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STUDY OF FOOD ADDITIVES ON BREAD QUALITY

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Abstract: This scientific work examined the effect of various food additives, including emulsifiers (mono- and diglycerides of fatty acids (E471), lecithin (E322), sodium stearoyl-2-lactylate (E481) and preservatives (potassium sorbate (E202), sodium propionate (E281), about the quality and shelf life of bakery products. The study was conducted at an enterprise in Gulistan (Uzbekistan) with the am of improving the organoleptic characteristics of products and extending their shelf life. To conduct the experiment, test batches of bread were made with the addition of the specified food additives in various combinations. An analysis was carried out of the influence of additives on indicators such as softness and elasticity of the crumb, porosity, moisture, and resistance to microbiological spoilage (yeast and mold). Microbiological analysis has shown that the addition of preservatives significantly reduces the number of colony-forming units (CFU) of yeast and mold in baked goods. In the control group, CFU levels reached 500 CFU/g by day 7, while in the combination group the levels were the lowest - only 50 CFU/g on day 7, which confirmed the effectiveness of the preservatives. It was also noted that the use of a combination of emulsifiers E471 and E481 leads to a significant improvement in bread texture, increase in volume and improvement in crumb porosity.

Keywords: Bakery products, sample, additive, aging, control, staling, improver, potassium sorbate.

Introduction. In recent years, much attention has been paid in the world to the enrichment of bread with various beneficial substances, giving it medicinal and preventive properties. The therapeutic and preventive effect of consuming dietary bakery products is ensured either by introducing the necessary additional components into the recipe, or by eliminating undesirable ones, as well as by changing the technology of their preparation.

Bread is one of the most consumed food products by the population. The introduction of components into its formulation that impart medicinal and preventive properties will make it possible to effectively solve the problem of prevention and treatment of various diseases associated with a deficiency of certain substances. The market for the production of domestic dietary products has great potential for growth. A significant number of various bakery products for therapeutic nutrition have been developed; There is a wide range of products for preventive nutrition, intended for

feeding people with a predisposition to certain diseases, as well as people living in environmentally unfavorable regions of the country, for workers in difficult professions, preschool children and the elderly. An analysis of the assortment policy of enterprises in the baking industry indicates that almost all enterprises produce products intended for preventive nutrition. These include: fortified bakery products, products made from dispersed grains, products with dietary supplements and iodized products. Products for medical nutrition are practically not produced in the country [1].

The production of bakery products for therapeutic and preventive nutrition in the context of economic regions of the country is characterized by great unevenness. The main share of the production of dietary bakery products falls on the Central Federal District (23%). The creation of technologies for dietary bakery products includes two areas:

- technology of bakery products with food ingredients in dosages from 3% to 20-30% of the total weight of flour - bran, various grain products, soy flour, etc.;

- technologies with micronutrients - vitamins, minerals and other substances. [2]

In the first direction, technologies are being developed that improve the quality of products, consumer properties (volume, porosity structure, etc.) as a result of reducing the negative impact of food ingredients (for example, bran), incompatible in their functional properties with the protein-carbohydrate components of flour, and also increase the microbiological purity of bread. For this purpose, the technologies mainly provide for semi-finished products in which biochemical transformations of food ingredients occur with a subsequent positive effect on the properties of the dough and the quality of the product [2].

This is how they are developed:

• technology of bread with soy flour using semi-finished products that swell and intensify colloidal processes in the soy mass; enzymatic with hydrolysis of protein substances; technologies based on minimal contact of soy proteins and wheat flour with the introduction of soy flour at the final stage of dough kneading;

• technology of bakery products with various grain products - bran, crushed wheat semolina, barley, oatmeal, corn flour by pre-fermenting them, in sourdoughs - lactic acid, propionic acid, which leads to a decrease in microbiological contamination, i.e.

preventing “potato” disease and molding, improving the quality of bread due to the breakdown of structural components into low molecular weight substances, increasing the probiotic properties of bakery products. In the second direction, technologies are being developed that increase the bioavailability of micronutrients or reduce their losses during the dough preparation process. So, developed:

• technologies that increase the digestibility of calcium in semi-finished products containing lactic acid (whey, lactic acid starter), ensuring the transition of indigestible calcium from edible chalk into calcium lactate involved in metabolism;

• technologies for the use of vitamins Bl, B2, PP, etc. by introducing them into semi-finished products of a certain composition, for example, containing whey, wheat

flour, vegetable oil, each of which plays a specific functional role, and reducing the loss of vitamins;

- to increase the bioavailability of iron, vitamin-containing products (wheat germ flour or flakes) or vitamin-mineral mixtures are introduced into the product formulation.

Thus, the studies reviewed demonstrate the relevance of using additives in the bakery industry to improve the properties of dough and finished products.

Methods. Considering the relevance of this topic, it is worth noting the work of Shahin Sadikhov, which notes that the Azerbaijani food industry has significant potential for export, especially if innovative approaches are introduced to improve the quality and safety of products[8].

The purpose of the work was to identify optimal combinations of these additives to improve the physicochemical characteristics of products, as well as to evaluate their impact on microbiological safety.

For each experiment, the dough was prepared according to a standard recipe, with the addition of appropriate ingredients. Control samples were prepared without food additives. For each sample, different food additives (emulsifiers and preservatives) were selected in a prescribed proportion. After kneading, the dough was fermented and baked under standard conditions in bakery ovens at 200°C for 30 minutes.

The products were evaluated according to several physical and chemical indicators, such as: crumb volume and porosity, softness and elasticity (in Newtons), humidity.

Tasting was carried out to assess the taste and consumer qualities of the products. A group of experts (bakers and enterprise specialists), consisting of 20 people, evaluated bakery products according to several criteria, such as taste, texture and aroma. Each criterion was assessed on a 10-point scale, where 10 is the maximum score. [1]

To assess the effectiveness of preservatives, microbiological analysis of bakery products was carried out. Samples were stored at 20°C for 7 days, after which microbial content (yeast and mold) was analyzed. For this purpose, the technique of inoculation on selective media was used, followed by counting the number of colony-forming units (CFU).

Results and discussion.

Microbiological analysis of baked goods was carried out to evaluate their microbiological purity and the effectiveness of preservatives in preventing the growth of microorganisms such as mold and yeast during storage.

Samples were taken on the 1st, 4th and 7th days of storage of the products. Each sample weighing approximately 10 g was taken from the central part of the product to exclude possible external contamination. Samples were crushed with a sterile knife and then placed in sterile containers. The samples were then diluted in sterile saline (0.85% NaCl) in a ratio of 1:10 (1 g of product per 9 ml of solution). The resulting suspensions were intensively mixed for 2 minutes to ensure uniform distribution of microorganisms. Selective nutrient media were used to evaluate the growth of microorganisms. From each diluted suspension, 0.1 ml was taken, after which the samples were applied to the surface

of agar in Petri dishes using surface inoculation. For each media type, 3 plates were used for each time point and experimental group. The inoculated Petri dishes were placed in an incubator at 25°C for mold and 30°C for yeast. Incubation time was 48 hours for yeast, 5–7 days for mold. [6]

After incubation, visual observations of the Petri dishes were made. Yeast and mold colonies were counted using the standard CFU (colony forming unit) counting method.

The amount of CFU was recalculated per sample weight and expressed in CFU /g product.

To study the shelf life, samples were stored at different temperature conditions (20°C and 5°C) for 7 days. Parameters such as moisture, texture and mold growth were monitored at regular intervals. [7]

In addition to organoleptic analysis, studies have been conducted on changes in the color characteristics of bakery products when using food additives. Color measurements were made using a spectrophotometer, where the parameters L* (lightness), a* (red/green tint) and b* (yellow/blue tint) were assessed. Products with added food additives showed a lighter shade (parameter L*) and more saturated red and yellow tones (parameters a* and b*, respectively). These changes were particularly pronounced in Product D, which used complex nutritional supplements (Table 4). From this we can conclude that such additives can have a positive effect on the appearance of the final product, which can also increase its consumer appeal.

Table 1. Color characteristics of bakery products

Parameter	Control	Sample 1	Sample 2	Sample 3
L*	65,2	68,5	66,8	70,1
a*	1,7	2,2	1,8	2,4
b*	15,3	16,8	16,2	17,1

Interesting results were also obtained in the context of the different types of flour used to create the products. The studies included both traditional wheat flour and alternatives such as rye and corn flour. The results showed that the addition of emulsifiers improved the texture of products made from all types of flour, but a particularly noticeable effect was observed when using rye flour, which is denser and tends to form a denser texture without additives.With the addition of emulsifiers, rye products became softer and airier, which made it possible to obtain a product similar in its characteristics to products based on wheat flour. [3].

Also, as part of the work, it was important to determine exactly how long the products would remain fresh. When establishing the shelf life of the samples, the important steps were to record the onset of staling of the products (assessing changes in texture and decrease in softness), as well as to record the appearance of mold (both visually and using microbiological analysis). In the control group, the products began to

go stale on the 3rd day, while in the group with potassium sorbate the shelf life was 5 days, and with sodium propionate - 6 days. In the combination group, the products remained fresh for 7 days. The moisture content of products with preservatives was maintained significantly better than in the control group, with maximum values in the combined group - 36% on the 7th day (Table 2).

Table 2. The influence of preservatives on the shelf life and moisture content of bakery products

Indicator	Control	Additive potassium sorbate (E202)	Additive sodium propionate (E281)	General group
Staling (days)	3	5	6	7
Humidity change on day 3 (%)	31	37	36	38
Humidity change on day 7 (%)	24	33	34	35

For yeast, colonies had a smooth, shiny surface, with different colors depending on the strain.

For mold, the colonies were rough and often had a branched structure, characteristic of mold fungi.

Microbiological results allowed us to evaluate the extent of microbial growth depending on the type of preservative added. [4] Quantitative data on the number of CFU /g were collected for each time interval (1st, 4th and 7th days). After this, a comparative analysis was carried out for each group. In the control group, the growth of microorganisms was significantly higher than in the groups with preservatives, especially by the 7th day. Sodium propionate and potassium sorbate were effective in inhibiting the growth of mold and yeast, especially in the combination group, which showed minimal amounts of CFU /g by day 7 (Table 3). The addition of preservatives significantly reduced the number of colony forming units (CFU) of yeast and mold in baked goods. The lowest level was in the combination group - only 50 CFU/g on day 7, which confirmed the effectiveness of the preservatives. [9]

Table 3. Bakery products with microbiological analysis

Indicator	Control	Additive potassium sorbate (E202)	Additive sodium propionate (E281)	General group
Number of CFU/g (on the 4th day)	280	110	90	70
Number of CFU/g (on the 7th day)	490	190	140	45

The use of emulsifiers led to an improvement in the textural characteristics of the dough, which, in turn, reduced the loss of raw materials during the kneading and baking process. This made it possible to optimize production costs, increasing the yield of finished products. It was also noted that the addition of preservatives reduced the amount of product returned due to premature spoilage. Extending the shelf life of products through the use of preservatives made it possible to reduce losses from the write-off of unsold products. The longer shelf life also expanded the ability to distribute products to remote regions, which increased overall sales. [6] The analysis process took into account data on product returns and their reduction after the introduction of additives. In parallel with production indicators, the impact of new product characteristics on consumer demand was assessed. A longer shelf life and improved organoleptic properties of bread led to increased customer loyalty and, as a result, an increase in sales volumes. These data were taken into account when calculating the increase in enterprise income.

Conclusion. The addition of preservatives such as potassium sorbate (E202) and sodium propionate (E281) has significantly increased the shelf life of baked goods. These preservatives effectively inhibited the growth of molds and yeasts, preventing microbiological spoilage of products during 7-10 days of storage under controlled conditions. This is especially important for baked goods with a long shelf life, produced in conditions of high humidity or temperature fluctuations. The inclusion of these preservatives ensured stable product quality, minimizing the risks of mold and unwanted enzymatic processes.

The third important aspect of the study was the combined use of emulsifiers and preservatives, which led to a synergistic effect. Products containing both groups of additives demonstrated not only improved textural properties, but also a significantly extended shelf life while maintaining microbiological safety. This allows us to recommend the combined use of food additives to improve the quality of bakery products on an industrial scale.

In addition, the analysis showed that an important factor in achieving positive results was precise adherence to dosages and technological production parameters. Changing the proportions of additives could have either a positive or negative effect on product characteristics, which confirms the need to carefully control the technological process at each stage. For example, excessive addition of preservatives could affect the organoleptic properties of products, and insufficient amounts of emulsifiers could lead to deterioration in texture and rapid staleness.

Significant differences in the microbiological stability of products were also identified depending on climatic storage conditions. Humidity- and temperature-controlled chambers have proven to be the most effective at extending product shelf life, highlighting the importance of creating optimal storage conditions for baked goods, especially in regions with high humidity levels and temperature fluctuations.

References

1. Амориелло, Тициана, Франческо Меллара, Винченцо Галли, Моника Амориелло и Роберто Чиккоритти. 2020. «Технологические свойства и приемлемость для потребителей хлебобулочных изделий, обогащенных пивной дробиной» Foods 9, № 10: 1492.

2. Anashwar Valsalan, Filiz Koksel, Christina M. Rosell, Maneka Malalgoda. 2023. Ingredient technologies and process modifications to increase the use of ancient grains in baking. Food Reviews International. 1-20.

3. Antonio V. Herrera-Herrera, Javier Gonzalez-Salamo, Barbara Socas-Rodriguez, Javier Hernandez-Borges. 2019. Chapter 5 - Organophosphate Pesticides (OPPs) in Bread and Flour. Flour and bread and their promotion in health and disease prevention (second edition). Academic Press, pages 53-70.

4. Ardoin R, Smith B, Bean S, Aramouni F. 2023. Optimization of sorghum bran tannin addition to gluten-free bread. J Food Sci. 88(3):952-961.

5. Bayramov, Eldaniz & Omarov, Yashar & Nabiyev, Ahad. 2024. Study of the influence of persimmon syrup on bread quality parameters.

6. Dankwa, Rita, Heikki Aisala, Eugenie Kayitesi, and Henriette L. de Kock. 2021. Sensory profiles of sorghum, cassava and cowpea flour tortillas,

используемых в качестве альтернативы пшеничной муке. Продукты питания. 10. № 12: 3095.

7. Els Debonne, Gabriele Giannotti, Celeste Verbeke, Mia Eeckhout, Frank Devlieger. 2023. Growth/no-growth models of propionic and sorbic acids for bakery and cake pans. Food control. Volume 152. 109872.

8. Sadikhov, Shahin. 2024. Development potential and prospects of the food industry of Azerbaijan. Economics, management and sustainable development. 9. 6-20

9. Turabekova, D. (2024). Analysis of the spread of microbiological diseases on grape plants in the syrdarya region. *Universal xalqaro ilmiy jurnal*, *1*(7), 21-27.

10. Tukhtamisheva, G. K., Sattarov, K. K., & Nuriddinov, B. R. (2023, June). Post-harvest processing of wheat grain. In American Institute of Physics Conference Series (Vol. 2789, No. 1, p. 030009).

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