semi-finished products weighing 30 g were placed in a thermostat at the temperature of 32 °C. Every 10 minutes, the level of dough lifting was recorded in the measuring cylinders during 150 min.

Dough acidity. The dough was also kneaded according to GOST 27842-88 on pre-activated yeast. The fermentation of the dough semi-finished products was carried out in the thermostat at the temperature of 32 °C for 150 minutes.

Dough sample acidity was checked every 30 minutes. The acidity of dough semi-finished products was determined by titration with 0.1% NaOH solution in accordance with GOST 27493 and expressed in degrees.

The quality of finished bakery products was determined according to the following indicators:

1. physical and chemical;
2. organoleptic.

Physical and chemical indicators. The moisture content of the crumb was determined in accordance with GOST 21094 by drying the samples in the drying cabinet SESH-3M and expressed in percentage. The acidity of the product crumb was determined according to GOST 5670 by titration with 0.1 N of NaOH solutions and expressed in degrees. The porosity of the products was determined according to GOST 5669 and expressed in percentage. The volume of bread was determined using a bulk meter, working on the basis of loose filler (fine grain) volume in cm3 displaced by bread. The specific volume of bread was determined via measured volume division by the mass.

3. RESULTS:

At the initial stage, the dependence of the yeast lifting force on the reduction of nutrient concentration was studied by water content increase in a nutrient medium. At that the following yeast ratio was used: KD: water - 2:5: (5-12.5), the mixture was held for 15 minutes and then the lifting force was determined by the method (Table 1).

Table 1 - The influence of nutrient medium composition on yeast lifting power

Component ratio			Lifting force, min	
Yeast	Complex additive	Water	Control	Sample
-	-	-	41 ± 1,0	-
2	5	5	-	26,3 ± 0,5
2	5	7,5	-	26,3 ± 0,5
2	5	10	-	26,3 ± 0,5
2	5	12,5	-	25,4 ± 0,5

It follows from Table 1 that due to the activation of yeast using a complex additive, the lifting force is increased by an average of 36% as compared to the control sample, while the lifting force remains practically unchanged when the nutrient medium is diluted with water within the specified limits. Based on this, further studies were carried out at the ratio of the complex additive and water 1:1.

The effect of various concentrations of the complex additive in the nutrient medium on the lifting power of the yeast is presented in Table 2. The following yeast ratio was used: KD: water -2:(5-20):(5-20), the mixture was held for 15 minutes.

Table 2 – The effect of a complex additive on yeast lifting force

Component ratio			Lifting force, min	
Yeast	Complex additive	Water	Control	Sample
-	-	-	41 ± 1,0	-
2	5	5	-	26,3 ± 0,5
2	10	10	-	19,0 ± 0,5
2	15	15	-	16,5 ± 0,5
2	20	20		16,3 ± 0,5

Table 2 data show that there is the tendency of the lifting force increase with the increasing concentration of the complex additive in the nutrient medium, and then, starting with the ratio 2:15:15, with the complex additive concentration increase, this indicator remains at the stationary level. The ratio of 2:15:15 is optimal, from the point of view of yeast fermentation activity. The increase of the lifting force at this ratio was 60% as compared to the control sample.

In bread baking, the readiness of dough semi-finished products is determined by dough volume increase in 2-2.5 times and by the achievement of the required final acidity. The following studies were aimed at the studying of activated yeast effect on these indicators. For convenience, the ratios of the complex additive used for the activation of yeast are further expressed in% to flour weight (for wheat bread receipt).
Table 3 provides the data on dough semi-finished product volume increase as compared to their initial volume after 150 minutes of fermentation.

Table 3 shows that the increase of the complex additive concentration to 10% in total flour weight, influences the increase of dough semi-finished product volume, and then, with the concentration increase from 10% to 20%, the decrease of dough volume growth is observed (despite the growth of yeast fermentation activity).

The decrease of volume growth is conditioned by the replacement of the first grafe wheat flour in the bread wheat formula with a complex additive, while the total content of gluten in the experimental samples decreases. As is known, the composition of wheat flour includes gluten proteins, which characterize the elastic properties of the dough, its extensibility and the ability to retain releasing carbon dioxide [14,15].

Further studies were related to the determination of acidity accumulation during the fermentation of dough semi-finished products. Before the dough kneading, the yeast was pre-activated and then the dough was made from wheat flour of the first grade. When they used wheat flour of the first grade, the dough is considered to be fermented to the acidity value of 3.5 degrees.

Table 3 – Increase of dough semi-finished product volume

Indicator	Control	Concentration of complex additive to flour mass, %			
		5	10	15	20
Growth, %	210	219	234	228	227

Figure 1 shows the dynamics of acid accumulation in dough semi-finished products during 150 minutes.

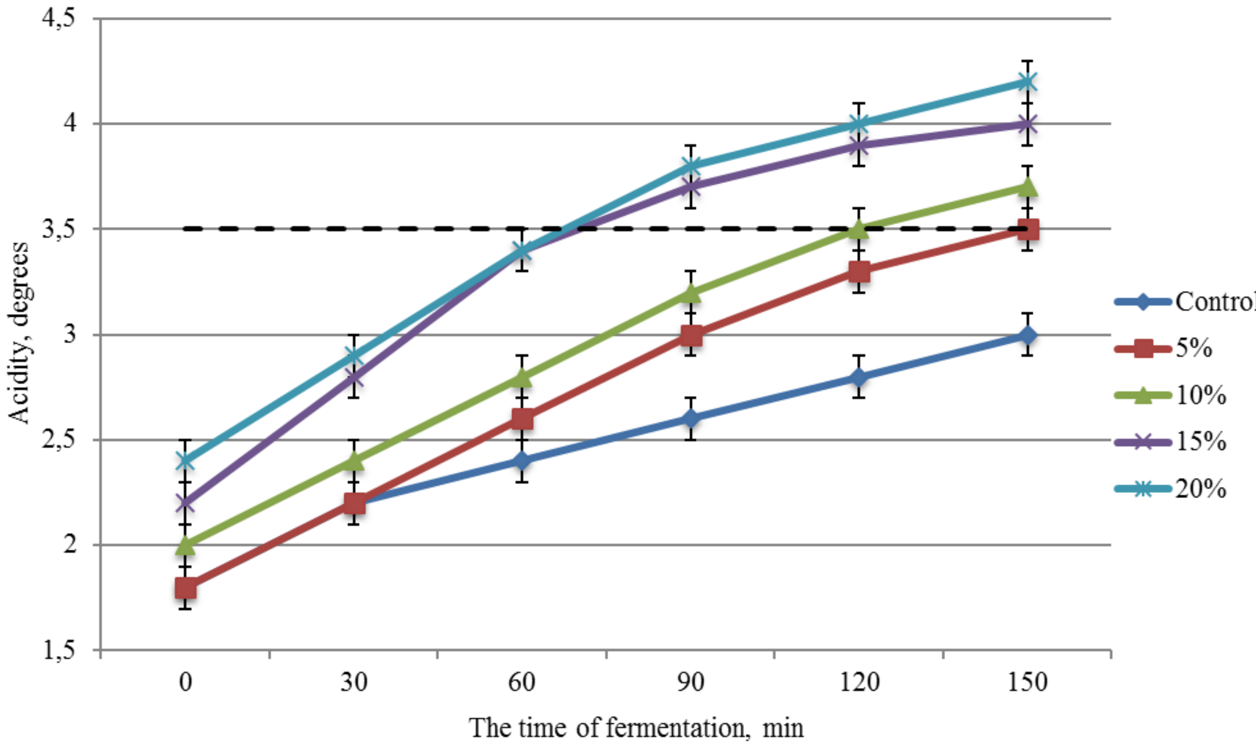

Figure 1 –Acid accumulation dynamics by dough semi-finished products

As can be seen from Fig. 1, the prototype with an additive concentration of 5% to the flour weight reached the standardized acidity during 150 minutes of fermentation, the sample with the concentration of 10% - for 120 minutes, the samples with concentrations of 15% and 20% during 70 minutes of fermentation approximately. At that, the control sample did not reach the normalized acidity during 150 minutes of fermentation.

Figure 2 presents the data on the increase of dough semi-finished product acidity. The increase of acidity in dough semi-finished products with the concentrations of complex additive of 5% and 10% to the flour mass was 1.7 degrees, in the samples of 15% and 20% - 1.8 degrees, the acidity increased by 42% in relation to the control sample and 50% respectively.

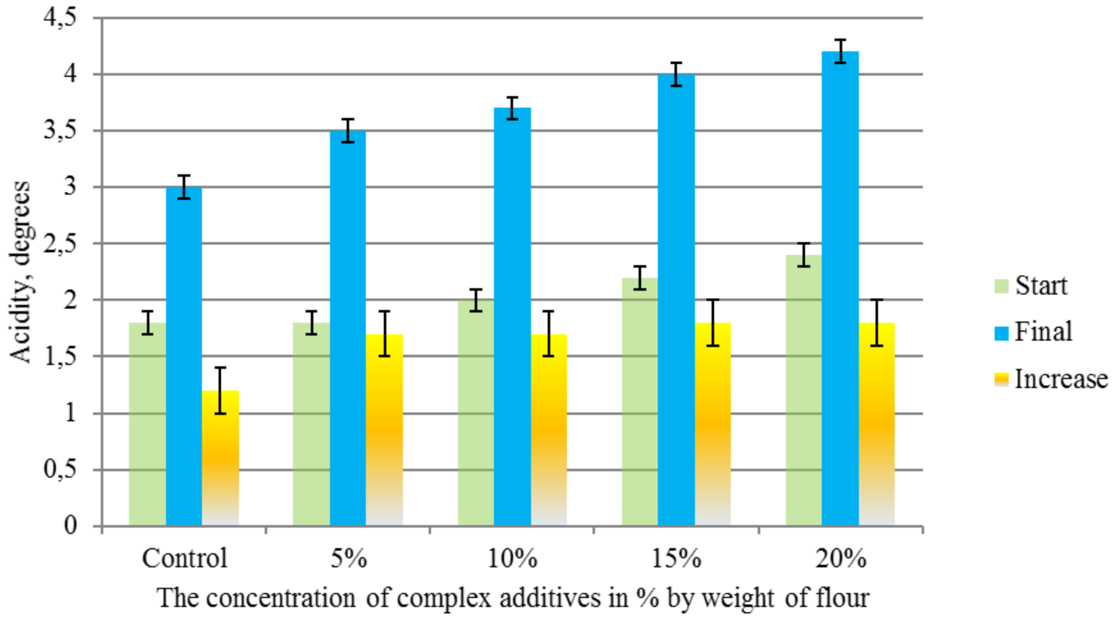

Figure 2 – Accumulation of acidity during 150 minutes of dough semi-finished product fermentation

Table 4 – Physical and chemical characteristics of the finished product

Indicator	Control	Concentration of complex additive to flour mass, %			
		5	10	15	20
Humidity, %	42,4±0,5	43,4±0,5	43,8±0,5	43,6±0,5	43,9±0,5
Porosity, %	71,3±1,0	71,4±1,0	71,3±1,0	69±1,0	67±1,0
Acidity, degree	2±0,1	2,2±0,1	2,3±0,1	2,3±0,1	2,4±0,1
Specific volume, cm³/g	2,9±0,1	2,8±0,1	3,2±0,1	3±0,1	2,8±0,1
Baking loss, %	10±0,5	10,2±0,5	9,3±0,5	8,7±0,5	9,3±0,5
Shrinkage in 4 hours, %	2,2±0,1	1,2±0,1	2,4±0,1	2,2±0,1	2,3±0,1

Table 4 shows the effect of a complex additive on the physicochemical parameters of finished bread. In prototypes, the moisture index increased from 2% to 4% due to the water-retaining agents contained in the complex additive. The greatest increase in the specific volume of the finished product (by 10% relative to the control sample) occurred when an additive was added at the concentration of 10% to the flour weight. Porosity decreased at the additive concentrations of 15% and 20% to the flour mass; At the additive concentration of 20%, the decrease in the specific volume of the finished product was observed relative to the control, due to the reduction of the amount of gluten in the test samples. The technological costs (baking and shrinkage) in the test samples were decreased with respect to the control - from 4% to 10%.

At an organoleptic evaluation of finished products, it was found that with the increase of the additive concentration, the color of the crumb darkened due to the dark color of the additive. The porosity was developed in all samples, a more developed porosity was observed in the sample with an additive concentration of 10% to the flour weight. A specific taste of cranberries was observed in the experimental samples. The highest score for organoleptic evaluation was obtained by the prototype with 10% concentration of complex additive to the flour weight.

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CONCLUSIONS:
1. It has been established that the preliminary activation of the pressed baking yeast in a nutrient medium containing a complex additive made it possible to increase the lifting power of the yeast by

54% with the ratio of nutrient medium components 2:10:10, and by 60% with the ratio of 2:15:15.
2. It was determined that the preparation of dough semi-finished products on activated yeast allowed to reduce the fermentation time at the additive concentration of 10% to the weight of flour for 30 minutes, at a concentration of 15% for 80 min as compared to control samples.
3. It was revealed that in the finished product the specific volume increased by 10% and technological costs decreased by 4% at the additive concentration of 10% to the flour weight. This sample has a more developed porosity as compared with other samples.

SUMMARY

Thus, the application of the studied complex additive at a concentration of 10% to the flour weight during the stage of the pressed baking yeast preactivation allows to increase the yeast fermentation activity, to intensify the fermentation process of the dough semi-finished product, to improve the physicochemical parameters of a finished product, and also to make the taste and the aroma more attractive, to increase the nutritional and biological value of bread.

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