

Applications Of Natural Additives - AcidimENTS And Probiotic Bacterial Preparations For Prevention Of Rye Bread Cretal Disease

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Abstract

In solving the problem of preventing bread diseases, research on the use of biotechnology achievements and natural additives from plant raw materials, including secondary ones, is becoming increasingly important. The article presents a way to solve this serious problem of the baking industry on the example of the cretaceous disease of rye bread. For the prevention of this disease, the authors used non-traditional raw materials, namely, tomato pomace powder, and pharmaceutical probiotic bacterial preparations from *Lactobacillus fermentum* strain No. 231 and *Bifidobacterium bifidum* strains No. 1, 791. The purpose of the study was to develop a technology for the production of rye bread varieties using natural additives - acidifiers and probiotic bacterial preparations for the prevention of cretaceous disease. The objects of the study were the product of processing tomato pomace (powder) and probiotic biologically active additives (hereinafter dietary supplements) to food "Lactonorm-H" (O'z DSt ISO 9001:2015) and "Bifidonorm-H" (O'z DSt ISO 9001:2015) produced by LLC "Sog'lomlik nektari" of the Republic of Uzbekistan, bread from rye flour. The experimental part of the work was carried out in the laboratories of the Department of Food Technology of the Bukhara Institute of Engineering and Technology. The dependence of the effect of tomato pomace powder and pharmacological preparations of freeze-dried lactic acid bacteria on the biotechnological properties of the dough and the quality of the finished product, the likelihood of the development of cretaceous disease during its storage is described. The work used traditional methods for laboratories of food production enterprises to study the properties of raw materials, semi-finished products and finished products. The effectiveness of the use of these additives for the prevention of microbial infection of bread is substantiated.

Keywords: rye bread, quality, chalk disease, prevention, tomato pomace powder; lactobacilli, bifidobacteria.

INTRODUCTION

Bread and bakery products are in consistently high demand among the population and are a staple food, especially for socially disadvantaged segments of the population. However, manufacturers of this type of product face problems such as bread defects caused by the quality of flour, or violations of technological requirements of production. Knowing the scientific foundations of the technological

process of preparing this product, it is possible to predict with sufficient reliability the dependence of deviations in the quality of flour or the technological process on its quality. In addition, defective bread can be processed at enterprises into crumbs or lobes and reused, for example, for the preparation of breadcrumbs.

Much more serious problems arise for producers of bread and bakery products with the disease of the latter. The most common are potato disease of bread and mold. There are also such diseases as chalky, "drunk" bread, fusarios ("plant AIDS"), pigmented spots [1, pp.348-356; 2, pp.205-211].

It should be particularly noted that all types of diseases make bread unfit for consumption, and, depending on the type and degree of infection, for further processing. As a result, manufacturers of these products suffer significant losses, and consumers do not get such an important product in the diet.

Consequently, research on the development of the most effective, less costly and time-consuming ways to prevent bread diseases, especially through the use of natural raw materials and bio-preservatives, is still relevant.

This problem is especially relevant for regions with a hot climate, in particular for Uzbekistan, since when storing bread in a package at elevated temperatures, a "greenhouse effect" is created, which contributes to the intensive development of pathogens.

MATERIALS AND METHODS

The aim of the study was to develop a technology for the production of rye bread varieties using natural additives - acidifiers and probiotic bacterial preparations for the prevention of Cretaceous disease.

The objective of the study was to determine the possibility of using natural acidifying additives and pharmacological preparations of freeze-dried lactic acid bacteria in the technology of rye bread preparation to improve the quality and prevent their disease during storage and sale.

The objects of the study were the product of processing tomato pomace (powder) and probiotic biologically active additives (hereinafter dietary supplements) to food "Lactonorm-H" (O'z DSt ISO 9001:2015) and "Bifidonorm-H" (O'z DSt ISO 9001:2015) produced by LLC "Sog'lomlik nektari" of the Republic of Uzbekistan, bread from rye flour.

The experimental part of the work was carried out in the laboratories of the Department of Food Technology of the Bukhara Institute of Engineering and Technology.

In order to study the effect of the studied additives on the development of cretaceous bread disease, flour was infected with pure cultures of yeast-like fungi of the species *Endomyces fibuliger* and *Hyphopichia burtonii*.

Bread was prepared on a thick leaven (prototype) was prepared from rye flour according to the traditional recipe and technology (prototype) in accordance with the methodological recommendations described in the manuals [2, pp.277-279; 3]. Experimental samples of starter cultures

were prepared using a powder of tomato pomace and dry probiotic bacterial preparations.

The recipe and modes of preparation of sourdough and dough are presented in Tables 1, 2.

Table 1. Recipe and modes of preparation of thick rye sourdough dough without additives (prototype)

Raw materials, semi-finished products and process parameters	Raw material consumption, kg	
	Sourdough	Dough
Sourdough	19,00	57,00
Peeled rye flour, including in sourdough for dough	22,00	67,00
	-	33,00
-Pressed yeast	0,10	-
Table salt, food	-	1,50
Water	16,00	By calculation
Temperature, oS	25-28	28-30
Duration, h	3-4	1,5-2,0
Humidity, %	48-50	$W_{xn} \pm 0,5-0,1$
Final acidity, deg	12-14	9-13
Lifting force, min	18-25	15-18

Table 2. Recipe and modes of preparation of thick rye sourdough dough with additives (experience)

Raw materials, semi-finished products and process parameters	Raw material consumption by variants, kg	
	Sourdough h	Dough
Sourdough	-	57,00
Rye flour, including in sourdough for dough	28,00	67,00
	-	28,00
Table salt, food	-	1,50
Table salt, food	23,00	By calculation
Water	5,00	-

Tomato powder	0,0025	-
Activated lacto- and bifidobacteria	25-28	28-30
Temperature, oS	48-50	50±0,5
Final acidity, deg	12-14	9-13

The quality of bread was analyzed by physico-chemical and organoleptic parameters [4]. The reliability of the data obtained is also confirmed by the multiplicity of experiments.

DISCUSSION

Quite a few works have been devoted to the study of the chalk disease (chalk mold) of bread and its pathogens. It is considered harmless to human health, but the bread affected by it loses its presentation and acquires an unpleasant taste.

It is noted that the cretaceous disease of bread is caused by yeast-like fungi of the following species: *Endomyces fibuliger* (synonym of *Endomicopsis fibuliger*), *Endomyces chodatii*, *Hyphopichia burtonii* (synonyms: *Trichosporon variabile*, *Monilia variabilis* and *Candida variabilis*) and *Chrysosporium sitophila*. All these fungi belong to the spore-forming ascomycetes. Species of the genus *Endomyces*, as well as *Hyphopichia burtonii*, form low white colonies consisting of a mixture of unpainted hyphae bearing yeast-like conidia on short outgrowths. Their spores are resistant to high temperatures and do not die during baking [1, p.356; 2, p.211; 5, p.166; 6, p.66-67; 7].

A typical source of the causative agents of the cretaceous disease of bread is flour, however, yeast widely used in the production of bread can also cause chalk plaque. Abroad, bread affected by yeast-like fungi is called "lime".

In practice, quite often, when studying the scraping of chalk disease from the surface of bread, it was found that this disease can be caused not only by ascomycetes, but also by asporogenic types of anamorphic (imperfect) yeast.

There are various methods of microbial decontamination of bread: technological (reduction of the mass and temperature of bread storage, disinfection), biological (starter cultures: propionic acid, complex, acidophilic) and physical (irradiation).

Technological measures consist mainly in maintaining maximum cleanliness in industrial premises, combating air dust and having good ventilation, especially in the grain storage. Equipment and inventory should be periodically disinfected. For this purpose, the bactericidal effect of ultraviolet irradiation can also be used separately and in combination with treatment with a 1.0% hydrochloric acid solution. These measures will be effective mainly in case of repeated contamination of bread and only if they are carried out in commercial enterprises selling bread products [1, p.351,354; 2, p.205-211]. But they are practically not effective for the prevention of bread diseases caused by microbial infection of

raw materials, that is, primary contamination.

Biological methods are more effective ways to prevent spoilage of bread, in particular, the use of starter cultures with directed cultivation of microorganisms with antimicrobial properties in them. [1, p.352; 8, p.10-14; 9, p.12-13].

The presence of propionic and formic acids synthesized by the *Propionibacterium freundenreichii* ssp strain in propionic acid starter culture. *Shermanii* BKM-103, has the maximum inhibitory effect on the development of spore bacteria by suppressing flavin enzymes of the respiratory cycle. In addition, this culture accumulates significant amounts of vitamin B12 during metabolism, which is involved in the process of hematopoiesis, prevents the development of microbiological infection in bread, increases the vitamin value of bread [9, pp.12-13].

The basis of the complex starter culture consists of museum strains of three types of lactic acid bacteria *L.casei* - C1, *L.brevis* - B78, *L.fermenti* - 34, propionic acid bacteria *Propionibacterium freundenreichii* ssp. *Shermanii* BKM-103 and yeast *S.cerevisiae*. Complex starter culture has antibiotic activity to spore-bearing bacteria and molds, it is recommended to use it to improve the quality of flour products with weak gluten, with an accelerated method of dough science, as well as in the technologies of products with wheat bran [10, pp.103-104].

Acidophilic starter culture consists of bacteria *L.asidophilus*-146 and yeast strain "Ryazan-17" adapted to high temperatures (40 ... 450C) based on the Ryazan race. A high level of amino acids was found in the starter culture: lysine content is 1585 mg/100 g, leucine - 1275 mg/100 g, valine - 510 mg/100 g [10, pp.104-105].

It is the biological methods of microbial decontamination that have a huge technological potential not only for preventing the most dangerous types of spoilage of bread, such as potato disease, but also as natural additives that improve the quality of bread with intensive methods of its preparation.

Currently, bifidobacteria synthesizing lactic and acetic acids, a number of organic carboxylic acids (succinic, pyruvic), specific antibiotic and other substances with antioxidant activity are widely used in the production of food products for therapeutic and prophylactic purposes. So, Kuznetsova L.I. et al. [11, pp.33-34; 12, pp.395-398] in the production of starter cultures, a strain of *Bifidobacterium bifidum*-2 isolated from the industrial preparation "Bifidobacterin" was used.

The attention of producers of bread and bakery products is increasingly attracted by medicinal and spicy-aromatic plants due to the unique chemical composition, high biological activity, immunomodulatory, antioxidant, antimicrobial properties, which can also manifest themselves in bakery products. The presence in medicinal and spicy-aromatic plants of compounds with bactericidal properties in relation to pathogenic microflora, the resistance of the fermentation microflora to them makes it promising to use this raw material and its processed products (phytodubments) to develop ways to stabilize the biotechnological properties of wheat starter cultures, liquid yeast, sourdough, wheat dough, as well as as a means of preventing microbiological spoilage of finished products. [13, pp.14-16; 14, pp.74-

76].

Herbal supplements from the following raw materials are promising: cones of ordinary hops, mountain ash and common, blood-red hawthorn, common barberry, dioecious nettle, St. John's wort, medicinal sage, etc. The use of these herbal supplements will slow down the microbiological spoilage of products [15, p.127; 16, p.101-107].

It should be noted that, despite the proven effectiveness of the use of biological and physical methods of preventing bread diseases, they have not found proper application, especially at low-capacity enterprises in remote areas from the center. There are certain problems in acquiring these starter cultures or breeding them in production, and special expensive equipment is needed for irradiating raw materials. Therefore, it is advisable to develop using local raw materials and available pharmacological preparations. It was in this direction that the research was conducted

RESULTS

To suppress the cretaceous disease, samples of bread made from rye floured flour, prepared using a thick rye sourdough, without additives (prototype) and with the additives under study (experiment), were examined.

After baking, the samples were cooled for 5 hours, then placed in plastic bags and stored at room conditions. The condition of the crust and crumb was checked every 12 hours. The results of the study are presented in Tables 3-6.

To obtain the powder, fresh tomato pomace was dried in a Hohenheim solar dryer (Germany) to a humidity of $9.0 \pm 1.0\%$. Then they were crushed (dispersed) in a laboratory micro-mill LZM-1 (the exit from the sieve No. 27 is not more than 2.0%, the passage of the sieve No. 38 is not less than 60.0%).

Table 3. Quality indicators of tomato pomace powder

Indicator	The value of sample indicators
Appearance and consistency	Finely dispersed homogeneous powder by weight
Colour	Red, uniform in weight, close to the color of the raw material
Taste and smell	Characteristic of mature tomatoes, slightly sour, without foreign tastes and odors
Humidity, %	7.0 ± 0.2
Acidity in terms of citric acid, in % per SV	9.8 ± 0.2

According to the results of the organoleptic and physicochemical analysis of the additives under study, the obtained values were found to comply with the requirements of TU 10.61.23-843-37676459-2018 and GOST 3343-2017.

Investigated the microbiological parameters of the powder from tomato pomace (table. 4).

Table 4. Microbiological parameters of tomato pomace powder

Indicators	The value of indicators		
	byND*, no more	Requirements TR TS 021/2011	Powde r
QMAFAnM, CFU / g, no more	1×10 ⁴	5×10 ³	2,3×10 ²
BGKP (coliforms), in 1 g	N / additional.**	N / add. (up to 1 g of product)	Not found
Salmonella in 25 g	N / additional.	N / add. (up to 25 g of product)	Not found
Mold, CFU / g, no more	1×10 ²	5×10 ³	0,1×10 ²

* ND - regulatory document - SanPiN 03366-19 (6.1.1. Vegetables and potatoes fresh, frozen and processed products); ** N / additional - not allowed

The data obtained indicate that the quality of the investigated mulberry fruits meets the requirements of GOST 976513-2020, sugar beet root crops - GOST 33884-2016, SanPiN No. 0366-19 of the Republic of Uzbekistan, TR TS 021/2011.

The investigated dietary supplement "Lactonorm-N" is a dry powder from the microbial mass of living antagonistically active microorganisms - lactobacillus *Laktobacillus fermentum* No. 231, obtained by lyophilization, whitish or beige in color. One dose of the drug contains at least 10 × 10⁶ live lyophilized lactobacilli. The optimum temperature for growth is 35-40 ° C, pH 5.0-6.0 [17; 18, p. 221-223].

Laktobacillus fermentum - heterofermentative bacteria (ICD VI group), along with lactic acid, form acetic, formic and other volatile acids, alcohol and carbon dioxide, improve the taste and aroma of products. Bacteria of this group were found in 19.9% of starter cultures, and in 44.4% - they are presented in approximately the same quantities with homofermentative LABs [16, p.197; 96, p.62]. Varying in size, mostly short rods measuring 0.5-1.0 × 3.0-15.0 microns [19, p. 248].

The investigated dietary supplement "Bifidonorm-N" is a microbial mass of live, antagonistically active bifidobacteria strains *Bifidobacterium bifidum* No. 1, 791, lyophilized in a cultivation medium with the addition of a protective sucrose-gelato-milk medium; crystalline or porous mass with possible stratification of biomass in the upper part, beige or whitish in color, with a specific odor. One dose of the drug contains at least 10 × 10⁶ live lyophilized bifidobacteria. The optimum temperature for growth is 35-40 ° C, pH 6.0-7.0 [20, p.100-109; 21, pp.76-79].

Strain *Bifidobacterium bifidum* No. 1, 791 was obtained by selection of strain *B. bifidum* 791. The strain is more resistant to damaging factors of cultivation media and aggressive media of the human gastrointestinal tract, ensures the utilization of a wider range of amino acids, that is, it has a

higher viability and colonizing properties, which provides obtaining drugs and products based on it with longer shelf life and higher therapeutic and prophylactic properties [22-28].

As the studies have shown, the addition of the investigated additives contributed to the improvement of the biotechnological properties of the starter cultures. Thus, an increase in the rate of consumption of amine nitrogen and reducing sugars in experimental samples indicates an intensification of the accumulation of bacterial and yeast microflora due to the enrichment of the substrate with powder nutrients.

The dough was kneaded on ready-made sourdoughs. Quality indicators of dough and bread are presented in table 5.

Table 5. Influence of tomato pomace powder and bacterial preparations on dough properties and bread quality

The name of indicators	Indicators of the quality of the dough prepared by options	
	control	an experience
Dough		
Humidity, %	49,00	50,00
Acidity, hail:		
initial	6,40	6,50
the ultimate	11,00	11,40
pH	4,80	4,72
Gas-generating capacity, cm ³ CO ₂ / 100 g for 1 hour	78	84
Хлеб		
Humidity, %	48,80	49,60
Acidity, hail	9,00	9,43
Porosity, %	60,40	64,20
Specific volume, cm ³ / g	1,68	1,72
Form stability (H:D)	0,42	0,45
Volatile acid content,% of total acidity	6,72	7,20
Alcohol content,% dry matter	0,54	0,58

From the data in Table 5 it follows that the intensity of acid accumulation both in the control and in the experimental variants proceeded with practically the same intensity. At the same time, the rate of gas formation in the dough had certain regular differences. So, in the experimental version, the volume of carbon dioxide released for 1 hour of maturation (fermentation) of the dough is 7.7% more than the control value, which is quite natural.[29-33]

The influence of the investigated additives and methods of their use in the preparation of thick starter cultures on the quality of bread from peeled rye flour was judged by the results of laboratory baking. The finished product was analyzed 14 ... 16 hours after baking.

The analysis of the data obtained showed that in the experimental variants the values of the porosity of bread increased by 3.8% (absolute value), the specific volume - 2.4% (relative value) relative to the control, the form-holding capacity of the hearth bread improved. There was also an increase in the mass fraction of volatile acids in the experimental version of 0.48% and alcohol - by 0.04% relative to the control values.

It was found that after 12 hours of storage, the first signs of the disease were found in the crumb of the prototypes of bread, which progressed quite intensively, and after 48 hours the signs of chalk disease were found on the surface of the products (Table 6). At the same time, in experimental samples, weak signs of chalk disease were found in the crumb of bread only after 48 hours of storage.

Table 6. Influence of tomato pomace powder and bacterial preparations on the disease of rye bread with chalk disease

Durationstorage, h	Microbiological condition of bread samples	
	control	an experience
12	+	-
24	++	-
36	+++	-
48	++++	+

It should be noted that the effect of the use of decontaminating additives in the production of rye breads will be significantly improved if the requirements of SanPin 0257-08 "Hygienic requirements for the production of bread, bakery and confectionery products and their transportation" are also met.

CONCLUSION

Thus, the complex of theoretical and experimental studies carried out confirms the feasibility of using combined methods of microbial decontamination of bread, including natural acidifying additives, especially from secondary plant materials, and pharmacological bacterial preparations containing bacterial species characteristic of the microflora of rye semi-finished products.

As a result of the study, it was found that probiotic preparations affect the biotechnological properties of rye semi-finished products and, as a result, the quality of finished products. It is especially effective to use the studied additives in activated form or to use natural acidifying additives, which will reduce the consumption of yeast and enrich the environment with nutrients that are vital for microorganisms. The use of this raw material in the production of rye bread is economically efficient,

and research in this direction has practical and scientific significance.

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