

The Influence of Bioadditive Complex on the Rheological Properties of Macaroni Dough

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Abstract: It is known that pasta is a very common food product-well-deserved popularity due to their long-term storage, fast and simple cooking, rather high nutritional value and low cost. However, macaroni products contains the protein only up to 12.3%, what covers the physiological need of a person in them only by 13-15%. The biological value of macaroni products are increasing due to different kind of additives such as protein additives. As enrichers in pasta production are most often used egg products, even adding a maximum amount of enrichers there is a deficit of the most important essential amino acid as lysine. As a result there is a task of developing the assortment of enriched macaroni products using the various types of protein additives, including non-traditional types of raw materials. In connection with the above, it is very actually to carry out the study directed to the creation of a new macaroni products technology using the complex of bioadditives from plant and low-value fish raw materials. One of the rational ways to solve this problem is to develop an assortment of pasta using a complex of bioadditives from plant and low-value fish raw materials with increasing food and biological value. The researchers have developed the technology of macaroni products using a complex of bioadditives from plant and low-value fish raw materials applying the biotechnical and electro physical methods. The results shows that adding a complex of bioadditives the water absorption (corrected to 500 FU) is decreasing at 5, 10, 15 dosage, respectively at 1.18; 3.04; 3.37%, adding 20% of bioadditives complex is increasing upto 2.87% according to Farinograph. In this case of adding the complex of bioadditives 5 and 20% shows the high consistency of dough in comparison to control test. Adding the complex of bioadditives 5-20% is increasing in 0.8-2.8 times. It is noted that with the introduction of 5-20% of the complex of bioadditives into flour, the number of quality according to the Farinograph increases accordingly: in 2.8; 3.5; 2.3; 2.2 times, the degree of dough development increases by 1.4, respectively 1.9 times [FU] and when applying 10-15% of the complex of bioadditives is reduced by 1.4; 2.5 times [FU], the time for the dough development increases by 3.0, respectively 1.1; 0.6; 1.5 min. The researchers also studied the rheological properties of macaroni dough on an alveograph. The results of studies on the alveograph indicate that the addition of a complex of bioadditives in the amount of 5.0-20.0% in comparison with the control test increases the elasticity of the dough by 20.2-73.0% and its extensibility is reduced by 40-60% and the index of the alveograph with introduction of 5% of the complex of bioadditives is reduced by 28.03% and with the addition of 10-15 and 20% of the complex of bioadditives is increased by 5.9-25.1%, respectively. It was found that the best option is to apply 5% of the complex of a complex of bioadditives from the water body. Thus, knowing the effect of the complex of bioadditives on the physical properties of the dough can take a technological decision on intensive mixing, it is recommended to make a complex of bioadditives in an amount of 5% of the water body in order to ensure the functional properties of the product.

Key words: Complex of bioadditives, rheological properties of dough, macaroni, electrophysical method, biotechnological method, farinograph, alveograph

INTRODUCTION

One of the goals of the State Program for Health Development of the Republic of Kazakhstan "Salamatty Kazakhstan" for 2011-2015, approved by Presidential Decree No. 1113 of November 29, 2010 is to provide

healthy nutrition to the population and prevent diseases that are dependent on nutrition. Sustain: supporting, maintaining alive and continuing and description of the world at which human and natural systems can continue living alongside to distant future. Sustainability is a feature belonged to systems (Pivovarov, 1995;

Ghasemi, 2017). One of the main tasks is to ensure sustainable supply of the population with safe and healthy food products, the solution of which should contribute to an increase in the “share of production of mass consumption products enriched with vitamins, minerals” and other essential nutrients.

To the products of mass consumption are undoubtedly pasta which are the most common food products in the diet of consumers. In recent years in Kazakhstan there have been both quantitative and qualitative changes in the production of pasta. The average annual growth of pasta production in the republic for 2006-2011 was amounted 17%. The domestic macaroni consumption is growing at a fast pace, its growth over the last 3 years was 33% reaching 161.1 thousand tonnes at the end of 2011. The import of macaroni products has considerably grown and in 2011, it was 30.3%. In 2013, 19.8 thousand tons of pasta was produced which to the level of 2012 is 107%. That is why macaroni products are the most convenient object which can in the desired direction adjust the nutritional value of any diet.

In the market of pasta, the products of dietary and functional purposes, enriched pasta of increased nutritional value is occupying a small segment that does not exceed 1%. In connection with this fact, the development of macaroni products assortment of increased nutritional value with a purposefully changed chemical composition is topical.

Today, the following tasks face to the macaroni industry: increasing productivity, expanding the range of products and increasing its biological value (Davydova and Beshpalova, 2005). Thus, the development of bioadditives made by natural vegetable and low-value fish raw materials using physical and biotechnological methods for the production of macaroni products of increased nutritional and biological value is a great importance.

The researchers developed a complex of bioadditives from natural vegetable and low-value fish raw materials using physical and biotechnological methods for the pasta production.

As a vegetable raw material was took carrots, licorice root. As a low-value fish raw material-river perch. It is noted that carrots are one of the main vegetable crops in almost all countries of the world. The use of carrots is diverse. It is consumed fresh and cooked, widely used in cooking as a condiment to soups, side dishes, sauces and other dishes. In the canning industry it is used in the preparation of various preserves. Up to 10% of carrots are added as a necessary component in the souring of cabbage. Used in the vitamin industry to produce carotene.

Carrots are a valuable dietary product. Daily consumption of carrots are good for metabolism in the human body and its resistance to diseases. Raw carrots strengthen the gums, boiled is recommended for wheezing, coughing, tuberculosis.

Carrot juice is used as a healing remedy, it is a good remedy against anemia and hypertension. On an empty stomach carrot juice is drunk with constipation and hemorrhoids.

From seeds of carrots receive daukarin-a remedy used for the treatment of angina. Essential oil contained in carrot seeds is used in the production of liqueurs and perfumery and cosmetics industries.

Carrots are a multivitamin. The nutritional value of root crops is determined by the high content of carbohydrates, fats, proteins, the presence of organic acids, mineral salts and special taste qualities. This culture is called a pantry of vitamins. In the root vegetables of carrots contain water-soluble vitamins B1, B2, B6 and fat-soluble-E, D, K, essential oils, flavonoids. Water in carrots is contained 88.8%, nitrogenous substances-1.1%, fats-0.2%, carbohydrates-9.2%. Carrots also contain a small amount of iodine.

The special value of carrots is explained by the high content of provitamin A-carotene In the human body and animals, carotene is converted into retinol-vitamin A. The minimum daily dose of vitamin A for a person is 3300IU which corresponds to 1 mg of pure vitamin or 2 g of carotene. The Institute of Nutrition under Russian Academy of Medical Sciences recommends consuming 120-140 kg of vegetables per year, incl. 20 kg of carrots.

Carrots as a source of carotene are prescribed after a myocardial infarction. Carotene carrot is necessary for normal growth of children, good vision, it improves the condition of the skin and mucous membranes (Pivovarov, 1995).

Carrots contains polysaccharides. Polysaccharides play a significant role in the life of organisms and plants. They take part in immune processes, ensure the adhesion of cells in tissues and also are one of the main sources of energy for the body which is released during metabolism.

In the fruits of carrots are high content of beta-carotene, 9 mg in 100 g. Beta-carotene is a natural antioxidant, protects our body from premature aging. In addition, beta-carotene reduces the risk of cardiovascular disease and the appearance of cataracts in the eyes and most importantly, protects a person from the effects of free radicals that form in cells during intracellular respiration, when contaminated air or tobacco smoke enters the body. Hippocrates spoke of the need to apply the root of celery not only in nutritional but also medicinal

purposes. Noteworthy is the fact that initially this plant was not used for cooking; fragrant ornaments were made from celery. However, later it became clear what good celery root and other parts of it and the vegetable quickly gained respect in China, India, America and Russia. Not only salads and soups are prepared from root vegetables but also cosmetic and even medicinal products. The answer to the question of how useful the root of celery can give its composition:

- Essential oils
- Minerals-salts of calcium, phosphorus, magnesium and sodium
- Organic acids (acetic, oxalic and oily)
- Vitamins of group B, PP, A and C
- Hormones of plant origin

Root has a pronounced toning effect so it is often included as a major component in the composition of beverages. In addition, the root of the vegetable contains a lot of iron which allows you to use it for the prevention and treatment of anemia. The pounded celery root is a natural flavor enhancer which can become an excellent substitute for table salt.

Physicians believe that regularly eating the root of celery is necessary for every person. You can meet him on the shelves of modern supermarkets at any time of the year. Add a small amount of vegetable to your favorite dishes and you will learn from your own experience how useful the root of celery for health. List a number of its basic medical properties:

- Has a powerful anti-inflammatory and diuretic effect
- Reduces stomach pain and relieves inflammation in diseases of the gastrointestinal tract
- Eliminates the symptoms of allergic reactions, dermatitis and urticaria
- Helps to cope with fatigue-improves overall tone, improves sleep, relieves stress and neuroses
- Strengthens bones and joints
- Facilitates the condition with kidney and liver diseases

In addition, the root of celery excellently strengthens immunity and vision. With its regular use, the condition of the skin, hair and nails is significantly improved.

Perch, a predatory fish of the percid. Perch is a valuable commercial fish as well as a favorite object of hunting for fishing enthusiasts. The meat of the perch is tasty and nutritious. Due to composition and useful properties, the perch can compete with many other species of river fish.

Meat perch consists of protein, water, some amount of fat and ash. Also in the chemical composition of perch include vitamins and mineral elements B vitamins, vitamin D, tocopherol, retinol ascorbic and nicotinic acid. Of the mineral substances it is worth noting in the perch of sulfur, chlorine, iron, chromium, manganese nickel, copper, zinc and cobalt. Fish meat is also saturated with phosphorus, iodine and fluorine.

Perch is a dietary fish due to the fact that its meat with a high nutritional value and an abundance of useful elements is low-fat and not high-calorie. Calorie perch river-only 82 kcal per 100 g of product.

Regular consumption of perch in food can greatly enrich the diet. The perch contains almost all the vitamins and minerals that the body needs. In addition, meat has a wonderful taste. In the frozen form it is able to maintain its taste for a long time, what is especially important for trade and transportation.

In this regard, the new technology developed for macaroni products of increased food and biological value using a complex of bioadditives is timely and relevant.

MATERIALS AND METHODS

The object of research is pasta dough and dough with 5-20% of the complex of bioadditives addition from the water body. The base of "The Kazakh Research Institute of Processing and Food Industry", Ltd. and "Kazakh National Agrarian University" JSC are equipped with modern instruments for determining the rheological properties of macaroni dough with a complex of bioadditives. Experimental studies were carried out using the farinograph (Fig. 1) and rheograph (Fig. 2). Farinograph consists of two parts:

- Farinograph consisting of kneading with a water jacket, burette and means for recording a dough consistency farinogramm
- Thermostat for water circulation

Includes: Software on Russian-mixer stainless steel type 300N-T1 51EPitanie thermostat 230V, 50 Hz. Farinograph®-E for many decades it considered a worldwide reference tool for determining the quality of wheat flour.

It successfully measure the amount of moisture and dough parameters of wheat grinding (duration formation tests, its resistance, softening). In order to adapt such devices to the latest requirements relating to the determination of the quality parameters of the analysis and processing of data obtained during the research, an



Fig. 1: The Farinograph instrument

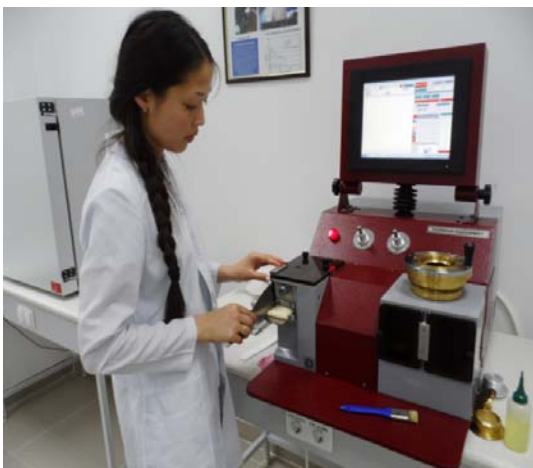


Fig. 2: The rheograph device

updated instrument made some technological innovations as well as a modern block parameters of analysis and generalization of the results.

Modern electronic measuring system ensures the exchange of data by USB. This makes it possible to ensure their automatic compilation and documentation using any of the Windows operating systems. New Farinograph[®]-E (Farinograph-E) can be used not only with conventional mixers 50 and 300 g and with devices for 10g. Thus, this device is suitable for use in analyzing the rheological properties in the presence of very small samples. To summarize the long-known parameter estimation quality factor Farinograph[®] it was developed a few years ago. It provides a quick and simple generalization farinogramm data. Measurements occur rapidly in time as with the standard methods for example,

during the analysis of the quality of flour from soft wheat varieties only a few minutes. After the analysis is printed generalized farinogramma. Summarize begins at the point where the curve on the chart from a maximum level deviates 30 FE (Farinograph[®]-units). The distance between this point and the beginning of the curve which is measured in millimeters is called Farinograph[®]-factor. This option displays information on parameters such as durability, softness and test valorimetric number.

Another quite important novelty-the possibility of modulating the number of revolutions of the mixer using the software that comes with the device. Due to this opportunity we can study the effect of different intensities of dough (the value of speed from 2-200 min⁻¹) during the use of one type of flour or check different batch programs. In the course of the studies conducted by the manufacturer, it was established that not every type of flour behaves as accustomed bakers.

That is why the kneading process was studied at speeds from 35-200 min⁻¹ with step changes in the rate of turnover of the mixer of 15-20 min⁻¹. Thus, a relatively high-quality meal during the study failed to find that the duration of the dough is reduced. Achieve this by increasing the number of revolutions from 35-63 min⁻¹ and a decrease in the duration of from 3.8-2.6 min (Fig. 1). When farinogramm shows the maximum values that exceed 500 FE and the number of revolutions >63 min⁻¹ the end of the length of dough is first shifted to a later point in time (6.8 min) and in the end of this process is reduced (1.7 min). In the analysis of poor quality flour is observed approximately what would be expected under these conditions (Fig. 2).

The duration of the test preparation was reduced to 2.8 min. under the turnover rate from 35 min⁻¹ to sustainable value 1 min. during kneading intensity increase to 200 min⁻¹. Thus, the use of different mixing speeds provided by the complex program so that it is possible to simulate the operation of devices, often used for the dough.

The following chart shows characteristic curves of flour dough and analysis of different quality. This allows to bakers creating a test preparation program with several options turnover values in accordance with their needs (e.g., 2 min slowly at 20 min⁻¹, then 6 min fast at 100 min⁻¹). In addition, you can enter a duration left standing the test which is used in various modes of extended of its receipt.

Another method that enables enhanced and optimized by studying the quality of data processing is thermostatic mixer. To carry out the analysis of flour quality according to current standards establish a

well-defined temperature. Achieve this due to the fact that distilled water which temperature is maintained thanks to the thermostat is pumped through the mixer with the two walls. On special request and for special applications is possible without any additional changes to set the temperature in the mixer at the right level. Due to this real change rheological characteristics as in traditional batch modes which are carried out at low temperature (for example, the formation of sheet dough) and dough in conditions under which requires considerably higher temperature than normally -30°C.

It should also be noted that the boundary defined in the standard ratings equal to 500 Farinograph®-units can be adapted to the optimum characteristics required production. If for example, test required consistency was found to be 350 FE, the software properly recalculate the corresponding parameter measuring curve. With the above farinograph with special measuring head can perform the following studies:

- Heat and cool the dough during kneading
- Determine water absorption of rye dough
- Establish consistency of sponge mass and hardness of the grains
- perform rheological measurements of other materials such as wholemeal flour, chocolate, cheese and dental porcelains gum

With the help of a special program determining the correlation device can compare up to 10 measuring curves. Terms of research and measurement results are compared in tabular form so that they are given the statistical evaluation. In the same way can be compared to corresponding curves and charts and file consolidated diagram.

Analysis: Stir the flour with the fixed blade speed for 1 min. Water was added from a burette into the right front corner Kneading for 25 sec while the conducting stylus on the blank line chart recording for 1 min.

Water is added in the required amount in which is possible to obtain the desired consistency, equal to 500 EF. When the dough is formed, his brushes with a spatula wall Kneading, adding all adhering to the walls of the particles to the total weight of the dough without stopping Kneading. If the dough is too strong consistency add some water to obtain the desired maximum consistency equal to 500 EF. Cease kneading Kneading and purified.

If necessary, make additional batch until receive two acceptable batch in which the time of water addition does not exceed 25 sec, the required consistency of the test is

in the range of 480-520 EF, the batch registration is continued for at least 12 min after the end of the time of dough formation if dilution started. Then, stop kneading and clean the dough kneader.

The alveograph measures the elastic-elastic properties of wheat flour. The analysis is based on kneading and subsequent deformation of the batter in the form of a ball under the influence of air pressure and recording all parameters of this dough deformation.

This technique best allows you to reproduce and measure the deformation of the dough by analogy with the processes occurring in the dough during fermentation under the influence of carbon dioxide. The device defines 4 key parameters:

- The parameter P denotes the elasticity of the dough that is ability to withstand deformation
- The parameter L denotes the maximum volume of air that the dough bubble can hold and indicates the extensibility of the dough
- The parameter, i.e., corresponds to the elasticity index
- The parameter W indicates the total energy of deformation or the so-called baking force of flour

The new AlveoPC uses software with a simple, modern and intuitive interface. It allows you to measure the elastic properties of wheat flour with constant moistening (50%). The device is designed for the following tasks:

- The choice, characterization and classification of wheat and flour relative to their future use
- Detection of wheat damage by insects, through the analysis of proteolytic activity
- Calculation and optimization of mixtures of wheat and flour, preparation of grinding batches
- The choice of the most suitable additives to improve the quality of the finished product
- Verification of the compliance of raw material quality with the declared specifications
- Analysis of the effect of salt content on the properties of the dough
- Analysis of the effect of gluten, protease or deactivated yeast on the elastic properties of the dough
- Measurement of elasticity, extensibility and baking force of flour in accordance with internationally recognized standards

Description and advantages of the device: Alveolab includes all the latest developments and >90 years of

experience of “CHOPIN Technologies” in the field of quality control of flour and dough. Use the generally accepted quality parameters (P, L, W, i.e.). Due to the automation of various stages of analysis and intuitive software, the test became even simpler and more accurate. Due to the automatic regulation of temperature and humidity in the deformation compartment of the dough, the results do not depend on environmental conditions and therefore have become more accurate. Alveolab allows you to increase the intensity of the analysis which maximizes the return on investment invested in the purchase of the device. With the help of special protocols, the equipment analyzes all types of wheat (soft, hard, durum) under optimal conditions that correspond to their use in industry. Measurement of drying ability, elasticity, elongation and baking force of flour, using internationally recognized standards. Measures elastic parameters of wheat and flour quality with constant or adapted moisture. Analyzes the properties and quality parameters of the dough during kneading. Allows to change test conditions, creating custom protocols. Automatically maintains the necessary temperature and humidity in the working environment.

The newest developments implemented on the new Alveograph: The new Alveograph Alveolab CHOPIN boasts some key innovations that allow the Alveographic test to become more accurate and easy to implement. Automatic pump calibration allows the operator to save time and ensure constant accuracy. Now during the kneading of the dough the water is added automatically and with high accuracy of dosing. The use of new accessories such as release plates with a release coating and a semi-automatic rounding knife, provide better preparation of test specimens. Placement and blowing of dough samples is now automated and carried out in a controlled temperature and humidity environment. The inverted bubble is more spherical and closer to the ideal dough conditions.

Another important innovation is the management software. It is simple, complete, intuitive and allows the user to get even more information from the alveographic test. Thus, new parameters are available such as the first derivative of the alveograph, the voltage/relaxation parameters and the consistency of the dough during the kneading process. A guide to the use of enhancers and correctors allows user to select the most appropriate additive to obtain the target alveographic values. In addition, the new function helps optimize the mixture of wheat and flour which is indispensable for the preparation of milling parties. It is possible to develop new test reports. For example, a change in the intensity and duration of batch makes the alveographic analysis even more informative in terms of predicting the properties of flour.

RESULTS AND DISCUSSION

Any cycle of mechanization and intensification of new technological processes of food processing goes to the stage of automation of process control systems. This requires careful research and monitoring of the rheological parameters of raw materials and finished products (Tahmassebpour, 2016).

It is known of using the additives from wheat, apple and potato fibers in an amount of 1-3% while studying on a pharynograph, the specific volume of laboratory tests for baking, hardness and sensory analysis has significantly decreased. It was noted that the enrichment of bread with additives from 1-3% increased the content of dietary fiber in bread with a slight negative effect on the quality of bread (Seyedhosseini *et al.*, 2016).

Romanian scientists developed bread with the addition of 5, 10 and 15% apricots and plums subjected to a series of rheological tests. The goal is to obtain some bread assortments with high nutritional value and improve their rheological properties by adding apricots and cream which successfully replace the strengthening apparatus for the dough and the aromas used in bakery. Young's modulus for bread, what contained various contents of plum and apricots was determined by compression tests. In addition, the effect of additives on cream and apricots on the viscoelastic characteristics of bread was studied with the help of relaxation tests (Tahmassebpour and Otaghvari, 2016).

The questions of the purpose of flour from wheat grain are considered depending on the degree of dispersion. Differences in the formation of grinding batches of grain are described in accordance with its structural and mechanical properties. Significant relationships between the hardness index of grain and the rheological properties of dough were revealed. The character of the bonds is determined, the regression equations are developed, what allow to predict the technological properties of grain by its hardness. The importance of the evaluation of structural and mechanical characteristics during the processing of wheat grain in industry is shown (Bakhitov and Fedotov, 2017).

Having considered the above literature, it can be said that there were no studies on the rheological properties of macaroni dough with the addition of a complement of bioadditives obtained from natural vegetable and low-value fish raw materials.

In connection with the above, it is topical to improve the quality of the rheological studies of the pasta on the Farinograph (Brabender) and the Alveograph since, even the smallest amount of water in the dough can have a significant effect on its structural and mechanical properties.

The physical properties of the dough are important during kneading, cutting and baking. The purpose was to

Table 1: Influence of the complex of bioadditives on the change in physical properties of macaroni dough according to the data of the Farinograph

Name of flour sample	Water absorption (%) (adjusted to 500 FU)	Water absorption (%) (adjusted to humidity 14%)	Stability (min)	Development time (min)	The degree of deviation (Tolerance index MTT), (FU)	Farinograph quality number
1	59.2	57.5	2.8	1.4	84	13
2	58.5	56.8	4.6	4.4	115	45
3	57.4	55.7	3.6	2.5	74	26
4	57.2	55.5	9.1	2.0	33	30
5	60.9	59.2	3.6	2.9	162	29

Table 2: Influence of the complex of bioadditives on the physical properties of the dough according to the data of the Chopin alveograph

Sample number	Deformation energy of dough (W, kJ)	Maximum overpressure (P, mm) of water. Art.	Average abscissa at break (L, mm)	Index of the shape of the curve (P/L) mm of water. Std/mm	Elongation, le (%)
1	239	89	61.8	1.44	64.2
2	172	107	37.1	3.68	58.5
3	253	124	46.6	2.86	58.1
4	255	162	35.3	5.57	54.8
5	299	243	25.1	10.42	-

study the rheological properties of macaroni dough with the addition of a bioadditive complex derived from natural plant and low-value fish raw materials using physical and biotechnological methods. In the experiment on the effect of the complex of bioadditives on the physical properties of the test, variants were added with the addition of a 5, 10, 15, 20% bioadditive complex based on the weight of the water. In studies, wheat flour of the first grade “Tsesna” was used:

- Sample 1: macaroni dough with the addition of a complex of bioadditives 5% of the mass of water
- Sample 2: macaroni dough with the addition of a complex of bioadditives 10% of the mass of water
- Sample 3: macaroni dough with the addition of a complex of bioadditives 15% of the mass of water
- Sample 4: macaroni dough with the addition of a complex of bioadditives 20% of the mass of water
- Control: pasta dough made from wheat flour of the first grade

The experimental data are shown in Table 1 and 2 shows the effect of the bioadditive complex on the physical properties of pasta on a Farinograph device. Table 2 shows the effect of the bioadditive complex on the physical properties of the test according to the data of the Chopin alveograph.

CONCLUSION

According to the results of the reading of the farinograph, the supplement is added, the water absorption value (corrected to 500 FU) decreases at a dosage of 5, 10, 15, respectively at: 1.18; 3.04; 3.37% and with the addition of 20% of the complex of bioadditives is increased by 2.87%.

In this case, a complex of bioadditives with the addition of 5 and 20% indicates a high stability of the dough in comparison with the control variant.

Stability (the dough stability time or the time between the first and second intersection points of the upper curve of the pharynogram with the line of consistency 500 FU) characterizes the stability of the flour to the batch. With increasing this indicator, it is necessary to increase the kneading time of the dough or its intensity. In this case with the addition of a bioadditive complex, 5-20% is increased by 0.8-2.8 times. Based on the stability data, it is necessary to increase the kneading time in the dough.

The flour quality index (quality number) can be used together or instead of the stability and degree of dilution. There is a high correlation of the quality index with the stability and degree of dilution [GOST R 51404-99] which is confirmed by the conducted experiments. The Farinograph quality number expresses the outline of the pharynogram with one meaning. Weak flour: softens early and quickly, low quality number. Strong flour: softens late and slowly, high quality number.

According to the data in Table 1, it is evident that a 5-20% complex of bioadditives is added to flour, the number of Farinograph quality increases, respectively at 2.8; 3.5; 2.3; 2.2 times. The data obtained may indicate that the addition of the bioadditive complex does not have a significant effect on the change in the physical properties of the flour.

The degree of dilution of the dough (the degree of deviation) is also an important characteristic of the quality of flour. Reduction of this indicator with the use of a complex of bioadditives testifies to the strengthening of the physical properties of the resulting semi-finished product which positively affects the quality characteristics of the finished products. Applying 5, 20% of the complex of bioadditives the degree of dilution of the dough increases by 1.4, respectively 1.9 times [FU]. Applying 10.15% of the complex of bioadditives is reduced by 1.4; 2.5 times [FU].

The time for the formation of the dough (development) is the time from the beginning of the addition of water to the point on the curve just before the first signs of a decrease in the consistency of the dough. Adding in an amount of 5, 10, 15, 20% of the complex of bioadditives, this value increases by 3.0, respectively 1.1; 0.6; 1.5 min. Increasing the time of dough formation leads to an increase in dough stability and a decrease in dough tolerance. A higher value of the dough dosing time results in a higher dough stability and no dilution of the dough.

As can be seen from Table 1, the best option is to apply 5% of the complex of bioadditives against the mass of water. According to the results of rheological studies, it is evident that using the bioadditive complex, the physical properties of the resulting semi-finished product are strengthened.

When studying the properties of pasta, it should be borne in mind that the qualitative characteristics of the test depend not only on the chemical composition of its components. In this regard, the properties of wheat pasta are constantly changing. In this case, the rheology of the dough was tested with the addition of the 5, 10, 15 bioadditive complex and 20% of the water weight, the dough was used as a control without addition of the bioadditive complex. Researchers studied the rheological properties of macaroni dough on an alveograph.

The physical properties of the dough with a complex of bioadditives, determined on the alveograph are given in Table 2. The results of studies on the alveograph indicate that the application of a complex of bioadditives in the amount of 5.0-20.0% with the replacement of water in comparison with the control increases the elasticity of the dough by 20.2-73.0% and its extensibility is reduced by 40-60% and the index of the alveograph with the addition of 5% of the complex of bioadditives is reduced by 28.03% and with the addition of 10.15 and 20% of the complex of the bioadditives is increased by 5.9-25.1%, respectively. The obtained data can be explained by a significant content of polysaccharides in additives that do not allow the formation of an elastic gluten-free skeleton which leads to a loss of elasticity of the dough and a reduction in the strength of the flour. The ratio P/L, characterizes the balance between the indicators of the physical properties of the dough is increasing. This is due to the fact that the elastic property of the dough is reduced at a lower rate than its extensibility.

From the data obtained, it can be seen that the addition of a complex of bioadditives leads to an increase in the elasticity of the dough with a slight decrease in its extensibility. In this case, the specific work of deformation increases (up to 172-255 kJ). The overall balance indicates

an improvement in the elastic properties of the dough. Thus, it can be concluded that the complex of bioadditives improves the structural and mechanical properties of the dough.

This can be explained by the significant content of lipids in the supplement, what did not allow the formation of an elastic gluten-free skeleton, what leads to a loss of ductility of the dough and a decrease in the strength of the flour. The ratio of elasticity to extensibility, what characterizes the balance between the indices of the physical properties of the dough, increases

significantly. This is due to the fact that the elastic property of the dough is reduced at a lower rate than its extensibility. Therefore, when kneading a dough with the addition of a vegetable additive, intensive mixing is necessary.

Thus, knowing the effect of the complex of bioadditives on the physical properties of the dough can take a technological decision on intensive mixing, during what it is recommended to make a complex of bioadditives in an amount of 5% in order to ensure the functional properties of the product.

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