

Section 4. Food processing industry

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TECHNOLOGICAL ASPECTS OF THE PRODUCTION OF WHEAT BREAD VARIETIES USING SPONTANEOUS FERMENTATION STARTERS

Abstract. The article substantiates the expediency of using in the production of bread to adjust the baking properties of the main raw materials, improve the quality of finished products and prevent microbial infection of the last natural bioadditives – starter cultures. The data of specialized information sources on promising types of starter cultures are considered, the reasons limiting their use in the baking industry are established. The expediency of using starter cultures of spontaneous fermentation, especially for regions with a hot climate, is substantiated. The results of a study of the biotechnological properties and composition of the microbiota of polystrain spontaneous fermentation starters (PSSB) are presented, using the example of pea-star anise starter culture traditionally used in the preparation of Uzbek flatbread. It has been established that PZSB affect the state of the main flour biopolymers, the intensity of their acid hydrolysis, the rheological properties of the dough, and the quality of the finished product.

Keyword: bread, sourdough, microbial contamination, pea and star anise sourdough.

Introduction

The most ancient method of biological loosening of the dough is the use of wheat, hop, wine, pea-star anise, pea-anise and other starter cultures, the microflora of which developed spontaneously. But even today, wheat sourdoughs are a means of increasing acidity, intensifying the dough preparation process, improving taste and aroma, preventing potato disease in bread and molding.

Satsaeva N. K. developed a technology for making wheat bread resistant to microbial contamination based on hop sourdough. The conditions for sour-

dough cultivation were optimized, the possibility of stabilizing the microbiological composition of the latter by using hop broth containing 90.8% isohumulone and wheat bran was established.

The use of concentrated lactic acid starter (CLSC) is recommended for enterprises with intermittent operation, since this starter does not require forced cooling or other preservation methods during non-working hours. The preparation of KMCZ is carried out according to the Leningrad scheme using liquid cultures of lactic acid bacteria *L. plantarum* – 30, *L. casei* – 26, *L. brevis* – 1, *L. fermenti* – 34 or dry lactobacterin (1–10).

Acidophilic starter consists of bacteria *L. acidophilus*-146 and yeast strain “Ryazanskiye-17” adapted to high temperatures (40...450 °C) on the basis of the Ryazan race. A high level of amino acids was found in the starter: the content of lysine is 1585 mg/100 g, leucine – 1275 mg/100 g, valine – 510 mg/100 g. The use of this starter is effective for improving the quality of products with strong gluten, with accelerated dough preparation technologies [10–15].

On the international market, Ernst Böcker GmbH & Co. KG (Germany) offers a wide range of both starter products and inactivated starter cultures (paste-like, liquid and dry) ready for use. The company’s product range includes various inactivated sourdoughs: Böcker Germe – dry sourdough for the production of wheat and wheat-rye bread; “Böcker Direkt25” – liquid sourdough for wheat bread; “Böcker Sprossenpaste Weizen” – a pasty sourdough containing germinated wheat grains; “Böcker Wellness-Krauter” – pasty sourdough, which includes a unique composition of herbs (ramson, basil, dandelion, nettle, violet, watercress, cornflower); “Böcker Kartoffelpaste” – pasty potato sourdough with potato cubes [15–18].

The expediency of using various composite mixtures based on barley subjected to bioconversion in the preparation of starter cultures has been established. With this method of processing grain raw materials, all pathogenic microflora is destroyed, while the value of the product increases by 1.4 ... 1.8 times, unlike its analogue.

Lebedenko T. E. et al. carried out a comparative assessment of methods for preparing dough from wheat flour to ensure high quality of finished products, duration, laboriousness of the process, etc., the advantages and disadvantages of each of them, as well as rational conditions of use.

The range of use of starter cultures is very wide, but their biotechnological potential has not yet been sufficiently studied. It should be noted that the technology of breeding sourdoughs is complex; in

the breeding cycle, “pure” cultures of acid-forming bacteria and yeast are needed, which is not always possible in the conditions of bakeries in regions remote from the center, as well as for small producers of bakery products. In addition, in the conditions of the hot climate of Uzbekistan, it is very difficult to maintain the stable required technological parameters, and, consequently, the quality indicators of starter cultures.

New prospects for the industry open up the possibility of using polystrain spontaneous fermentation starters (hereinafter referred to as PZSB), which are characterized by their availability and the absence of the need to purchase “pure” cultures for the breeding cycle. However, they are practically not used in the production of mass varieties of bread due to the production of products of reduced volume with insufficiently loosened crumb.

As a result, it is necessary to develop technological solutions to stabilize the microbiological composition of this type of starter cultures in order to obtain high-quality products.

Purpose of the study

The aim of the work was to study the microbiological composition of PZSB and its effect on the main flour biopolymers, dough properties and the quality of bread from wheat flour of the 1st grade.

Objects of study: pea-star anise sourdough (hereinafter GBZ), wheat bread.

Methods and materials

GBZ was prepared according to the recipe and technological parameters presented in table 1 [12, p. 263-264].

Previously, a mixture of peas and star anise in a ratio of 1.0:0.1 was poured into 1 liter of hot water at a temperature of 80 ± 20 °C, sprinkled with flour, then kept at a temperature of 30 ± 10 °C for 24 hours. in a ratio of 1:1.

The resulting starter was accumulated to the required amount by periodic refreshment, observing the proportions of the recipe and technological parameters of the second phase of the breeding cycle. To

prepare the nutritional mixture, wheat flour of the second grade and water were mixed in a ratio of 1:2, the enzyme preparation Amilorizin P10x was added in an amount of 0.01% to the mass of flour in the mixture.

Table 1. – Consumption of raw materials and semi-finished products and the mode of preparation of the starter culture in the breeding cycle

Name of raw materials, semi-finished products and process indicators	Breeding phase	
	I	II
Peas peeled crushed	1.0	–
star anise	0.1	–
Wheat flour II grade	–	10.0
Milk serum	–	10.0
Water	1.0	10.0
Leaven	–	2.1
Humidity,%, no more	–	72.0 ... 75.0
Initial temperature, °C	30	35 ... 40
Acidity final, hail, no more	–	18.0 ... 22.0
Fermentation duration, h	24	8 ... 12

The nutrient mixture was thoroughly mixed with pre-sour starter, placed in a thermostat and incubated at a temperature of $28 \pm 10\text{C}$ for 20 ... 24 hours until the final acidity was 22.0 deg. Then, every 12 hours, a selection of 50.0% of the finished starter was made and a similar amount of the nutrient mixture was added [19–23].

Titrate acidity was determined by titration with a 0.1 mol/dm³ solution of sodium hydroxide, active acidity was determined on a pH-meter brand pH-673; the number of bacteria – in the Goryaev counting chamber using a ZSM microscope (Poland); bacterial activity – to restore methylene blue; species and quantitative composition of the microflora – by phase-contrast microscopy after preliminary incubation on specialized agar media. A series of trial baking was carried out according to the generally accepted method according to GOST 27669–88 “Baking wheat flour.

Method of trial laboratory baking of bread. GBZ was prepared according to the generally accepted method [122, p. 263–264], wheat dough – by non-dough and sponge methods. The mass fraction of sugar in semi-finished products was determined by an accelerated semi-micro method; the amount of gluten washed from the dough – according to GOST 27839–88 “Wheat flour. Methods for determining the quantity and quality of gluten, water-soluble proteins – by colorimetric method. The quality of bread was analyzed for compliance with the requirements of GOST 27842–88 “Bread from wheat flour. Specifications” [24–30].

Results and discussion

We studied the traditional technology for the preparation of GBZ, which belongs to the group of PZSB. Every 24 hours for 8 days in the starter without renewal, the dynamics of changes in acidity, the composition of microflora and its activity was determined (Table 2).

Table 2. – Quality indicators of starter cultures during spontaneous fermentation

The name of indicators	Values of indicators of the quality of the starter when diluted during, days								
	initial	1	2	3	4	5	6	7	8
Acidity, hail	1.6	10.0	12.6	15.0	17.5	17.0	22.0	26.8	32.4
pH	6.30	3.70	3.65	3.55	3.50	3.50	3.40	3.00	2.80
Quantity	–	226	1329	2320	2385	2769	2851	2512	2192
acid-forming bacteria, mln/g	–	70	65	50	40	35	55	60	75

It was found that the studied starter culture reached its optimal acidity on the 4th... 5th day. At the same time, the bacteria were distinguished by the best reducing activity (40–35 min), which then naturally decreased.

Rod-shaped bacteria and yeast microorganisms were found in the studied sourdough. At the same time, bacteria of the Enterobacteriaceae R. family, which belong to the natural microflora of flour, dominated. As a result of increasing the acidity of the starter and lowering the pH value to 3.5... 3.7, the rest of the microflora weakened or was inhibited, the medium became elective and acid-resistant, rod-shaped bacteria began to dominate in it. At the same time, the number of gram-negative bacteria of the Enterobac-

teriaceal group decreased, and the number of gram-positive rod-shaped bacteria belonging to the genus *Lactobacillus* naturally increased. Simultaneously, yeast cells began to multiply in the medium, which at the beginning of the process were present only in single copies. As the period of incubation of the starter increased, a gradual death of yeast cells of both genera was noted, so after 3 days the number of cells of the cultural yeast race *Saccharomyces* dropped to $15.8 \cdot 10^6$, a *Zygomycetes* – to $3.4 \cdot 10^6$ cells in 1 g of sourdough [31–35].

The ratio of bacteria and yeast on days 1.3 and 5 of dilution was about 13:1, 151:1 and 1025:1, respectively. After 3 days, coccal forms of bacteria and mold fungi began to develop in the sourdough (Table 3).

Table 3. – Species and quantitative composition of microorganisms in sourdough

Time incubation leaven, days	Number of microorganisms ($N \times 10^6$ in 1 g of sourdough) in a nutrient medium	
	MPA	SA
Through 4 h	15.4 (baker's yeast <i>Sacch. cerevisiae</i>)	17.8 (baker's yeast <i>Sacch. cerevisiae</i>) 12.0 (wild yeast <i>Zygomycetes</i>)
1	16.0 (<i>Sacch. cerevisiae</i>) 10.0 (wild yeast <i>Zygomycetes</i>)	18.0 (<i>Sacch. cerevisiae</i>) 12.0 (<i>Zygomycetes</i>)
2	14.5 (<i>Sacch. cerevisiae</i>) 15.0 (<i>Zygomycetes</i>)	17.5 (<i>Sacch. cerevisiae</i>) 18.0 (<i>Zygomycetes</i>)
3	5.8 (coccal forms of bacteria <i>Sarcina</i>) 12.6 (<i>Zygomycetes</i>)	15.8 (<i>Sacch. cerevisiae</i>) 3.4 (<i>Zygomycetes</i>)
4	5.2 (<i>Sarcina</i>)	5.6 (<i>Sacch. cerevisiae</i>) 5.8 (<i>Zygomycetes</i>)
5	2.6 (<i>Zygomycetes</i>) 0.7 (<i>Sarcina</i>)	2.7 (<i>Sacch. cerevisiae</i>) 2.0 (<i>Zygomycetes</i>)
6	0.7 (<i>Sarcina</i>) 0.2 (mushrooms <i>Aspergillus</i>)	2.3 (<i>Sacch. cerevisiae</i>) 1.9 (<i>Zygomycetes</i>)

Further, the properties of the dough and the state of the main biopolymers of wheat flour of the 1st grade were investigated in variants without sourdough, on sourdough without yeast, on sourdough and yeast. With a non-dough method of dough preparation, 8.0% was added to the dough, and 4.0% of sourdough was added to the prescription amount of flour with a sponge method. Samples without yeast and sourdough served as controls. The results of the analyzes are given in (table 3).

Analysis of the data in Table 4 showed that after 3 hours of ripening, the residual amount of sugars in the dough in variants with sourdough exceeded similar values in the variants with yeast and yeast with sourdough, respectively, by 1.4 ... 0.8 and 0.9 ... 0, 5%. An increase in the duration of ripening of semi-finished products in variants with sourdough and yeast, even up to 5 hours, did not lead to depletion of the mass fraction of sugars, moreover, in these variants, their amount exceeded similar values

in semi-finished products with yeast by 1.5 ... 0.9 ... 1.4% (rel.) – with the sponge dough method.

Conclusion

Thus, it was found that it is advisable to use the biologically active mixture after three days. During five days of cultivation, a variety of microflora was preserved in the starter: cocci, rod-shaped bacteria, yeast, mold fungi, etc. With longer cultivation,

acid-resistant rod-shaped bacteria began to dominate. There was a process of displacement of the original microflora of the spontaneously fermented sourdough. Particularly effective is the joint use of yeast and starter cultures in the sourdough dough method, which will intensify the technological process of making bread, reduce the pH of semi-finished products to 5.5 ...

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