Современная наука и инновации.
2023. № 3 (43). С. 86-98
Modern Science and Innovations.
2023; 3(43):86-98

*ТЕХНОЛОГИЯ ПРОДОВОЛЬСТВЕННЫХ ПРОДУКТОВ /
TECHNOLOGY OF FOOD PRODUCTS*

Научная статья / Original article

УДК 664.664.9
https://doi.org/10.37493/2307-910X.2023.3.8

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Исследование влияния растительных добавок на кислотность теста пшеничного хлеба и пшенично-ржаного хлеба

Study of the effect of herbal additives on the acidity of wheat bread dough and wheat-rye bread

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Аннотация. *Изучено влияние растительных добавок (изолята горохового белка, муки яблочной, муки из пророщенной зеленой гречневой крупы, муки из пророщенной овсяной крупы, порошка из выжимок ростков пшеницы) на кислотность теста пшеничного хлеба и пшенично-ржаного хлеба. В результате проведенных исследований установлено, что растительные добавки способствуют интенсификации жизнедеятельности дрожжей и кислотообразующей микрофлоры, это выражается в большем объеме, лучшей бродильной активности и кислотности теста, данный факт вероятно связан с более благоприятным составом питательных веществ растительных добавок. Увеличение содержания растительных добавок в ингредиентном составе хлеба способствует повышению кислотности теста по сравнению с контрольными образцами. Введение в рецептуру хлеба муки яблочной и смеси изолята горохового белка и муки яблочной приводит к росту начальной кислотности по сравнению с контрольными образцами в среднем на 1,5 град при сохранении динамики в процессе брожения, что является основанием для сокращения продолжительности технологического цикла. Кислотность теста образцов с изолятом горохового белка и муки из пророщенной зеленой гречневой крупы повышается в среднем на 1 град. Порошок из выжимок ростков пшеницы, смесь муки из пророщенной овсяной крупы и муки из пророщенной зеленой гречневой крупы, мука из пророщенной овсяной крупы незначительно увеличивают кислотность теста пшеничного и пшенично-ржаного хлеба.*

Ключевые слова: хлеб пшеничный, хлеб пшенично-ржаной, изолят горохового белка, мука яблочная, мукой из пророщенной зеленой гречневой крупы, мука из пророщенной овсяной крупы, порошок из выжимок ростков пшеницы, тесто, кислотность

Для цитирования: *Кольман О. Я., Губаненко Г. А., Сафронова Т. Н., Казина В. В., Петренко Е. В. Исследование влияния растительных добавок на кислотность теста пшеничного хлеба и пшенично-ржаного хлеба // Современная наука и инновации. 2023. № 3 (43). С. 86-98.* https://doi.org/10.37493/2307-910X.2023.3.8

Финансирование: *работа выполнялась в рамках реализации научно-технических и инновационных проектов в интересах первого климатического научно-образовательного центра мирового уровня «Енисейская Сибирь» (совместно с субъектами реального сектора экономики и АНО «Корпорация развития Енисейской Сибири») на тему: «Разработка научно обоснованной рецептуры и технологии шоковой заморозки хлебобулочных изделий и хлеба длительного срока хранения, повышенной пищевой ценности с использованием продуктов переработки из регионального растительного сырья Красноярского края». » Исследование выполнено при финансовой поддержке Стратегического проекта «Гастрономический RnD Park» Программы развития ФГОС ВО «Сибирский федеральный университет» на 2021–2030 годы.*

Abstract. *The influence of vegetable additives (pea protein isolate, apple flour, sprouted green buckwheat flour, sprouted oatmeal flour, wheat germ pomace powder) on the acidity of wheat bread dough and wheat-rye bread was studied. As a result of the research, it was found that herbal supplements contribute to the intensification of the vital activity of yeast and acid-forming microflora, this is expressed in a larger volume, better fermentation activity and acidity of the dough, this fact is probably associated with a more favorable nutrient composition of herbal supplements. An increase in the content of vegetable additives in the ingredient composition of bread contributes to an increase in the acidity of the dough compared to control samples. The introduction of apple flour and a mixture of pea protein isolate and apple flour into the bread recipe leads to an increase in initial acidity by an average of 1.5 degrees compared to control samples, while maintaining dynamics during the fermentation process, which is the basis for reducing the duration of the technological cycle. The acidity of the test samples with pea protein isolate and flour from germinated green buckwheat increases by an average of 1 deg. Wheatgrass pomace powder, a mixture of germinated oatmeal flour and germinated green buckwheat flour, germinated oatmeal flour slightly increase the acidity of wheat and wheat-rye bread dough.*

Keywords: wheat bread, wheat-rye bread, pea protein isolate, apple flour, sprouted green buckwheat flour, sprouted oatmeal flour, wheat germ pomace powder, dough, acidity

For citation: *Kolman OYa, Gubanenko GA, Safronova TN, Kazina VV, Petrenko EV. Study of the effect of herbal additives on the acidity of wheat bread dough and wheat-rye bread. Modern Science and Innovations. 2023;3(43):86-98.* https://doi.org/10.37493/2307-910X.2023.3.8

Funding: *the work was carried out as part of the implementation of scientific, technical and innovative projects in the interests of the first world-class climate scientific and educational center "Yenisei Siberia" (in cooperation with subjects of the real sector of the economy and the ANO "Yenisei Siberia Development Corporation") on the topic: "Development of scientifically based recipes and technology for blast freezing of bakery products and bread with a prolonged shelf life, increased nutritional value, using processed products from regional plant raw materials of the Krasnoyarsk Territory." The study was carried out with the financial support of the Strategic Project "Gastronomic RnD Park" of the Development Program of the Federal State Educational Standard of Higher Education "Siberian Federal University" for 2021–2030.*

Introduction. Currently, retail chains offer a wide range of bread and bakery products. This group of products is mainly a source of carbohydrates, vitamins (group B, PP), minerals (sodium, magnesium, etc.), but despite this, bread and bakery products have a number of disadvantages: bread proteins are not balanced in the content of essential amino acids (lysine, threonine), the carbohydrate composition of wheat bread made from premium flour is mainly due to starch and there is practically no dietary fiber in it, the introduction of various types of seeds into the recipe helps to increase the energy value of bread and bakery products, the protein content in rye-wheat bread is lower, than in wheat. Therefore, research aimed at developing new recipes for enriched bread is relevant. Targeted combination of various types of plant raw materials will make it possible to create bread and bakery products that are balanced in basic nutrients [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]. As a promising source of proteins and dietary fiber, products from the processing of plant raw materials can be considered - pea protein isolate, apple flour, sprouted green buckwheat flour, sprouted oatmeal flour, wheat sprout powder.

The addition of plant additives to the bread recipe affects the quality of the finished bread and its quality directly depends on the accumulation of acids during the ripening process of the dough. During the fermentation process of the dough, the organoleptic (taste, aroma) and physicochemical (acidity, porosity) properties of the finished bread are formed. The accumulation of organic acids, products of the interaction of acids with other dough substances (alcohols) determine the taste, aroma, acidity, and porosity of the finished bread. Changing the acidity of the dough affects the activity of yeast cells. An increase in the acidity of the dough depends on the intensity of accumulation of organic acids and carbon dioxide in it with the formation of carbonic acid [11, 12, 13]. Therefore, research related to the study of the influence of plant additives introduced into the recipe on the acidity of the dough is of particular relevance in the process of developing new recipes for bread and bakery products.

Materials and research methods. Recipes have been developed for wheat and wheat-rye bread with the addition of plant additives (pea protein isolate, apple flour, sprouted green buckwheat flour, sprouted oatmeal flour, wheat sprout powder). Plant additives were introduced to enrich bread with proteins, dietary fiber and reduce its energy value by replacing part of the premium flour with plant additives in the following quantities: 2.5%, 5%, 7.5% of the total amount of premium flour provided for in the recipe. Control samples of wheat and wheat-rye bread do not contain vegetable additives.

Research objects: wheat bread (control sample), wheat bread with pea protein isolate, wheat bread with apple flour, wheat bread with pea protein isolate and apple flour, wheat bread with sprouted green buckwheat flour, wheat bread with sprouted oatmeal flour cereals, wheat bread with sprouted oatmeal flour and sprouted green buckwheat flour, wheat bread with wheat sprout powder, wheat-rye bread (control sample), wheat-rye bread with pea protein isolate, wheat-rye bread with apple flour, wheat-rye bread with pea protein isolate and apple flour, wheat-rye bread with sprouted green buckwheat flour, wheat-rye bread with sprouted oatmeal flour, wheat-rye bread with sprouted oatmeal flour and flour from sprouted green buckwheat, wheat-rye bread with wheat sprout powder.

The ingredients included in the bread must meet the requirements of current regulatory documents.

The acidity of the dough of control samples and samples with plant additives was determined by the well-known method [14].

The purpose of the work is to study the effect of plant additives on the acidity of wheat bread dough and wheat-rye bread.

Research results and their discussion. The influence of plant additives (pea protein isolate, apple flour, sprouted green buckwheat flour, sprouted oatmeal flour, wheat sprout powder) on the acidity of wheat bread dough and wheat-rye bread was studied.

The dynamics of the acid accumulation process depending on the dosage of pea protein isolate in comparison with the control sample are shown in Figures 1–2. In the test with increasing dosage of pea protein isolate, the process of acid accumulation is 1 degree higher compared to the control sample at all stages of dough fermentation.

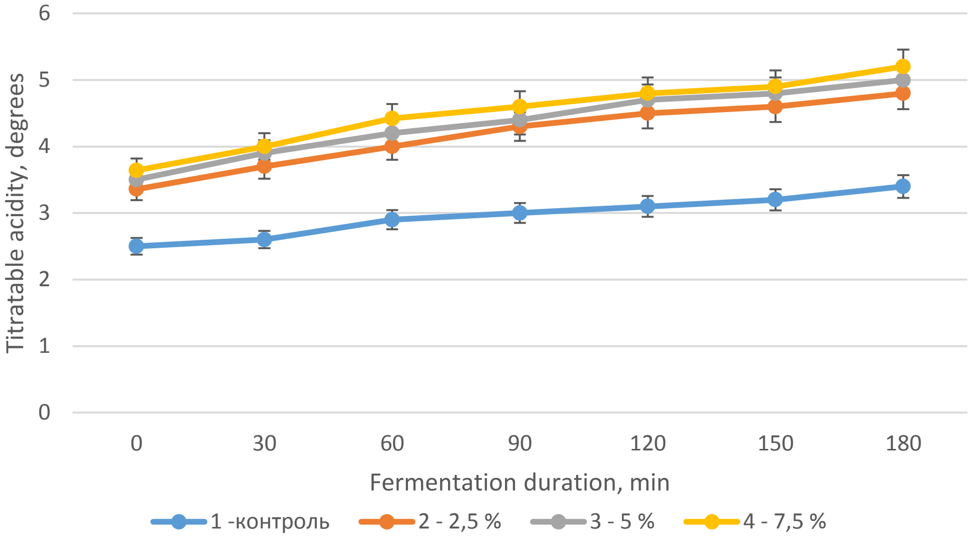

Figure 1. Change in titratable acidity during dough fermentation depending on the dosage of pea protein isolate in wheat bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5 %

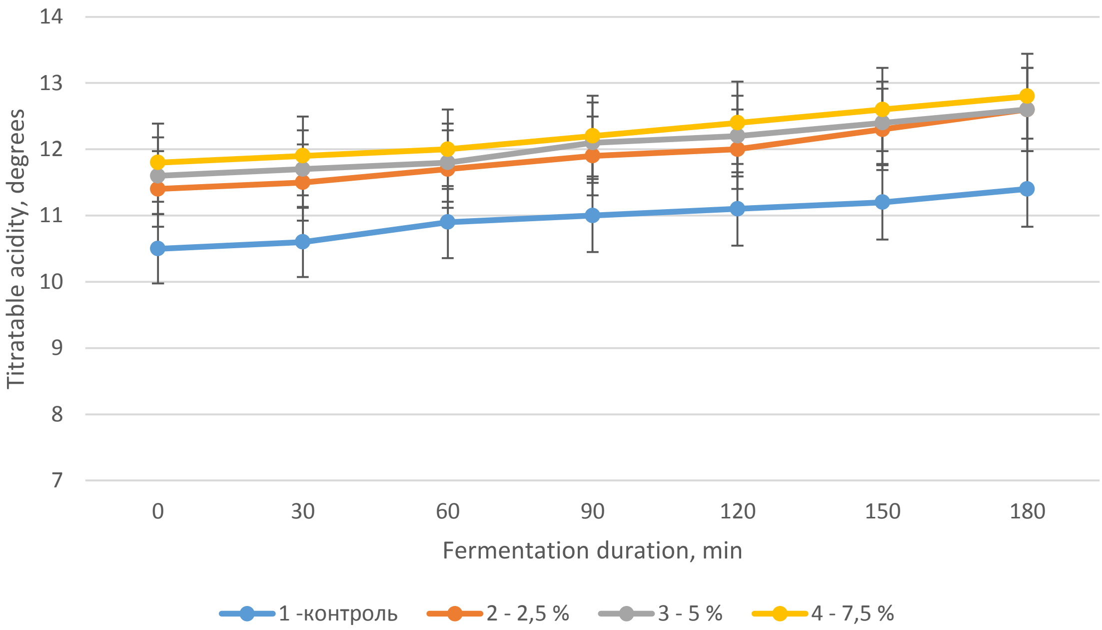

Figure 2. Change in titratable acidity during dough fermentation depending on the dosage of pea protein isolate in wheat-rye bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

The change in the overall acidity of the dough during fermentation indicates that the addition of pea protein isolate leads to an increase in the initial acidity of the dough. At the stage of dough maturation, the accumulation of acids in experimental samples is achieved faster.

Figures 3, 4 show the change in acidity during dough fermentation depending on the dosage of apple flour.

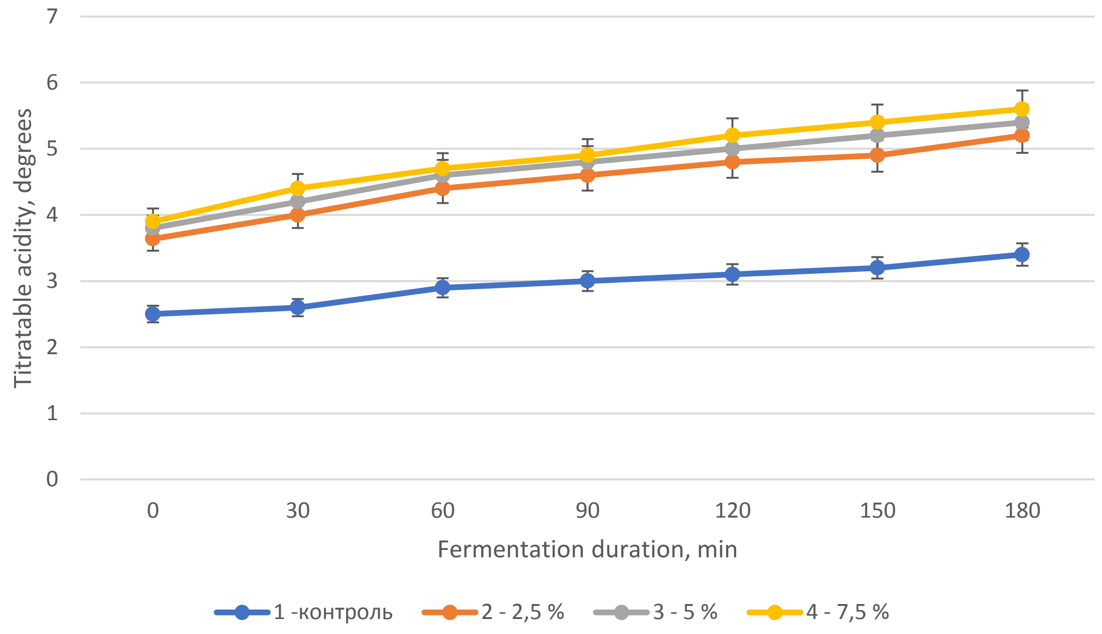

Figure 3. Change in titratable acidity during dough fermentation depending on the dosage of apple flour in wheat bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

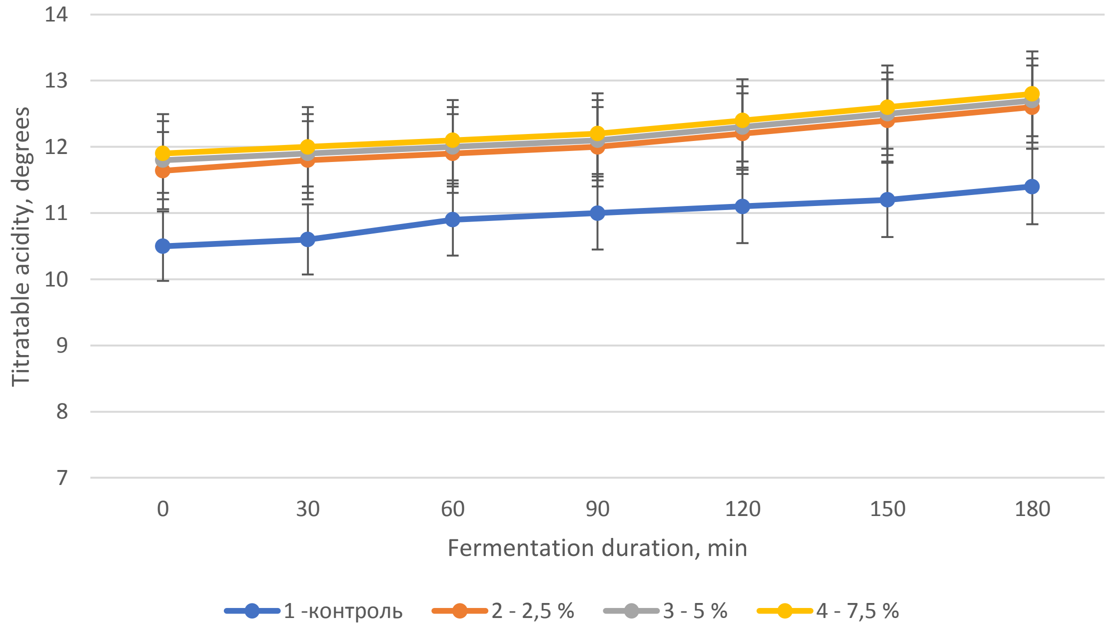

Figure 4. Change in titratable acidity during dough fermentation depending on the dosage of apple flour in wheat-rye bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

The presence of organic acids in malic flour leads to an increase in initial acidity by an average of 1.5 degrees while maintaining dynamics during the fermentation process, which is the basis for reducing the duration of the technological cycle.

The change in acidity during dough fermentation depending on the dosage of pea protein isolate and apple flour is presented in Figures 5, 6.

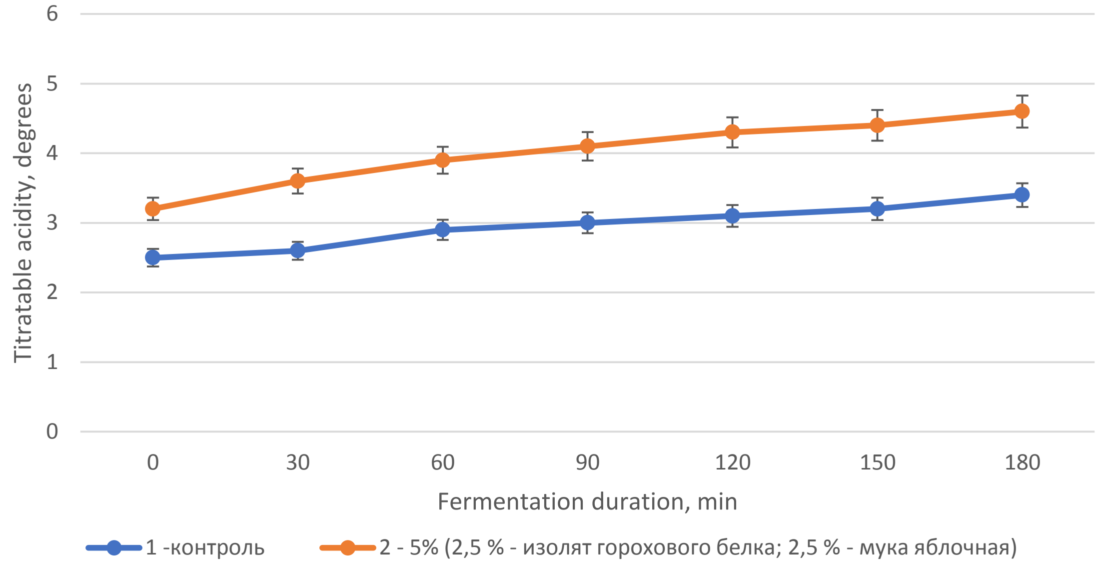

Figure 5. Change in titratable acidity during dough fermentation depending on the dosage of pea protein isolate and apple flour in wheat bread: 1 – control; 2 – 5% (2.5% – pea protein isolate; 2.5% – apple flour).

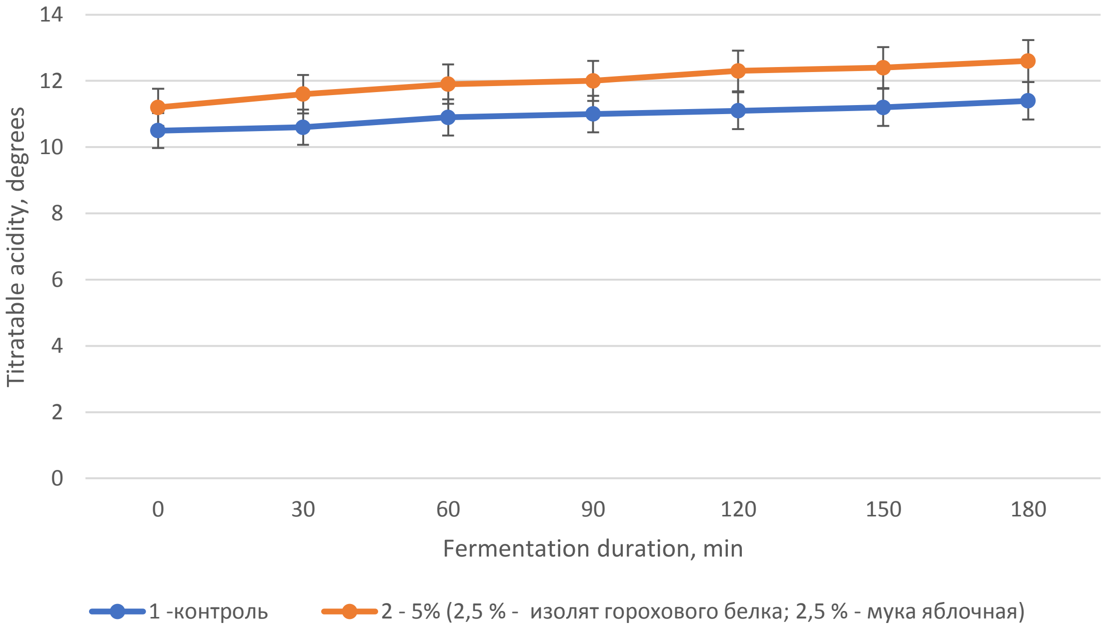

Figure 6. Change in titratable acidity during dough fermentation depending on the dosage of pea protein isolate and apple flour in wheat-rye bread: 1 – control; 2 – 5% (2.5% – pea protein isolate; 2.5% – apple flour).

The effect of flour from sprouted green buckwheat on the dough fermentation process is presented in Figures 7, 8. The introduction of flour from sprouted green buckwheat into the dough helps to increase the titratable acidity compared to the control sample, which in turn helps to accelerate the fermentation process of the dough.

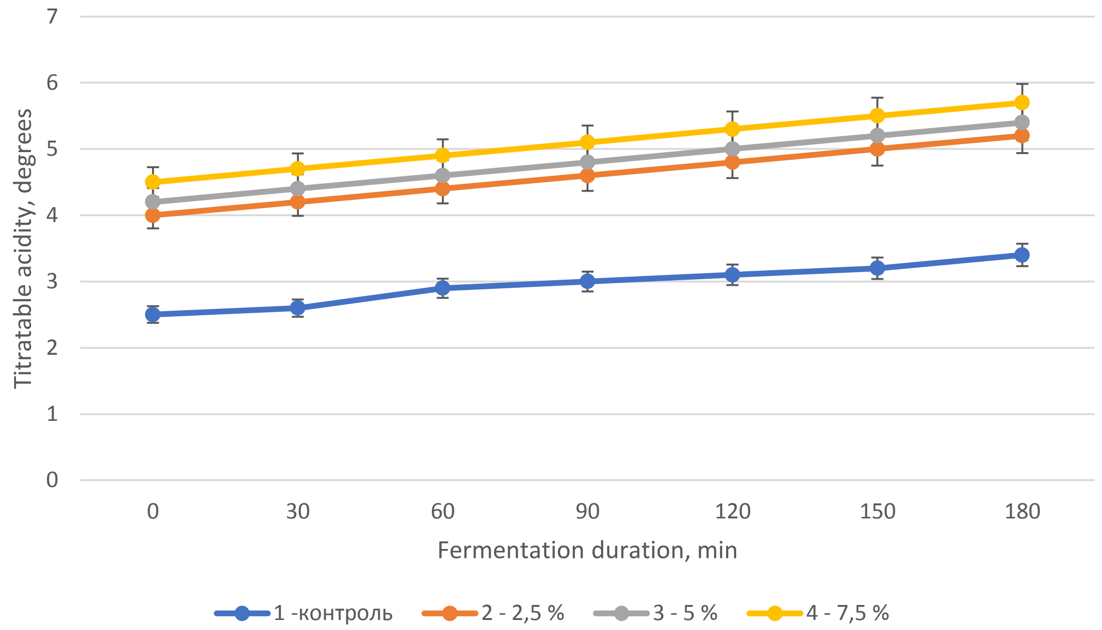

Figure 7. Change in titratable acidity during dough fermentation depending on the dosage of flour from sprouted green buckwheat in wheat bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

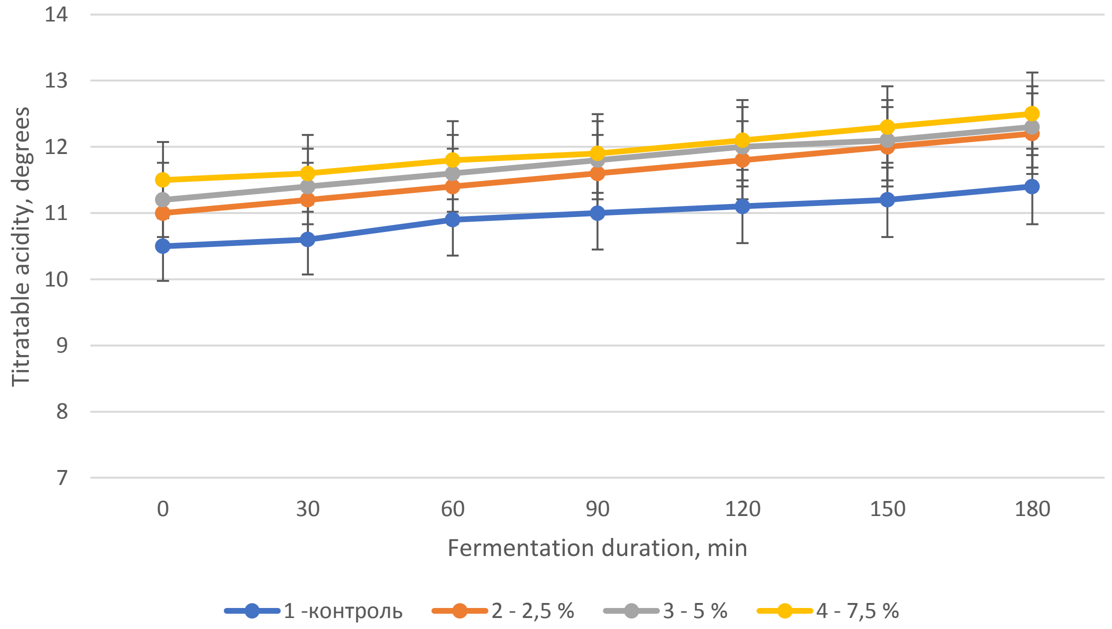

Figure 8. Change in titratable acidity during dough fermentation depending on the dosage of flour from sprouted green buckwheat in wheat-rye bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

The change in titratable acidity during dough fermentation depending on the dosage of sprouted oatmeal flour is shown in Figures 9, 10, and when a mixture consisting of sprouted oatmeal flour and sprouted green buckwheat flour is introduced into the dough in Figures 11, 12. By introducing sprouted oatmeal flour and a mixture consisting of sprouted oatmeal flour and sprouted green buckwheat flour into the dough, the titratable acidity of the dough increases slightly compared to the control sample.

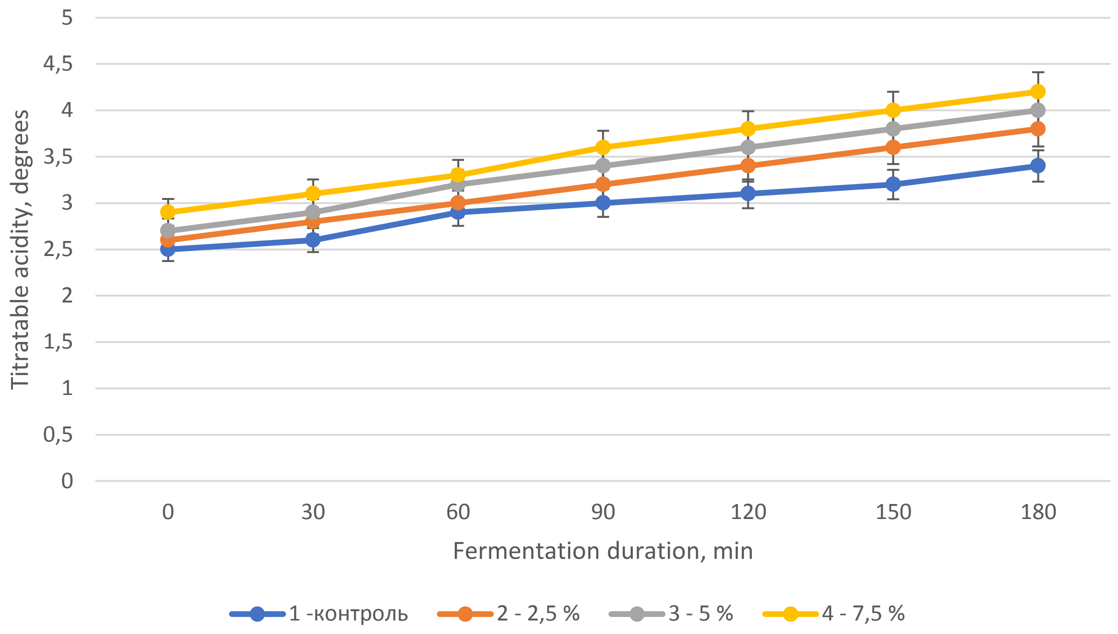

Figure 9. Change in titratable acidity during dough fermentation depending on the dosage of sprouted oatmeal flour in wheat bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

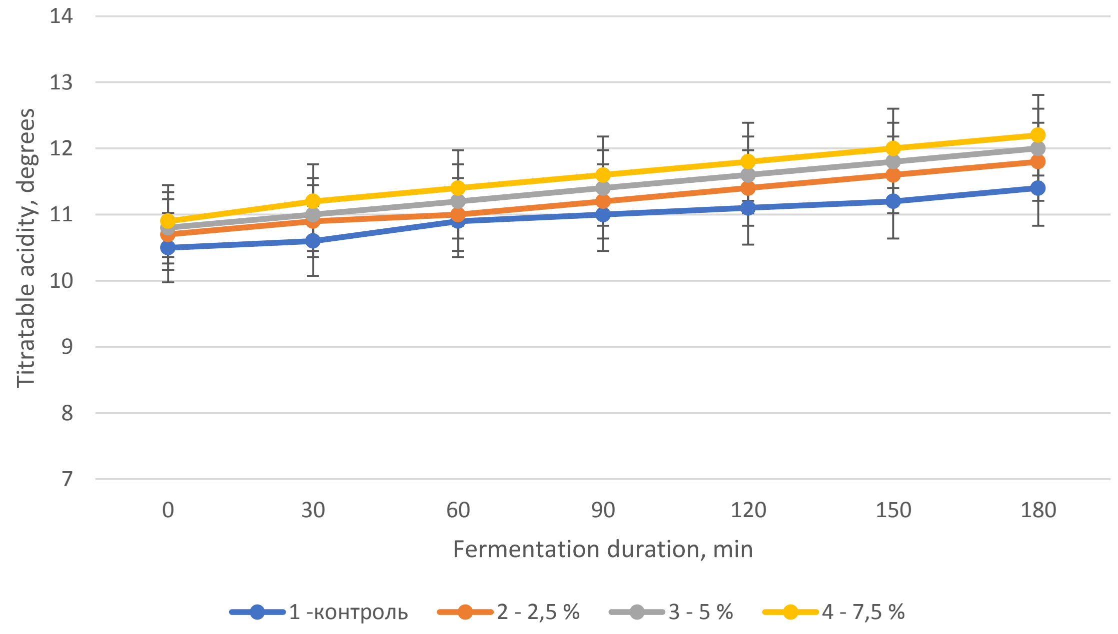

Figure 10. Change in titratable acidity during dough fermentation depending on the dosage of sprouted oatmeal flour in wheat-rye bread: 1 – control; 2 – 2.5%; 3 – 5%; 4 – 7.5%.

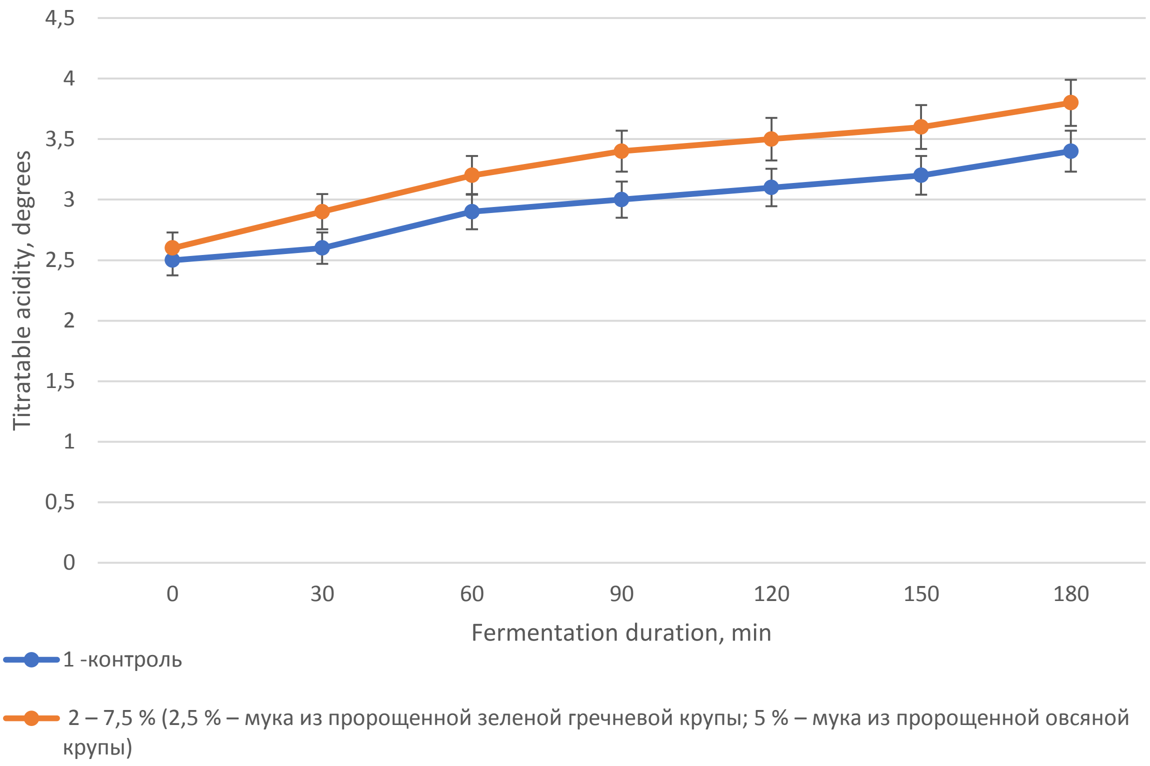

Figure 11. Change in titratable acidity during dough fermentation depending on the dosage of a mixture of sprouted oatmeal flour and sprouted green buckwheat flour in wheat bread: 1 – control; 2 – 7.5% (2.5% – flour from sprouted green buckwheat; 5% – flour from sprouted oatmeal).

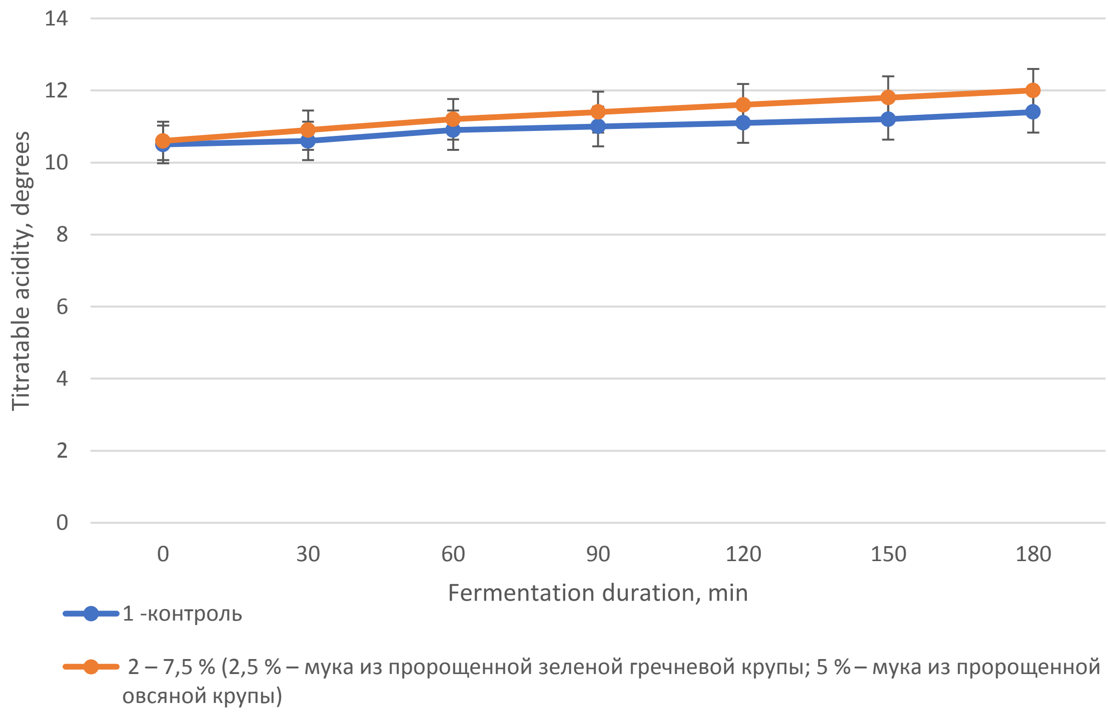

Figure 12. Change in titratable acidity during dough fermentation depending on the dosage of a mixture of sprouted oatmeal flour and sprouted green buckwheat flour in wheat-rye bread: 1 – control; 2 – 7.5% (2.5% – flour from sprouted green buckwheat; 5% – flour from sprouted oatmeal).

The effect of wheat sprout powder on titratable acidity during dough fermentation was studied; the results are presented in Figures 13, 14. Samples with the addition of wheat sprout powder are closest in titratable acidity to the control sample.

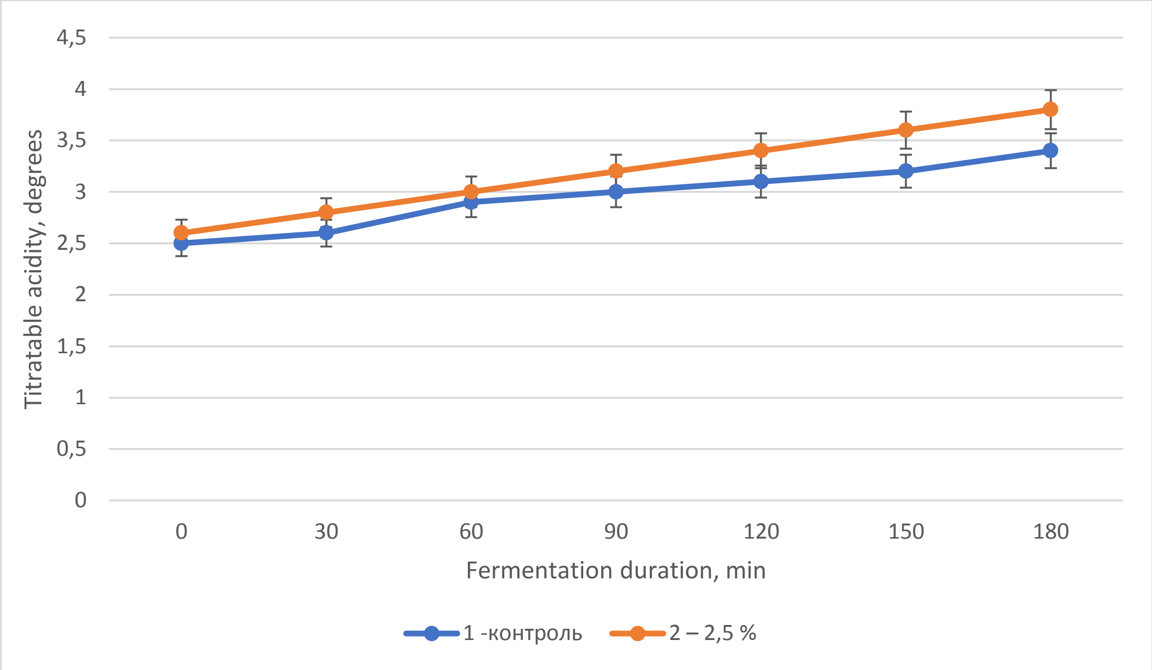

Figure 13. Change in titratable acidity during dough fermentation depending on the dosage of powder from wheat sprouts in wheat bread: 1 – control; 2 – 2.5%.

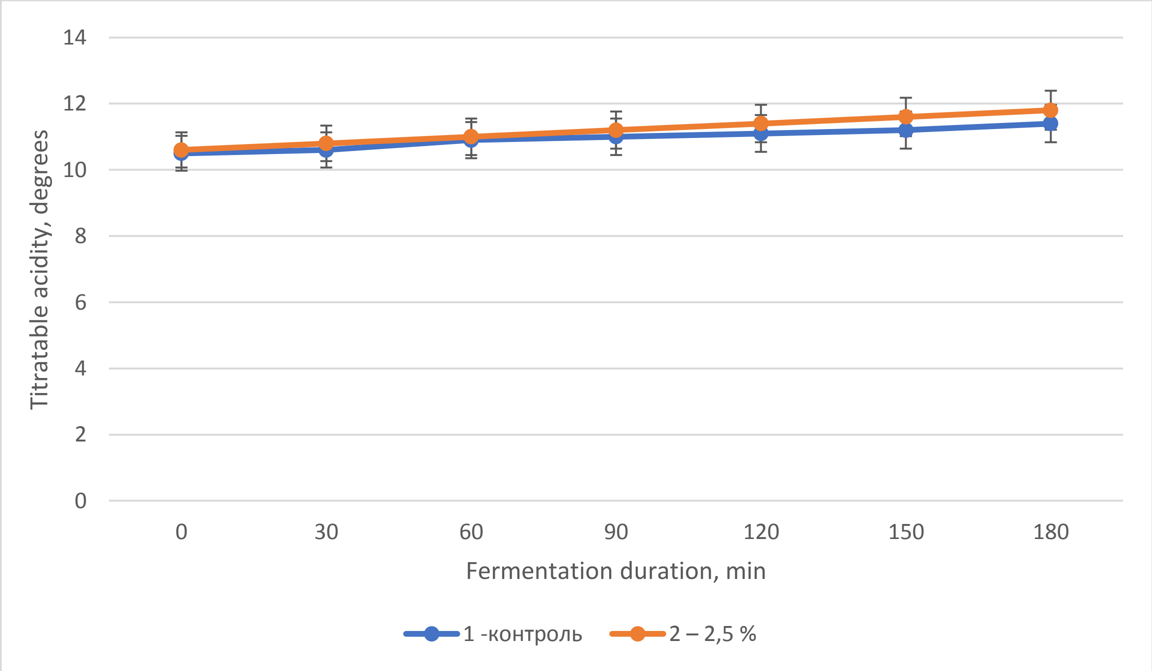

Figure 14. Change in titratable acidity during dough fermentation depending on the dosage of wheat sprout powder in wheat-rye: 1 – control; 2 – 2.5%.

Conclusion. The use of herbal additives promotes the intensification of the vital activity of yeast and acid-forming microflora, this is expressed in a larger volume, better fermentation activity and acidity of the dough, this fact is probably associated with a more favorable composition of nutrients of the herbal additives introduced. An increase in the content of plant additives in the ingredient composition of bread helps to increase the acidity of the dough compared to control samples. The introduction of apple flour and a mixture of pea protein isolate and apple flour into the bread recipe leads to an increase in initial acidity compared to control samples by an average of 1.5 degrees while maintaining dynamics during the fermentation process, which is the basis for reducing the duration of the technological cycle. The acidity of the dough of samples with pea protein isolate and sprouted green buckwheat flour increases by an average of 1 degree. Wheat sprout powder, a mixture of sprouted oatmeal flour and sprouted green buckwheat flour, sprouted oatmeal flour slightly increase the acidity of wheat and wheat-rye bread dough.

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ИНФОРМАЦИЯ ОБ АВТОРАХ

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Вклад авторов: все авторы внесли равный вклад в подготовку публикации.

Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

Contribution of the authors: the authors contributed equally to this article.

Conflict of interest: the authors declare no conflicts of interests.

Статья поступила в редакцию: 12.07.2023;
одобрена после рецензирования: 15.08.2023;
принята к публикации: 05.09.2023.

The article was submitted: 12.07.2023;
approved after reviewing: 15.08.2023;
accepted for publication: 05.09.2023.