Research of the enzyme preparation «Fungamyl Super BR» effect on technological properties of wheat flour of the first grade and the quality of bread

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Abstract. The influence of the «Fungamyl Super BR» (glucose oxidase and alpha-amylase, Aspergillus niger) on the of light wheat flour baking merits was determined. The using of «Fungamyl Super BR» promoted to the amplification of crumb vesiculation by 3.5%, and bread yield by 12.0% towards to the test specimen, due to the effect of alpha-amylase on the fermentation and impact of glucose oxidase on the gluten. Organoleptic performance of manufactured object obtained with «Fungamyl Super BR» differed from the test specimen with a brighter colour (higher amount of amino acids and reducing sugars in a dough). However, when the addition of 0.05% «Fungamyl Super BR» redounded to wetted hand feel soft part of bread, which can be explained with the derivation of dextrins entailed by alpha-amylase.

Wheat is certainly one of the accepted grain in baked goods manufacturing, although the treatment of rye is quite significant in some countries [1]. Other cereals are consumed rarer. Wheat flour is a very common in baked goods industry.

The implementation of white flour was carried out in order of enhancement the aesthetic grade of baked goods, has resulted to a sharp lowering in the its bioavailability.

Recently, consumers started showing an interest in consuming of wholesome food covering basic nutritional needs.

Exists a tendency to produce specialized functional bread with functional ingredients [2]. The long extraction causes the obtaining low grade flour [3], the closer its chemical ingredients to the initial source. In this connection, the search for ways to amend technological performances of wheat flour is a relevant point.

The working purpose was the investigation of the influence of glucose oxidase and alpha-amylase derived from Aspergillus niger on the performances of gluten and the baking merits of flour, on the intensity of the panary fermentation, and baked goods.

The objects of research were light wheat flour (manufacturer «Zernoproduct», Russia), pressed baker’s yeast, not subjected to genetic modification [4], dough and baked goods; «Fungamyl Super BR» produced by company «Novozymes» [5].
«Fungamyl Super BR» is a combination of glucose oxidase and alpha-amylase obtained from \textit{Aspergillus niger}. It allows to reveal the own native gluten flour, volumizes of bread, shortens the duration of the proofing, delays the firming of bread. The recommended «Fungamyl Super BR» amount is 0.025-0.05 ppm.

The performances of light wheat flour gluten were investigated. Handwashing of gluten promotes removing of waterthinnable substances, starch and bran. The gluten was weighed its sum was calculated relative to the initial dry souse. The essence of the usage of IDK device is to estimate the mutilation of a gluten sample weighing 4 g assisted with a tared load for 30 s. Deformation is characterized with the deformation index (gluten deformation meter index).

Flour acidity was counted using titration-based method with a 0.1 N NaOH solution with the availability of phenolphthalein until a faint rose-coloured shade does not disappear for 20-30 s; flour moisture - by drying a portion of flour at of 130°C for 45 minutes, weighing and calculating the amount of evaporated water, the drop number - by measuring the free fall time of the stirrer-rod in an gelatinized water-flour suspension. The whiteness of the subject of inquiry was estimated with photovoltaic device at a dominant wavelength of \( (540 \pm 10) \) nm in the wavelength range from 510 to 580 nm on a SKIB-M device.

The gas-forming ability of flour was determined using an Yago-Ostrovy device (figure 1) [6].

![Figure 1. The Yago-Ostrovy set for estimation of the emitted carbon dioxide volume.](image)

The dough (table 1) is place in a sealed vessel (1) immersed in a heated bath (2) \((t = 30 \, ^\circ C)\), gas outlet pipe (3), through which carbon formed dioxide is expelled. Gas through the tube enters the upper part of the second sealed vessel (4), filled with a saturated solution of NaCl, in which carbon dioxide does not dissolve. The second vessel contains a siphon tube (5), one end of which is lowered almost to its very bottom, and the second is brought out. The volume of the displaced saturated NaCl is measured (6) [5].

\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
Raw material & Raw material consumption, kg experiment & control \\
\hline
Light wheat flour & 100 & 100 \\
\hline
\end{tabular}
\caption{Unified wheat bread recipe.}
\end{table}
Pressed baker's yeast 1.5 1.5
Food grade salt 1.3 1.3
Enzyme preparation «Fungamyl Super BR» 0.025-0.05* -
Water by calculation by calculation

Kneading of the dough was carried out on a dough mixing machine U1-ETB during five min. The length of fermentation was three hours. The dough acidity changes were measured every hour of fermentation. The termination of fermentation was determined by an acidity value and changes in volume.

Dough pieces were placed in pre-greased forms with vegetable oil. They were placed in an oven during 40 min (35-40 °C) then baked at 200-220 °C (24-26 minutes). After 5 hours the properties of bread were determined [8].

To determine the porosity of the bread, samples (volume 27 cm³) were made with a Zhuravlev sample instrument, then the samples were pressed to obtain a non-porous mass, which was immersed in a graduated cylinder half filled with oil.

Porosity was calculated by the formula [7]:

$$P = \frac{(\sum V_1 - \sum V_2) \cdot 100 \%}{\sum V_1},$$

$\sum V_1$ – total volume of samples, cm³;
$\sum V_2$ – total volume of non-porous mass, cm³.

The breadcrumb volume was measured using Zhuravlev sample instrument (GOST 27669-88).

Flour, characterized by good baking qualities, gives bread of sufficient volume, the correct form, with a crust, normally colored and without cracks, with an elastic and dry to the touch crumb, well loosened and with fine, uniform and thin-walled grain of bread.

For wheat bread, an additional indicator of its quality is the color of the crumb: the lighter the crumb, then higher the customer value of bread. Bread should be tasty and flavorful. The quality of bread depends on the manufacturing method, and on the properties of flour [9].

In current article the physicochemical properties of light wheat flour produced by «Zernoproduct», which determine its baking characteristics were analyzed. The research results are presented in table 2.

Flour acidity is not standardized by GOST. Determining the acidity of flour, it is possible to identify signs of spoilage due to high amount of free fatty acids and phosphates [10].

The titratable acidity index of light wheat flour should be in the range of 3.2-3.8 degrees.

**Table 2.** Physico-chemical parameters of light wheat flour produced by «Zernoproduct».

| Parameter                                      | Light wheat flour | Standard Values a |
|-----------------------------------------------|-------------------|-------------------|
| Acidity, deg.                                 | 3.0               | -                 |
| Moisture, %                                   | 11.8±0.49         | ≤15               |
| Falling-number value, s                       | 297               | ≥200              |
| Gluten content, %                             | 33.04±3.00        | ≥30               |
| Gluten extensibility, cm                      | 12                | -                 |
| Gluten elasticity                             | good              | -                 |
| Gluten deformation index device (gluten       | 50.1              | 45-90             |
| deformation meter index).                     |                   |                   |
satisfactory strong

| Flour color | 38.9 | ≥36.0 |
|-------------|------|-------|

*GOST 26574-2017

The acidity of light wheat flour produced by «Zernoproduct» does not exceed these values, which indicates its good quality. Gluten content is important in determining the baking properties of wheat flour. Gluten is found only in the endosperm of wheat grain, which is used to produce graded flour. Bran is made from the shells of grain, the aleuron layer and the germ.

According to GOST 27839-2013, gluten obtained from light wheat flour produced by «Zernoproduct» can be referred to group II (satisfactory strong 33-52 units of gluten deformation meter index) [11].

Addition of the 0.05% enzyme preparation «Fungamyl Super BR» (ppm) led to the change in units of gluten deformation meter index (from 50.1 to 44.2 units).

Strengthening of gluten under the action of the enzyme preparation «Fungamyl Super BR» is explained by the presence of glucose oxidase in its composition, which catalyzes the oxidation of glucose to gluconic acid. The released hydrogen peroxide oxidizes the sulfhydryl groups of gluten proteins with the formation of disulfide bridges, which makes the gluten protein network stronger.

The study of the effect of the enzyme preparation «Fungamyl Super BR» on CO₂ emission in the dough was determined using Yago-Ostrovsky device.

The capacity of light wheat flour to produce CO₂ was studied without making an enzyme preparation, as well as with the introduction of the «Fungamyl Super BR» preparation (0.04%, 0.05%, 0.06% and 0.07% by flour weight). The results of the study are presented in figures 2 and 3.

Figure 2. Dynamics of CO₂ emission during dough fermentation.

Figure 2 shows that there is a cyclic process of CO₂ emission. In the study of samples with using of enzyme preparation a higher rate of carbon dioxide evolution was observed reaching 5 ml/min (in the samples without the use of the «Fungamyl Super BR», the CO₂ emission rate was 2 ml/min, after 120 minutes the fermentation ceased due to a decrease in the content of fermentable sugars). The use of the enzyme preparation contributed to a longer fermentation (more than 300 min), which leads to the formation of more fermentation products that increase the organoleptic characteristics of the finished product.

The addition of 0.05% and 0.06% «Fungamyl Super BR» (by weight of flour) boosts the rate and intensity of CO₂ formation (helps to accelerate the fermentation process through the more intensive hydrolysis of starch).
The effect of the enzyme preparation on the falling-number value of flour was determined (figure 4).

The method of determining the falling-number value characterizes the autolytic activity of flour, and mainly the activity of α-amylase. The low falling-number value in the dough during first part of baking promotes the hydrolysis of starch to dextrins and consequently leads to formation of a moist, soggy, clammy crumb. High falling-number value leads to low bread volume, slightly coloured crust, perishable product because of the poor amount of dextrins.

According to the presented results, the amylolytic enzymes be promotive of rapid and high-quality wheat flour starch hydrolysis to obtain high-grade product low amylolytic activity flour.

«Fungamyl Super BR» slows down staling of bread by inhibiting the retrograde of starch in the crumb [6]. The high activity of the enzyme preparation is shown by the lowering of the flour falling-number value (to 249 s) using 0.07% of the enzyme compared to the number of drops for light wheat flour without the addition of the enzyme preparation (297 s).
The next stage was determination of the «Fungamyl Super BR» influence on the intensity of the fermentation process of the dough and the quality indicators of the finished products. The objective of this stage of the work was to bake bread with different dosages of the enzyme preparation and study the physicochemical characteristics of the dough and the bread.

The increase in acidity of the test in the process of obtaining bread using glucose oxidase and alpha-amylase obtained from Aspergillus niger is shown in figure 5.

![Figure 5](image_url)

**Figure 5.** The effect of the drug «Fungamyl Super BR» on the change in titratable acidity of the dough during fermentation.

The increase in acidity of the dough was more pronounced in samples with the addition of an «Fungamyl Super BR», which demonstrates the stimulation fermentation by means of reducing substances formation. The fermentation duration can be shortened by 30-60 minutes, according to the enzyme load. The effect of the enzyme preparation «Fungamyl Super BR» addition on the physicochemical parameters of bread is presented in table 3.

**Table 3.** The effect of adding the enzyme preparation «Fungamyl Super BR» on the physicochemical parameters of wheat bread from light wheat flour.

| Parameter                          | The content of the enzyme preparation «Fungamyl Super BR»,% by weight of flour |
|-----------------------------------|--------------------------------------------------------------------------------|
| Grain of bread, %                 | 0   0.025 0.03 0.04 0.05                                                        |
| Breadcrumb moisture content, %    | 56.5 57.1 57.3 59.3 60.0                                                        |
| Breadcrumb acidity, deg.          | 39.1 40.2 40.4 39.3 38.1                                                        |
| Volumetric yield of bread, cm³    | 2.1 2.3 2.6 2.6 2.8                                                            |
| from 100 g of flour               | 280.8 284.6 288.7 291.4 292.8                                                  |

The porosity of bread is an indicator of the quality of bread. The porosity of bread is the ratio of grain of bread volume to the entire volume of the crumb (expressed in %). The grain of rye bread should not be less than 45%, wheat bread - 55%. Low grain of bread value reduces the digestibility of bread, as it is poorly saturated with digestive juices. The addition of the enzyme preparation «Fungamyl Super BR» contributed to an increase in the grain of bread relative to the control from 56.5% to 60% (table 3). The addition of the «Fungamyl Super BR» enzyme preparation at a concentration of 0.05% contributed to an increase in bread porosity by 3.5%, and a volumetric yield of bread by 12.0% relative to the control.

The organoleptic characteristics of baked bread are presented in figure 6.
The diagram shows that the introduction of amylolytic enzymes improves the organoleptic characteristics of the bread compared to the control sample. The crust of breads with the «Fungamyl Super BR» enzyme preparation was more brightly colored compared to the control sample, and the color intensity increased with increasing dosage of the enzyme preparation (because of the formation of ample quantity of reducing substances and amino acids turned into melanoidin at high temperatures). This is also evidenced by the fact that bread with the addition of an enzyme preparation had a more pronounced taste and aroma. Thus, the use of the enzyme preparation «Fungamyl Super BR» in the process of testing allows to reduce the fermentation process duration, increase the volume of bread, taste, flavor and color of the crust of the finished product.

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