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РОЗДІЛ 1

АКТУАЛЬНІ ПИТАННЯ ЗБЕРІГАННЯ ТА ТЕХНОЛОГІЇ ПЕРЕРОБКИ ЗЕРНА, ОВОЧІВ ТА ФРУКТІВ

потребам та особливостям культури, водночас потребують постійного вдосконалення технології вирощування, які б найбільш повно відповідали фізіологічним потребам культури та кліматичним змінам регіону.

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ADJUSTING WHEAT FLOUR QUALITY BY ENZYMES: COMPARISION OF SOME ENZYMES MIXES

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Анотація.

Борошно є складним багатокомпонентним продуктом і повинно відповідати ряду вимог до складу та властивостей. Різні умови вирощування та зберігання зерна призводять до суттєвих відхилень показників його якостей при надходженні до борошномельних підприємств.

Стаття оглядає питання коригування пшеничного борошна за допомогою різних ферментів та їх сумішей.

Модифікація борошна відбувається за допомогою ряду технологічних добавок, одними з яких є ферментні препарати. Дія ферментів значною мірою дозволяє коригувати властивості тіста та готових кінцевих виробів з борошна. Крім того, ферменти додатково впливають на показники поживності борошна, що дає можливість при виробництві борошна використовувати зерно пониженої якості, при зберіганні запланованих показників якості борошна. Функціональні властивості фракцій борошна, отриманих на різних технологічних етапах, залежать від вмісту різних анатомічних частин зерна, з яких вони походять. В залежності від виду розмелювального обладнання суттєво варіюються крупність, ступінь пошкодження крохмалю, вміст білків, жирів, зольність та інтенсивність ферментативної активності. Все це дає підстави рекомендувати введення ферментів ще на етапі виробництва борошна, а не безпосередньо при виробництві виробів з борошна.

Актуальним також є питання усунення антипоживних факторів, присутніх в борошні, які значною мірою є інгібіторами дії як власних ферментних систем зерна, так і додатково введених ферментних препаратів.

Було порівняно дію різних ферментів та їх сумішей, доданих в пшеничне борошно вищого ґатунку, на кінцеві хлібні вироби, отримані з такого борошна, шляхом визначення таких показників як еластичність, запах, смак, об’єм хліба, розмір пор, об’ємна вага, тощо.

Надані рекомендації та запропоновані напрямки подальших досліджень.

Introduction

The dynamics of human development is directly related to its diet. Any technological or social breakthroughs depended directly on what a particular social group was eating. Indicative in this regard is the use of food made of grain processing products. The first successful attempts to domesticate wild wheat, barley, peas, nut, lentils etc. dated about 12000 BC in Fertile Crescent (Arabia), and findings of the first grain processing areas and objects dated about 8000 BC in Jericho. There were specially prepared areas for grain peeling and rubbing in the primitive mortars. Later, there was found the way of grain rubbing in flour using sever-

al mills. Due to the ease of implementation, this method can still be found today in a number of countries as part of their cultural legacy.

With the development of science and knowledge of grain naturally there was a need to use a more complicated approach to grain processing technology. That allowed to differentiate significantly the products obtained from the processing of grain, basing on their nutritional and technological properties. Later, the combination of such products made it possible for moving to complex formulations that were balanced over number of indicators.

The rationale for choosing a research topic, relevance

Wheat is the main grain crop for the production of bread products in Ukraine. Grown in different climatic conditions, on different soils, wheat varieties differ significantly from each other by a number of technological properties [1]. Such diversity significantly affects the structure of the of wheat grain processing technological cycle – a set of preparation modes, the grinding of grain, and also determines the quality and output of end products [2].

Rationale. Classic wheat grinding is a mechanical gradual reduction process, during which the endosperm is separated from the bran and embryos. During the production process of high-quality flour, a significant amount of nutrients is eliminated [1, 3]. Because of this, the quality and quantity of streams in the production of flour significantly differ both in technological parameters and in the set of nutritional components [4]. The combination of different streams leads to the appearance of different types of flour for a variety of end-use products.

Despite the efficiency of combining technological flows and providing indicators of finished flour, observance of effective rheological parameters of the dough in some cases requires the introduction of additional technological additives. The feasibility of using them is substantiated, mainly, by the influence on the rheology of the dough and finished products [5]. However, we cannot ignore the effect of some technological additives, in particular, enzymes systems, on the anti-nutritional factors. This results to an increase of the bioavailability of a number of nutrients.

The purpose and objectives of the study. The study of enzyme systems of flour in the process of making flour products devoted to numerous publications by both home and foreign authors. Significant changes in the technologies of enzyme synthesis over the last 15 years have led to a significant differentiation of conditions and mechanisms for their action, as well as the emergence of a huge number of highly specialized products.

This makes the purpose of this work as practical approaches to the adjusting of flour properties with the enzyme products of different manufacturers that currently available. As the priority objectives, it will be expedient to compare efficiency of different product and end-decisions, as well as to make some recommendations and to highlight the main factors affecting the bread-making properties of flour.

Relevance of research. Monitoring studies of wheat grain quality show a strong tendency for its decrease, and as a result – the production of flour with unsatisfactory baking properties [6-11]. In this regard, the flour mills face the problem to bring the bread-making properties of the flour to the standard level. Therefore, the technological additives implementation for flour bettering at Ukrainian mills is relevant [5, 12, 13].

Special additives using is an effective direction to adjust the properties of wheat and rye purpose flour and to increase its range [4]. This led to the expediency of their adding at the final stages of flour production to adjust needed baking properties for customers.

The use of enzymes in bread-making: advantages and problems

The current tendency of replacing chemical additives in flour with analogues from natural sources is determined more to the need for enrichment of food products with components that have a beneficial effect on human health. Numerous studies have shown the neces-

sity of using enzymes to obtain bread-rich cellulose [14, 15], to develop of gluten-free products [16], and products with high arabinoxylan content with high prebiotic potential [15].

Enzyme additives have a number of advantages compared with other food additives. The main ones are natural origin and high specificity of action. That ensures ecological compatibility of end products and the lack of negative effects that occur in the latest stages of production. In addition, in practice, enzymes allow bakeries to expand the products range of their enterprise and save both raw materials and energy.

Today, the rapid development of biotechnology has made enzyme preparations indispensable participant in many of food technologies. Usage of enzymes can increase the speed of technological processes, significantly increase the output of finished products, improve its quality, save valuable raw materials and reduce the amount of waste.

For industrial manufacture of enzymes for food purposes, sources of animal, plant and microbiological origin are used. Different origin of enzymes determines the conditions of their application. The modern market of enzymes is largely represented by enzymes of bacterial genesis, since the rate and volume of production of enzyme preparations for bacterial genesis are significantly higher compared to fungal genesis enzymes. The enzymes of the bacterial genesis are more narrowly specialized in relation to the substrate comparing to enzymes of fungal origin. This is to a certain extent a useful feature for using them in the flour-mill industry, since it allows adjust the production process to be more predictable.

We should also mention about the usage of enzyme preparations which is derived from of gene-modified producents. Despite the different points of view concerning the lawfulness of the use of such organisms in the issue of human food security, nowadays the high rate of purification during production actually excludes the presence of residues of microorganisms with a modified genome in their composition, and therefore the use of such enzyme products is completely safe and expedient [17, 18].

Inhibitors of enzymes in the grain differ for their origin. The inhibitor action is very often complex, which significantly impairs the control of the enzyme systems behavior of during dough process. However, the issue of reducing the natural inhibitors impact is extremely relevant for whole-wheat flour, which is considered more useful than white flour. Although quantitative indicators, forms of vitamins and minerals in such grain shells are often indigestible for human. One of example is indigestible phosphorus, calcium, magnesium, and zinc in wheat grains, which are bound tightly in the structure of the myo-inosithexafosforic acid salts molecules, serving as a kind of "nutrient depot" in the grain and almost not digested by humans. In order to convert the useful components into easily digestible forms, it is expedient to develop enzyme complexes that contribute to this process.

Another problem in the use of complex enzyme systems in the production of flour is the complexity of evaluating of own grain enzyme system activity. While making different purpose flour from Ukrainian grain, you need to know how much external enzyme activity to add. That requires knowing own grain enzyme systems activity. Currently, such an assessment requires either specialized laboratory and appropriate methods of analysis or to use some indicators (e.g., grain falling number, gluten deformation index, etc.) that characterize indirectly protein-protease, carbohydrate-amylase and lipase complexes in grain. The development of inexpensive methods for express estimation of own enzyme systems of grain would be extremely relevant, especially in cases of damage to the grain from corn bug. Given the assessment of the quality of the grain, the introduction of enzyme preparations should be carried out at the stage of flour production, to ensure stable indicators of its quality.

Materials and methods.

Different enzyme products of wide range of manufacturers were added to higher grade wheat flour in order to compare with control sample of flour without added enzymes. A bread samples made from these flours were baked and compared by appearance, porosity, smell and taste, volume, weight, color and elasticity of crumb. Further combinations of enzymes were compared to `pure` control flour sample:

— Maltogenic amylase;
— Fungal heat-stable amylase;
— Amylase and Glucoamylase;
— Amylase and Phosphatase;
— Xylanase and Cellulase;
— Xylanase, Cellulase and Phosphatase.

Dosages were taken from manufacturer's recommendations.

Results.

All enzyme products added to flour demonstrated showed good elasticity, white crumb, good taste and smell in final baked bread.

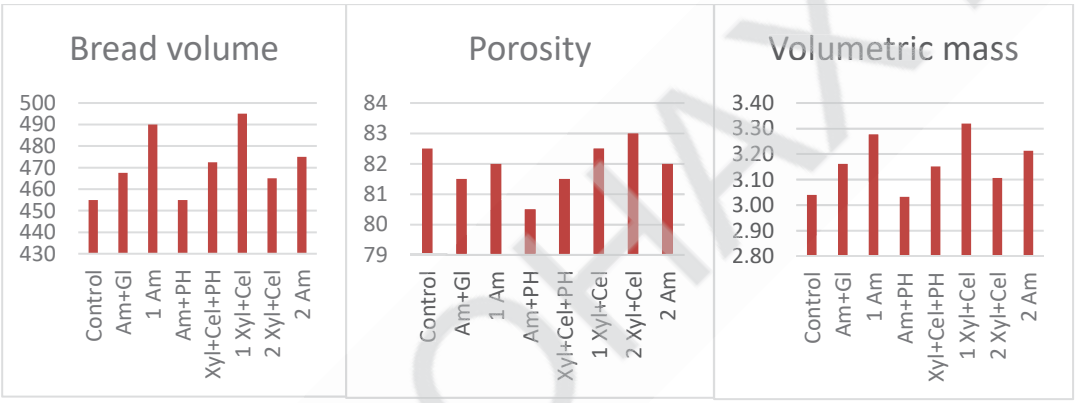

Figure 1

According to Fig. 1 data, maximum bread volume was achieved while using 1) pure fungal amylase 2) combination of xylanase and cellulase. Smallest pore size was achieved by using 1) combination of amylase and phosphatase 2) xylanase and cellulase. Maximum volumetric mass was shown by use of 1) pure fungal amylase 2) combination of xylanase, phosphatase and cellulase. All other enzyme combinations added to flour demonstrated slightly higher or equal indexes comparing to control flour sample.

Conclusions and further development prospects.

1. Own enzyme activity estimation of flour cannot be made by direct methods at flour mills. Indirectly, the amylolytic activity of the flour can be estimated by the falling number, the proteolytic activity – by gluten deformation index.

2. The enzymatic activity of the flour may be corrected by adding external enzyme preparations. Enzyme-based improvers for flour production are widely used in western countries; in Ukraine this promising direction has not yet become significantly widespread.

3. In order to improve the baking properties of flour, it is advisable to use enzyme preparations of complex action, but neither their formulation nor the dosage for purpose flour from Ukrainian grain is not scientifically based yet.

4. Usage of either flour with lower quality indexes or whole-wheat flour is more preferable due to stronger enzymes action and, therefore, clearly expressed results.

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Наукове видання

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