



УДК : 664.665:664.654.1(045)

TECHNOLOGY OF MANUFACTURING GLUTEN-FREE BREAD USING SPONTANEOUSLY FERMENTED YOURDERS**ТЕХНОЛОГІЯ ВИГОТОВЛЕННЯ БЕЗГЛЮТЕНОВОГО ХЛІБА З ВИКОРИСТАННЯМ ЗАКВАСОК СПОНТАННОГО БРОДІННЯ****Verbets T.M. / Бербец Т.М.***s.p.s., as. prof. / к.п.н, доц.*

ORCID: 0000-0002-9334-7112

Dzhoha O.V. / Джога О.В.*PhD, as. prof / докт. філ., доц.*

ORCID: 0000-0003-2574-4906

*Pavlo Tychna Uman State Pedagogical University, Sadova, 2, Uman, 20300,
Уманський державний педагогічний університет імені Павла Тичини,
Умань, Садова, 2, 20300*

Abstract: *An increasing number of people recently refuse to consume products containing gluten, citing its harmful effects on the body . According to WHO data, about 1% of the world's population suffers from celiac disease, a hereditary gluten intolerance. Celiac disease requires strict adherence to a special gluten-free diet. The article describes the expediency of using leaven of a spontaneous fermenter from the flour of cereal crops (corn, buckwheat and rice) in the technology of gluten-free bread. It was established that leavens have a positive effect on the physico-chemical and organoleptic indicators of finished products with a control sample.*

Keywords: *gluten-free bread, technology, leavens, fermentation*

Formulation of the problem.

Gluten is a group of proteins that is part of cereal seeds: wheat, rye, oats. An increasing number of people recently refuse to consume products containing gluten, citing its harmful effects on the body .

Products such as rye, wheat, and barley are 80% gluten protein. This protein, or more precisely, its particles, moving through the small intestine, can damage the villi on the surface of its mucous membrane. Villi help move food through the intestines and promote its assimilation. Excluding products containing gluten from the diet, you can strengthen the villi and, as a result, normalize the work of the digestive tract.

In the food industry and everyday life, gluten is also known as gluten. The concentration of gluten in flour is one of the indicators of quality: the greater the amount of gluten, the more aromatic and lush the baked bread will be. Gluten proteins make up 80% of the total amount of proteins present in bread. These proteins are rich in essential amino acids that enter the body with food.

According to WHO data, about 1% of the world's population suffers from celiac disease, a hereditary gluten intolerance. Celiac disease requires strict adherence to a special gluten-free diet. However, experts at the University of Maryland Center for the Study of Celiac Disease say that many more people suffer from mild gluten intolerance.

Scientists and manufacturers of many countries of the world are paying attention to the issue of developing the technology of gluten-free bakery products. The problem of creating gluten-free bakery products is also relevant in Ukraine, but the population's needs for them are met mainly by expensive imported products.



Analysis of recent research and publications.

Gluten-free food products are intended for people with celiac disease, which is caused by an allergic reaction of the body to α -gliadin, which is manifested in the irritation of the mucous membrane of the small intestine [1,2].

As a result of such processes, the assimilation of food nutrients by the patient's body deteriorates, which causes a decrease in body weight, vitamin deficiency, nervous disorders and others. Patients with celiac disease follow a gluten-free diet and completely exclude from the diet products that contain wheat, rye, barley and oats. At the same time, there is a problem in following a diet, since many products on the market contain "hidden gluten". It is known that in the technology of cheeses and meat products, dry wheat gluten is used, and cereal products are added to milk drinks. Eating bread, pasta, confectionery and products that contain gluten leads to an exacerbation of the disease, so the diet of such people is very limited. To ensure the diversity of the diet, special dietary products are made: gluten-free bread, gluten-free pasta, cereals based on various types of starches and gluten-free types of flour. To prevent this, traditional bread products are replaced with protein-free or gluten-free ones. To ensure the diversity of the diet of patients with celiac disease, special protein-free or gluten-free dietary products are made - bread, confectionery and pasta products, the recipe of which includes various types of starch and gluten-free types of flour. The gluten-free diet has become a fashionable trend over the last decade, and its supporters believe that it contributes to the health and rejuvenation of the body [3].

For the production of gluten-free bread, it is allowed to use rice, corn, buckwheat, millet, sorghum and amaranth flour. The production technology of this bread, in contrast to the traditional one made from wheat and rye flour, involves only the proofing of the dough blanks and the absence of the dough fermentation process, so the products are characterized by a fresh taste and a faint aroma [4].

One of the ways to improve the quality of gluten-free bread is the use of sourdough starters.

The easiest way to determine hypersensitivity to gluten is to exclude certain products from the diet. The main source of gluten is flour, so the first step is to eliminate any flour products. However, giving up only bread and muffins will not allow you to accurately identify problems with gluten absorption. The reason for this is that, in addition to gluten, flour products contain a large amount of carbohydrates (sugar, starch). Therefore, it is impossible to say with certainty which of the components has a harmful effect on the body. Also, a large number of vegetables and the absence of starch in the diet make a gluten-free diet very similar to a carbohydrate-free diet. For some reason, the fact that the refusal of flour products led to the loss of extra kilograms and the acquisition of vigor does not give certainty that gluten itself is harmful to the body [5].

Spanish and Argentinian scientists have proven the relevance of developing gluten-free products, in particular, using the process of spontaneous fermentation [6].

In Turkey, the influence of spontaneous fermentation rice starter on the rheological properties of the dough and the technological process of baking bread from rice flour was investigated [7].

Irish scientists from the School of Food Sciences studied starters of spontaneous



fermentation from buckwheat flour under different fermentation conditions and found in them a wide range of developed microflora: various types of lactic acid bacteria and yeasts, which were traditional for wheat and rye starters, and some species, in particular *Pediococcus pentosaceus*, *Leuconostoc holzapfelii*, *Lactobacillus gallinarum*, *Lactobacillus vaginalis*, *Lactobacillus sakei*, *Lactobacillus graminis* and *Weissella cibaria*, *Lactobacillus plantarum*, were unconventional. They proved that the composition of stable microflora as a whole depends on the fermentation conditions [8].

Nigerian scientists developed a spontaneous fermentation starter from corn flour and studied the microflora at different pH values [9].

At the University of Hohenheim in Germany, universal and microbiologically resistant strains of lactic acid bacteria were isolated using spontaneous fermentation of amaranth flour dough [10].

The purpose of the work is the study of the feasibility of using starters of spontaneous fermentation from the flour of cereal crops for the production of gluten-free bread.

Materials and methods.

Trial laboratory baking of bread with the addition of corn, buckwheat and rice sourdough was carried out. 10% of the flour specified in the recipe was added with the leaven. Control sample of bread - without using leaven.

Organoleptic indicators of the quality of finished products are established according to DSTU 7044:2009, physico-chemical indicators - according to DSTU 7045:2009 in 4 hours after baking.

Results.

The first stage was the preparation of the starter for spontaneous fermentation, consisting of cycles of dilution and renewal.

In the dilution cycle, sourdough is prepared from flour of a certain type of cereal crop and water with a temperature of 30–32 °C. The cycle lasted 72 hours. After every 24 h, a nutritional mixture of flour and water was added to the previously ripe sourdough. The moisture content of the sourdough was 56–60%, depending on the water absorption capacity of the flour, and it had a final acidity of 10.5–18.5 degrees. Since the water-absorbing capacity of each type of flour is different, water was added until the mixture reached a "sour cream-like" consistency (the ratio of flour to water was from 1:2 to 1:2.5). The production cycle involved the selection of 30% of the starter and the addition of a nutrient mixture.

Renewal of sourdough was carried out in order to accumulate its quantity and wash out of it "wild microflora", which gives sourdough a bitter taste and a specific sour smell.

After the fifth renewal, the quality of the sourdough stabilizes, it has good organoleptic properties, accumulates the necessary acidity and acquires sufficient activity of lactic acid bacteria and can be used in the production cycle for making bread. This can be explained by the change in the composition of the sourdough microflora during its fermentation.

In spontaneous sourdough, fermentation is carried out by microflora introduced with flour, which is quite diverse. However, the main microflora is the lactic acid



bacteria *Lactobacillus plantarum* and *Lactobacillus brevis*, as well as the acid-resistant yeast *Saccharomyces minor*.

Corn sourdough is characterized by the lowest activity, which correlates with the lowest accumulated acidity. During the study of the composition of the microbiota of cereal starter cultures, it was found that they are represented by a wide range of microorganisms of different taxonomic groups, among which lactic acid bacteria of the genera *Lactobacillus*, *Lactococcus*, *Enterococcus* and *Leuconostoc* dominate.

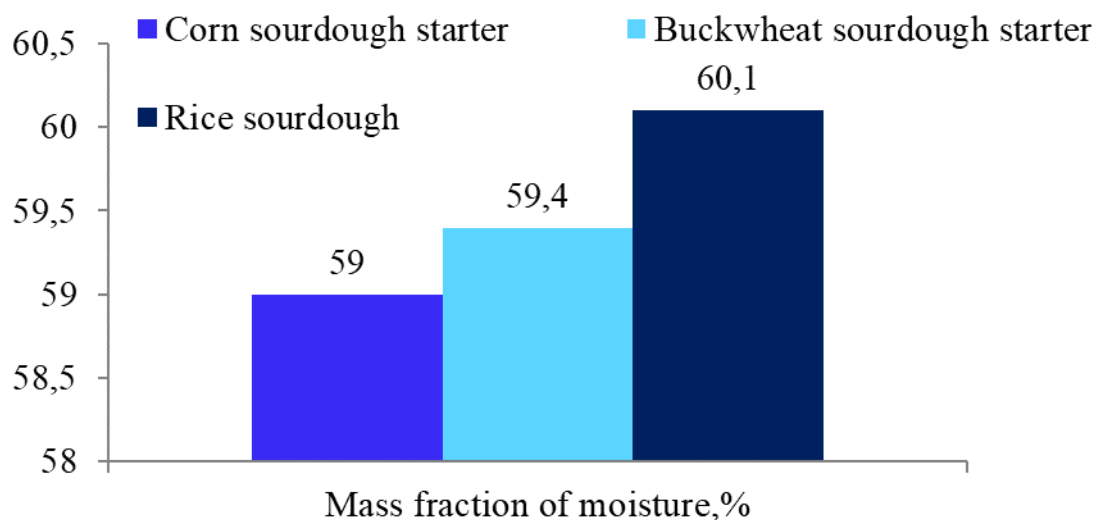


Fig. 1. The mass proportion of moisture in starter cultures

Author's development

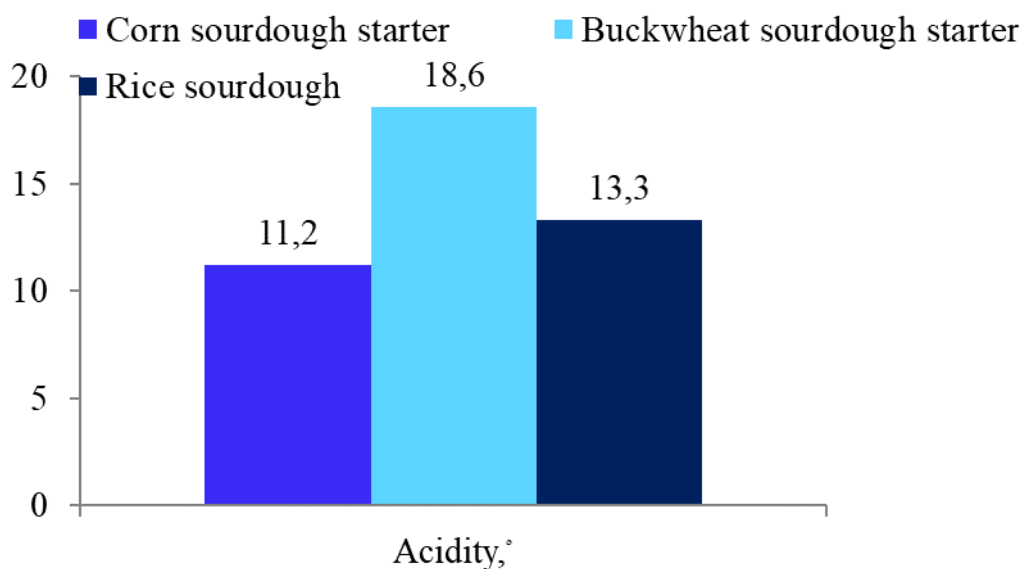


Fig. 2. The Acidity in starter cultures

Author's development

Research into the technological properties of cereal flour and the results of trial laboratory baking showed that gluten-free bread with cereal flour differs in terms of quality from bread made from starch. Rice, corn and buckwheat flour affects the rheological parameters of the dough quality, which leads to a decrease in the specific volume of bread.

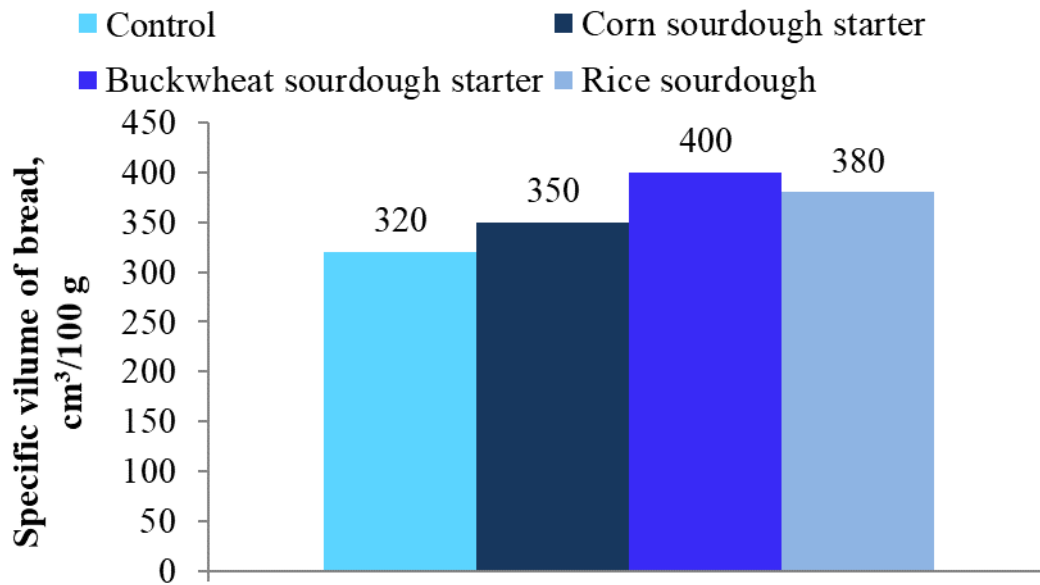


Fig. 3. Specific volume of bread produced in laboratory conditions, cm³/100 g
 Author's development

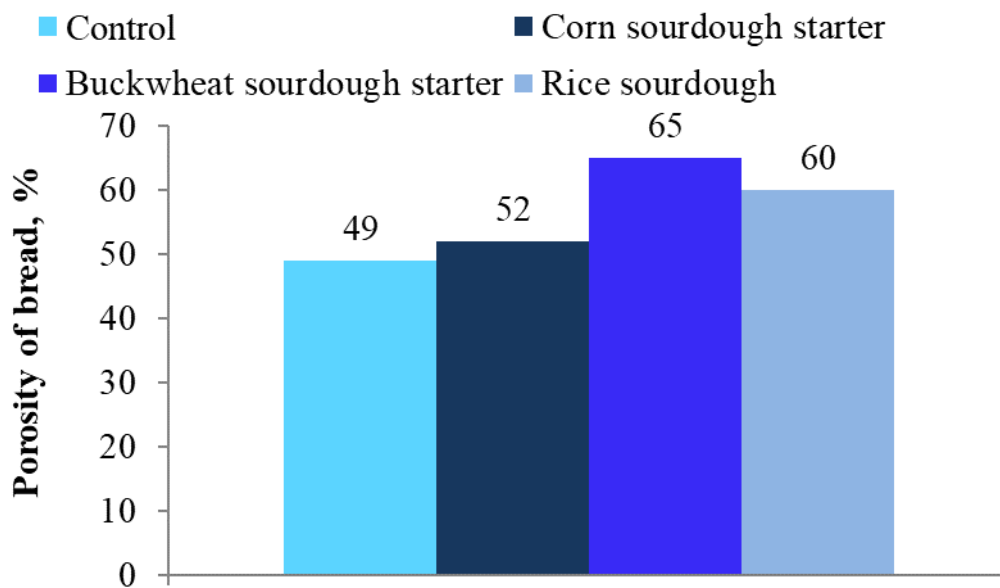


Fig. 4. Porosity of bread made in laboratory conditions, %
 Author's development

In order to improve the existing technology for making gluten-free bread and to improve the organoleptic and physico-chemical quality indicators, trial baking of bread was conducted in laboratory conditions using leavens of spontaneous fermentation.

It has been investigated that the addition of leavening agents from cereal flour increases the accumulation of acids in the dough, and the duration of the proofing of the dough blanks is reduced by 10–15 min compared to the control

Sourdough bread has an elastic crumb with uniform porosity, a pronounced taste and aroma, a larger volume, a better porosity index than the control sample.

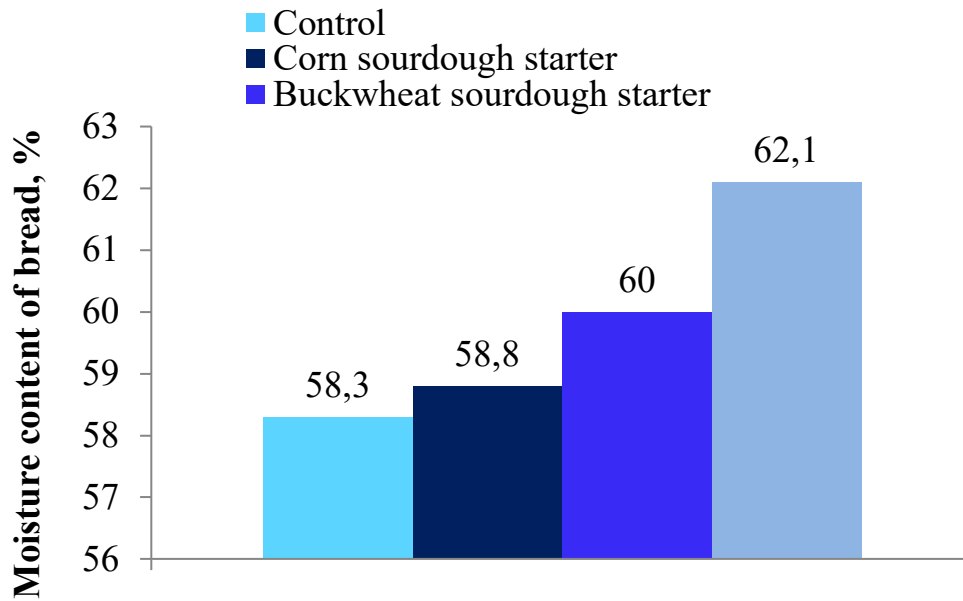


Fig. 5. Moisture content of bread made in laboratory conditions, % *Author's development*

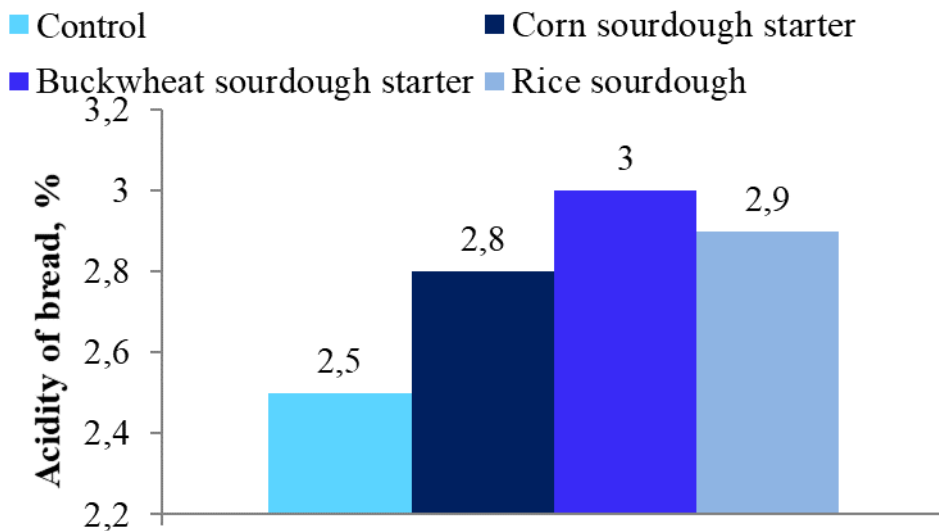


Fig. 6. Acidity of bread made in laboratory conditions *Author's development*

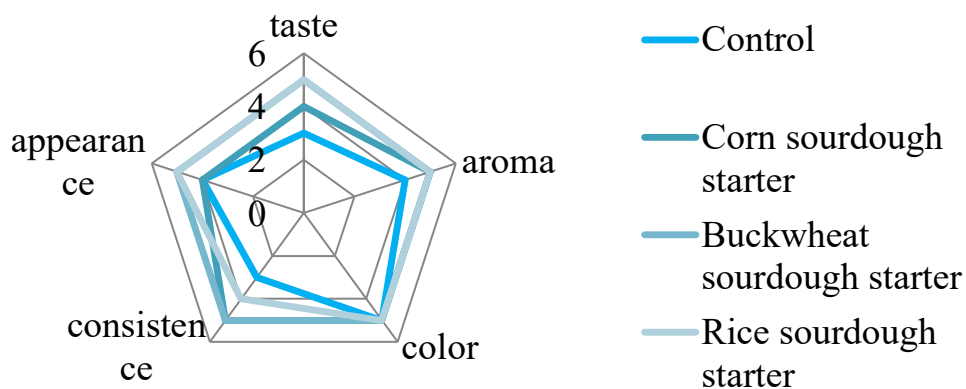


Fig. 7. Organoleptic evaluation of gluten-free bread produced in laboratory conditions *Author's development*



According to the results of the tasting commission, it was established that the organoleptic indicators of bread with the addition of sourdough have higher ratings. The unleavened bread had a fresh taste and a pale crust.

Conclusions. The effectiveness of the use of leavens of spontaneous fermentation from corn, buckwheat and rice flour in the technology of gluten-free bread has been proven. These starters intensify the accumulation of acids in the dough and speed up the ripening process.

As a result of the vital activity of lactic acid bacteria, ready-made bread has a pronounced taste and aroma, and their positive effect on the volume of bread and its porosity is observed.

References

1. Šmídová Z., Rysová J. Gluten-free bread and bakery products technology. *Foods*. 2022. № 11(3). P. 480-495.
2. Bender D., Schönlechner R. Innovative approaches towards improved gluten-free bread properties. *Journal of Cereal Science*. 2020. № 91. P. 102-109.
3. Muzaffar K., Sofi S. A., Mir M. B., Bhat, N. A. Technological Aspects of Gluten Free Bread. *Gluten-free Bread Technology*. 2021. P. 29-48.
4. Mir S. A., Shah M. A., Naik H. R. Influence of hydrocolloids on dough handling and technological properties of gluten-free breads. *Trends in Food Science & Technology*. 2016. № 51. P. 49-57.
5. Dubrovskaya N., Savkina O., Kuznetsova L., Parakhina, O. The development of gluten-free sourdough bread technology with rowan powder. 2018. P. 1-12.
6. Naqash F., Gani A., Gani A., Masoodi F. A. Gluten-free baking: Combating the challenges-A review. *Trends in Food Science & Technology*. 2017. № 66. P. 98-107.
7. Conte P., Fadda C., Drabinska N., Krupa-Kozak U. Technological and nutritional challenges, and novelty in gluten-free breadmaking: A review. *Polish Journal of Food and Nutrition Sciences*. 2019. № 69(1). P. 1-15.
8. Padalino L., Conte A., Del Nobile M. A. Overview on the general approaches to improve gluten-free pasta and bread. *Foods*. 2016. № 5(4). P. 87-98.
9. Arendt E. K., Morrissey A., Moore M. M., Dal Bello F. Gluten-free breads. In *Gluten-free cereal products and beverages*. 2008. P. 289-307.
10. El Khoury D., Balfour-Ducharme S., Joye I. J. A review on the gluten-free diet: Technological and nutritional challenges. *Nutrients*. 2018. № 10. P. 14-22.
11. Wang K., Lu F., Li Z., Zhao L. Recent developments in gluten-free bread baking approaches: a review. *Food Science and Technology*. 2017. № 37. P. 1-9.

Анотація: Останнім часом все більше людей відмовляються від вживання продуктів, що містять глютен, посилаючись на його шкідливий вплив на організм. За даними ВООЗ, близько 1% населення планети страждає на целиакію – спадкову непереносимість глютену. Целиакія вимагає суворого дотримання спеціальної безглютенової дієти. У статті описано доцільність використання заквасок спонтанного бродіння з борошна круп'яних культур (кукурудзяного, гречаного та рисового) у технології безглютенового хліба. Встановлено, що закваски позитивно впливають на фізико-хімічні та органолептичні показники готових виробів порівняно з контрольним зразком.



Ключові слова: безглютеновий хліб, технологія, закваски, бродіння

Стаття відправлена: 13.11.2023р.
© Бербец Т.М., © Джога О.В.