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TECHNOLOGICAL CHARACTERISTICS OF YEAST-CONTAINING CAKES PRODUCTION USING WAXY WHEAT FLOUR

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Abstract. This article shows the feasibility of using waxy wheat flour, the starch of which doesn`t contain amylose, in order to stabilize the quality of yeast-containing cakes. The influence of the waxy wheat flour mass fraction and the stage of its adding on the physical, chemical and organoleptic characteristics of the products are studied. According to the technological properties of a new type of wheat flour, two methods of its adding are proposed – adding the maximum amount of waxy wheat flour at dough kneading stage or using the mixture of waxy and bakery wheat flours for kneading sourdough and dough. It is shown that the replacement of 60 % bakery wheat flour with waxy wheat flour in the recipe of yeast-containing cakes at the dough kneading stage contributes to the production of products with higher quality and organoleptic characteristics compared to both the control and cakes based on a mixture of different types of wheat flour. These samples are characterized by increased by 1.7 – 11.3 % specific volume, porosity – 2.6 – 5.5 % and the total deformation of the crumb – 6.5 – 41.4 %.

Key words: waxy wheat flour, yeast-containing cakes, porosity, specific volume, organoleptic characteristics, quality.

ОСОБЛИВОСТІ ТЕХНОЛОГІЇ КЕКСІВ НА ДРІЖДЖАХ ПРИ ВИКОРИСТАННІ БОРОШНА З ВАКСІ-ПШЕНИЦІ

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Анотація. У представленій статті показано доцільність використання борошна з пшениці ваксі, для стабілізації якості кексів на дріжджах. Досліджено вплив масової частки безамілозного пшеничного борошна і стадії його внесення на фізико-хімічні та органолептичні показники готових виробів. Із огляду на особливості технологічних властивостей нового виду пшеничного борошна, запропоновано два способи приготування кексів із його використанням – внесення максимальної кількості борошна з ваксі пшениці на стадії замісу тіста або заміс опари і тіста на суміші хлібопекарського пшеничного борошна з безамілозним. Показано, що заміна 60 % хлібопекарського пшеничного борошна на борошно з пшениці ваксі в рецептурі кексів на дріжджах, при внесенні його на стадії замісу тіста, сприяє отриманню виробів з більш високими показниками якості та органолептичними характеристиками, в порівнянні як з контролем, так і з кексами з суміші різних видів пшеничного борошна. Так, дані зразки відрізнялися підвищеним на 1,7 – 11,3 % питомим об'ємом, пористістю – на 2,6 – 5,5 % і загальною деформацією м'якушки – на 6,5 – 41,4 %.

Ключові слова: борошно з пшениці ваксі, кекси на дріжджах, пористість, питомий об`єм, органолептична оцінка, якість.

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Introduction

High quality of pastry is a major factor to ensure their competitiveness. Manufacturers of this product group increasingly began to use innovative technologies and appled modern organization of the quality management system, but also the formation of high consumer properties of flour products is mainly dependent on the technological properties of the raw materials.

Waxy wheat flour (WWF) represents a special interest among the new varieties of Ukrainian breeding crops with specific characteristics. A numbers of studies have been conducted to confirm the potential of WWF as a main component of the flour products recipe due to its modified starch (non-amylose) content [1-3].

Statement of the Problem

Bakery products constitute one of the most consumed foods in our country. Among them, cakes are popular and are associated in consumer`s mind with the delicious sponge product with desired organoleptic characteristics. It should be noted that assortment of cakes is wide enough and is defined by the ratio of

their recipe ingredients and the type of used leavening agent.

For the formation of the porous structure of pastry products the following leavening agents are applied: chemical – mixtures or compounds that release gases when they react with each other, with moisture, or with heat. Most are based on a combination of acid (usually a low molecular weight organic acid) and a salt of bicarbonate; biological – the yeast cells leaven dough by fermentation of the glucose present and excreting its waste products (alcohol and carbon dioxide gas); physical - as a result of mechanical action by which air is incorporated [4,5]. Based on loosening method the cakes are classified as cakes containing chemical leavens, yeast-containing cakes, without leavening agent.

At the same time, the yeast-containing cakes, despite their high organoleptic characteristics and traditional popularity among consumers of these products, are produced in a small volume, which is probably due to a long process of their production and dependence of the products quality on the technological properties of the main raw material – wheat flour. Thus, the current problem is to find technological solutions directed at the intensification of production and the stabilization of the quality of yeast-containing cakes without the use of synthetic improvers.

Literature review

Researchers throughout the world have tried to stabilize the cake`s quality through the addition of various untraditional recipe ingredients and changes of technological parameters during its production. Gubanenko G.A. reported that adding 0,6 % of Scotch pinewood greenery pectin to the weight of flour exert a favorable effect on the quality of yeast-containing cakes. Samples were characterized by increased specific volume and porosity of crumb compared with the control [6]. For intensification of the technological process of yeast-containing cakes production it is suggested to use rye sourdough. Cakes, containing 10 % of rye flour in blend, also had higher specific volume and more loosened crumb [7]. Prisukhina N.V. found that adding 4 % of the dog rose powder in the recipe of yeast-containing cakes caused to the production of products with high consumer characteristics. But when the level of additive was increased, the quality of cakes decreased. Samples with more than 6 % of the dog rose powder were characterized with a pronounced flavor and taste of rose hips and reddish crumb color [8]. Another work investigated the effects of substituting 10 %, 15 % or 20 % of sprouted or blanched soybean flour and 30 % cassava flour for wheat flour in cakes. Increasing mass fraction of soy flour in cakes increased nutritive value of samples. The authors reported that sensory analysis indicated high acceptability for all the cake samples with soybean and cassava flour [9]. It should be noted that despite the effectiveness of the proposed studies, the use of non-traditional ingredients in recipe requires additional technological preparations and is not convenient for the manufacturer.

According to the results of previous studies it was found that adding WWF to the recipe of yeast-containing cakes leads to intensification of its dough fermentation as indicated by increased acidity and gas production compared with samples based on bread wheat flour (BWF). Thus, it can be assumed that the use of WWF in yeast-containing cakes technology will improve the quality of products, the porous structure is formed due the fermentation process.

The effect of waxy wheat flour and the stage of its adding on the quality of yeast-containing cakes

The objective of this study was to determine the effect of waxy wheat flour and the stage of its adding on the quality of yeast-containing cakes.

To justify the rational mass fraction of the WWF and the stage of its adding, taking into account the high autolytic activity [10], its effect on the quality of baked products were studied. We have suggested two methods – adding the maximum amount of WWF at dough kneading stage (method 1), and using the mixture of WWF and BWF (method 2).

The research of WWF influence and the stage of its adding on moisture content and acidity of yeast-containing cakes shows that their values remained within the requirements of the standard (acidity – less than 2,5 degree, moisture content – 25,0±3 %) [11]. Such results were obtained due to the reduction of the dough fermentation time in case of its intensification. Also the results indicated the increase of moisture content of cakes with WWF. Thus, compared with a control, moisture content for sample with 60 % waxy flour blend increased by 1,0 % (1st method of adding), and using a mixture BWF and WWF (2-nd method of adding) – by 2,0 %.

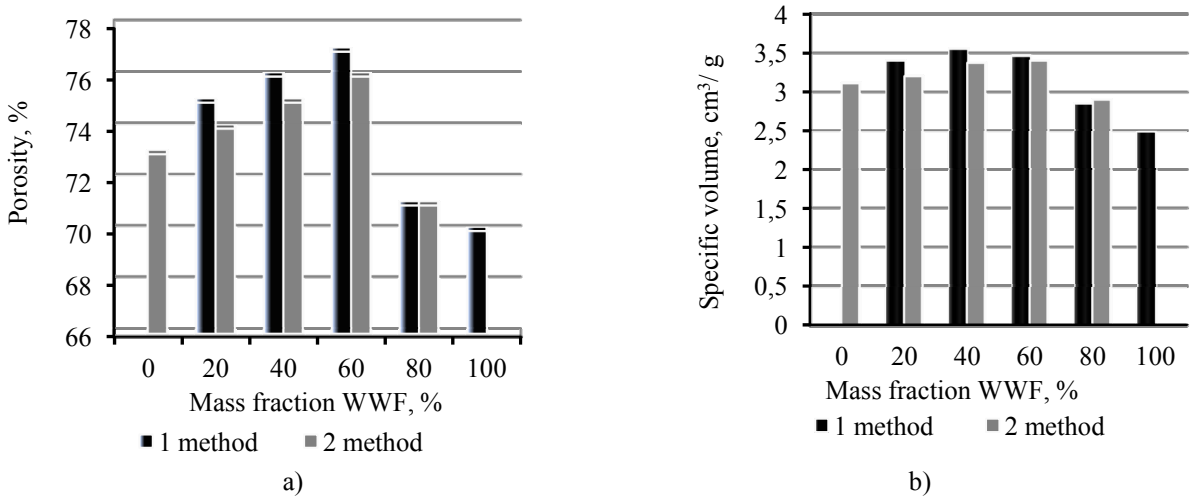
Fraction of gas (air) phase, which forms the organoleptic characteristics of products, was evaluated for cake`s porosity. It is found that the replacement of 40 % BWF on WWF in the recipe of yeast-containing cakes according to the 1st method has increased the porosity by 4 % compared with the control, but using mixtures of different types of flour (2nd method) – by 2 % (Fig. 1a).

The obtained results were mostly attributed to the higher gas production in yeast semi-finished products with WWF from the time of mixing till the first minute of baking compared with samples based on BWF. As it`s known, under high temperatures in the baking oven gas bubbles, which are products of fermentation, along with water vapor and alcohol, increase its volume and evaporate which caused transformation of cake`s dough into a light, porous flavourful product [12].

Another characteristic, releated to the porosity of products from yeast dough, is the specific volume.

At 60 % addition of WWF in the recipe of cakes, the specific volume increased (Fig. 1b).

Addition of more than 60 % WWF, in spite of the higher gas (carbon dioxide) production during fermentation of cake`s semi-products, caused to the reduction of the porosity and the specific volume of products. We speculate that such results could be attributed to the intensification of the biochemical processes during maturation of cake`s dough [13], which leads to the greater gas production in dough system, to the increasing of gas cell volume and gas pressure inside the cells due to the thermal expansion. In this case, the cell walls expand to their maximum and the wall tension rises above its breaking point, which leads to evaporation of substantial part of gases into the environment of the baking oven and reducing the amount of the air phase in the products.

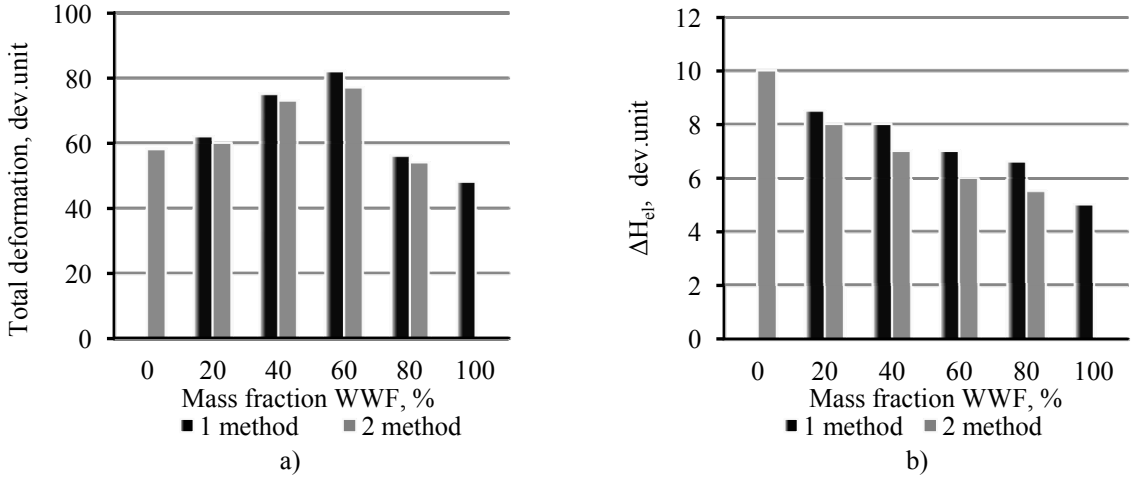


a) b)

Fig. 1. Influence of WWF and the stage of its adding on porosity (a) and specific volume (b) of yeast-containing cakes.

Reduced porosity and specific volume of cakes with a mass fraction of 80 – 100 % WWF is also due to the influence of waxy wheat flour on the rheological properties of dough. Addition of WWF in the recipe of yeast-containing cakes resulted in a significant increase of plastic viscosity, which serves as a structural-mechanical barrier for the formation of the dough porous structure, and prevents the development of pores and volume of pastry dough as a result of plastic deformation [14].

The structure and mechanical properties of crumb, which characterize the ability of baked products to resist compression applied or changed under its effect, were studied by changing the total deformation of cakes crumb and its elastic deformation (ΔH_{el}). The data show that the use of WWF leads to a change in the crumb characteristics (Fig. 2).



a) b)

Fig. 2. Influence of WWF and the stage of its adding on the structure and mechanical properties of crumb

The total deformation of crumb significantly increased for samples with a mass fraction of 20 – 60 % WWF, which technology provides the addition of WWF on the stage of kneading (1st method). Thus, compared with the control, total deformation of crumb increased by 7 – 41 % for the first method, whereas for the second – by 3 –33 %. The obtained results were due to less intensive gas production in the dough, kneaded with a blend of different types of wheat flour (2st method), and related to the fact that the main part of the sugars, introduced in semi-finished products with the WWF, fermented at the first stage of dough preparation – in sourdough. Adding the new type of wheat flour according to the first method promotes intensification of cake dough fermentation mostly, resulting in a more porous crumb, which has a lower ability to retain its shape at applied compression.

The influence of WWF and the stage of its adding on the elastic properties of the yeast-containing cake crumb were studied. When the BWF was replaced with 40 % WWF, the elasticity of the crumb decreased by 20 % compared to the control for the for the first method samples and for samples with BWF and WWF (2nd method) – by 30 %. Thus, cake crumb, containing 100 % WWF, waa characterized by a decrease of this value by 2 times. This is due to the higher autolytic activity of the WWF [10], which leads to more active starch molecules depolymerization by amylase. This process is accompanied by the formation of more water-soluble substances, leading to the formation of sticky crumb with reduced ability to recover from deformation. Also the obtained results are due to reduced content of gluten proteins in WWF [15], which does not allow the formation of sufficiently strong structure of baked products, defining its structural and mechanical characteristics.

Organoleptic characteristics of pastry are the main criterion that oriented the consumer. The texture of baked products affect on the sensory impression during its consumption and has a great influence on the perception of their quality. Formation of these characteristics is largely determined by the quality of used raw materials and technological parameters of their production.

Due to the fact that the physico-chemical characteristics (porosity, specific volume) were higher for samples with a mass fraction of 60 % WWF (1st method) and 40 % WWF (method 2), this blending ratio was used to compare their organoleptic profilograms with control and cakes based on WWF (Fig. 3).

The results indicated that adding of WWF in recommended blending ratio in recipe of cakes leads to improvement of its consumer characteristics. Baked products were characterized with increased volume, smooth surface, more saturated color of crust, elastic finely porous crumb, increased cell wall thickness. Cakes based on WWF had unsatisfactory quality – insufficient volume, lumpy, soggy and sticky crumb with uneven large pores.

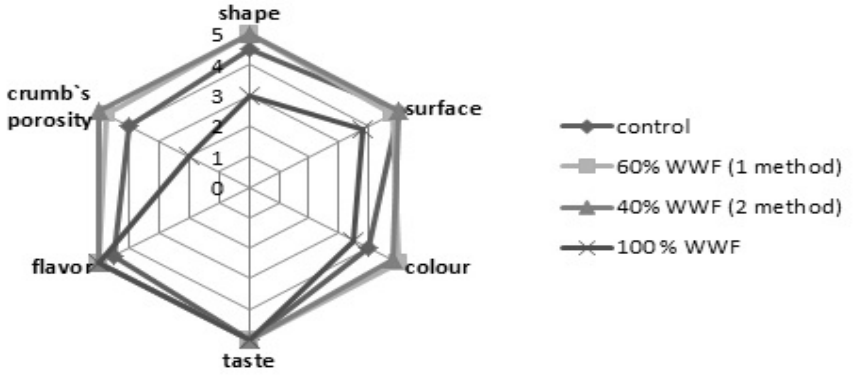


Fig.3. Profilograms of yeast-containing cakes

Conclusion

The studies found that the replacement of 60 % BWF with waxy wheat flour at its maximum introduction during dough kneading stage (1st method) or usage of a mixture of two types of flour with a mass fraction of 40% WWF (2nd method) results in a yeast-containing cakes with high physicochemical and organoleptic characteristics compared to samples based on BWF.

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ОСОБЕННОСТИ ТЕХНОЛОГИИ КЕКСОВ НА ДРОЖЖАХ ПРИ ИСПОЛЬЗОВАНИИ МУКИ ИЗ ВАКСИ-ПШЕНИЦЫ

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Аннотация. В представленной статье показана целесообразность использования муки из пшеницы вакси, в составе крахмала которой отсутствует амилоза, для стабилизации качества кексов на дрожжах. Исследовано влияние массовой доли безамилозной пшеничной муки и стадии ее внесения на физико-химические и органолептические характеристики готовых изделий. Учитывая особенности технологических свойств нового вида пшеничной муки, предложены два способа приготовления кексов с ее использованием – внесение максимального количества муки из вакси пшеницы на стадии замеса теста либо замес опары и теста на смеси хлебопекарной пшеничной муки с безамилозной. Показано, что замена 60 % хлебопекарной пшеничной муки на муку из пшеницы вакси в рецептуре кексов на дрожжах при внесении ее на стадии замеса теста способствует получению изделий с более высокими показателями качества и органолептическими характеристиками по сравнению как с контролем, так и с кексами из смеси различных видов пшеничной муки. Так, данные образцы отличались повышенным на 1,7 – 11,3 % удельным объемом, пористостью – на 2,6 –5,5 % и общей деформацией мякиша – на 6,5 – 41,4 %.

Ключевые слова: мука из пшеницы вакси, кексы на дрожжах, пористость, удельный объем,органолептическая оценка, качество.

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