Journal of Chemistry and Technologies, 2025, *33*(2), 519-527

Journal of Chemistry and Technologies

pISSN 2663-2934 (Print), ISSN 2663-2942 (Online).

journal homepage: http://chemistry.dnu.dp.ua
editorial e-mail: chem.dnu@gmail.com

UDC 664.682-024:634.54:543.06

THE EFFECT OF HAZELNUT FLOUR ON THE STRUCTURAL AND MECHANICAL PROPERTIES OF DOUGH FOR SHORTBREAD COOKIES

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Received 16 February 2025; accepted 28 April 2025; available online 15 July 2025

Abstract

The aim of this study was to determine the effect of defatted hazelnut flour on the structural and mechanical properties of dough for shortbread cookies. The test samples were made using hazelnut flour to replace 15, 30 and 45 % of wheat flour with an equivalent amount, adding turmeric powder, as well as partially (30 %) replacing butter with hazelnut flour. These types of flour have different chemical and granular compositions. The quality of wheat and hazelnut flour used to produce shortbread cookies was assessed, and it was found that the moisture content of wheat flour was higher than that of hazelnut flour. The acidity was higher in hazelnut flour. The water-binding capacity of wheat flour was higher than that of hazelnut flour, and the fat-binding capacity was higher in hazelnut flour. The ash content in hazelnut flour was 10 times higher than in wheat flour. The paper establishes the technological parameters of dough mixing and baking. When determining the changes in the dough samples by structural and mechanical properties, it was found that the strength of the experimental samples significantly increased. Thus, in samples with 15; 30 and 45 % hazelnut flour and a 30 % butter replacement, the strength increased by 3.5; 4 and 7 times, respectively, compared to the control sample. When determining the adhesive strength, it was found that in samples with 15 % and 30 % hazelnut flour and 30 % butter replacement, the specific tear strength increased. And in the sample with the addition of 45 % hazelnut flour and a 30 % butter replacement, the adhesive strength of the dough decreased. The optimal ratio of recipe ingredients, namely hazelnut and wheat flour, to provide the necessary technological properties of the dough was recommended.

Keywords: hazelnut flour; wheat flour; turmeric; shortbread cookies; structural and mechanical properties of dough; shear stress limit; adhesive strength; technological parameters of dough preparation.

ВПЛИВ ФУНДУЧНОГО БОРОШНА НА СТРУКТУРНО-МЕХАНІЧНІ ВЛАСТИВОСТІ ТІСТА ДЛЯ ЗДОБНОГО ПЕЧИВА

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Анотація

Метою даного дослідження було визначення впливу знежиреного фундучного борошна на структурно-механічні властивості тіста для здобного печива. Дослідні зразки виготовляли з використанням фундучного борошна в кількості 15, 30 та 45 % шляхом заміни еквівалентної частки пшеничного борошна, додавання порошку куркуми, а також часткової (30 %) заміни вершкового масла на фундучне борошно. Дані види борошна мають різний хімічний та гранулометричний склад. Оцінено якість пшеничного та фундучного борошна, що використовуються для одержання печива здобного, і встановлено, що вологість пшеничного борошна вища, ніж у фундучного. Кислотність вища у фундучного борошна. Водозв'язувальна здатність пшеничного борошна вища, ніж у борошна з фундука, а жирозв'язувальна – більша у борошна з фундука. Вміст золи в фундучному борошні в 10 разів більше, ніж у пшеничного. В роботі встановлені технологічні параметри замісу тіста та випікання. Під час визначення зміни зразків тіста за структурно-механічними властивостями встановлено, що в дослідних зразках значно підвищується міцність. Так, у зразках з 15, 30 та 45 % борошна з фундука та заміною 30 % вершкового масла міцність зросла відповідно у 3.5, 4 та 7 разів порівняно з контрольним зразком. Визначення адгезійної міцності встановило, що в зразках із внесенням 15 % та 30 % борошна з фундука і заміною 30 % вершкового масла відбувається підвищення питомої сили відриву. А для зразку з внесенням 45 % борошна з фундука та заміною 30 % вершкового масла відбувається зменшення адгезійної міцності тіста. Рекомендовано оптимальне співвідношення складових рецептури, а саме фундучного та пшеничного борошна, яке забезпечує необхідні технологічні характеристики тіста.

Ключові слова: фундучне борошно; пшеничне борошно; куркума; здобне печиво; структурно-механічні властивості тіста; гранична напруга зсуву; адгезійна міцність; технологічні параметри замісу тіста.

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Introduction

Confectionery has traditionally been associated with high calorie content, large amounts of sugar, fat and flour, which limits its consumption for certain categories of people, such as diabetics, overweight people or those who follow healthy eating habits. Hazelnut flour is one of the most promising ingredients for creating healthy confectionery products. Hazelnut is the second most popular nut in the world after almonds [1; 2]. Hazelnuts are rich in nutrients and are characterized by a high content of fat, protein, vitamin E, and minerals [3; 4]. Unfortunately, the culture of nut consumption is not sufficiently developed in Ukraine due to high prices for this type of plant material, which is mainly imported to Ukraine. But today, the situation in the country has changed and Ukrainian nut producers are present on the market, which will allow the introduction of this local raw material into production and the replacement of wheat flour in confectionery recipes [5]. Turmeric is also a natural ingredient that is advisable to include in food formulations [6; 7]. Curcumin is a powerful antioxidant [8], can improve brain function [9], and is effective in treating depression [10]. It can reduce the risk of cardiovascular disease [11], improves the health of patients with arthritis [12], has a powerful anti-inflammatory effect [13], and exhibits antiparasitic, antispasmodic, antitumor, radioprotective, and anticarcinogenic activity [14; 15].

Currently, the Ukrainian confectionery market does not have any BCAs using hazelnut flour and turmeric. However, there are scientific developments in the works of world scientists on the introduction of these ingredients into the composition of finished products [16–23]. Therefore, the introduction of hazelnut flour and turmeric into flour confectionery is an urgent task for scientists.

The aim of the work was to investigate the effect of defatted hazelnut flour on the structural and mechanical properties of dough and substantiate the feasibility of its use in shortbread cookie technology.

To achieve the goal, it was necessary to complete the following tasks:

- justify the choice of hazelnut flour and turmeric as recipe ingredients;
- study the quality of wheat and hazelnut flour;
- determine the effect of hazelnut flour on the quantity and quality of gluten;
- experimentally determine the technological parameters for dough preparation;
- investigate the effect of hazelnut flour on the structural and mechanical properties of dough for shortbread pastry with 30 % butter replaced and turmeric powder added;

Research objects and methods

The object of the study was shortbread cookies "Orange" made according to the unified recipe No. 186e [24] (control sample) and shortbread cookies with 15, 30 and 45 % defatted hazelnut flour replacing equivalent amount of wheat flour and turmeric powder (experimental samples).

Raw Materials

Raw materials from the following manufacturers were used: hazelnut flour, skimmed, produced by LLC "NVO Filbert". Metro Chef wheat flour; butter Extra 82.5 %, Pervomaisky Milk Cannery; turmeric powder Everest Everest Food Products Pvt. Ltd. (India).

Analyasis method

The moisture content of the flour was determined according to DSTU GOST 29144:2009 "Grain and grain products. Determination of moisture content".

The content of raw and dry gluten in the flour, its hydration capacity, and gluten quality assessment were performed according to the methods detailed in the laboratory manual [25].

The moisture content of dough and cookies (DSTU 4910:2008) was determined by accelerated method: drying a crushed sample weighing 5 g in pre-dried boxes in a drying cabinet at a temperature of (130±2) °C for 30 min for cookies and 40 min for dough; or in a drying oven at 160 °C for 5 min [25].

The adhesion stress was determined by the method of separating the plate from the structured body (dough) on a device developed in ONAFT [26].

The shear stress limit was determined on an AP-4/1 penetrometer, the value was calculated using the Rebinder formula [25].

The alkalinity of cookies (DSTU 5024:2008) was determined by titrating the product filtrate with a solution of sulfuric or hydrochloric acid with a molar concentration of 0.1 mol/dm^3 with bromothymol blue indicator [25].

Wetness capacity (DSTU 5023:2008) was determined by the increase in the mass of pastries when immersed in water at 20 °C for a set time [25].

The fat-binding capacity (FBC) of flour was determined according to the following method. A

1 g sample was placed in a centrifuge tube, 10 g of unrefined sunflower oil was added and centrifuged for 1 min at 1000 rpm. The mixture was left to stand for 5 min, then centrifuged again for 15 min at 4000 rpm. The oil that was not absorbed was then drained, and the tubes were left in an inverted position on filter paper. After 10 min, the tubes were weighed and calculated using the formula:

$$FBC= ((m_2 – m_1) / m_{s)} *100\%,$$

where m_1 was the mass of the centrifuge tube with flour before adding oil, g;
m_s was the mass of the flour sample, g;
m_2 was the mass of the centrifuge tube with flour after draining the oil, g.

The water-binding capacity (WBC) of flour was determined by centrifugation (according to the Yamazaki method). 5 g of flour and 25 g of water were placed in a 50 ml test tube. The closed test tube was shaken for 20 minutes, and then centrifuged at 1000 rpm for 15 minutes. The solution was decanted. The test tube with the precipitate was weighed.

$$WBC = (m_2 – m_0) / m_1,$$

where m_0 was the mass of the empty test tube, g;
m_1 was the mass of the flour sample, g;
m_2 was the mass of the test tube with wet flour, g.

The ash content was determined by the dry method without an accelerator [25].

Method of making cookies

The dough of the experimental samples was mixed according to the technology of preparation of the control sample, but with certain changes: the ingredient preparation was carried out according to the instructions for preventing the impurities from entering the mixture. The dough was mixed for 20 min according to the following method. The ingredients (powdered sugar and pre-plasticized butter) were placed in a mixer and beaten for 15 min, gradually increasing the speed. After that, a mixture of liquid components was added, namely, egg whites, honey, and flavor enhancer, and beaten for 5 min. Lastly, a mixture of dry ingredients (wheat flour, defatted hazelnut flour, and soda) was added and mixed until the mass was homogeneous. Dough moisture content was 22 %, dough temperature was 22 °C. Unlike the control sample, water was added to the dough with hazelnut flour, along with the liquid ingredients.

The dough was formed into cookies and placed on a sheet, their surface was decorated with candied fruits. They were baked for 10 minutes at 200 °C. They were cooled to room temperature and packed.

Results and discussion

Determination of quality indicators of wheat and hazelnut defatted flour

In this study, the recipe for shortbread cookies "Orange" was used as a control sample. The test samples were prepared with 15, 30 and 45 % of wheat flour replaced by defatted hazelnut flour. Additionally, preliminary studies established that the optimal amount of butter to be replaced with hazelnut flour was 30% by weight. Also, turmeric powder was added to the recipe in the amount of 0.33 kg per 1 ton of finished products to give the pastries functional properties and ensure a good color. This data was established empirically.

Wheat flour is one of the main components in the production of pastries, thus the control sample was made from wheat flour. The dough for shortbread cookies is an emulsion system, which includes wheat flour, butter, and sugar. Due to the high content of sugar and fat in them, the finished products were crumbly. This was not only due to the presence of fat and sugar in the recipe, but also due to the certain properties of flour and the features of the technological process.

The control sample was the dough made from wheat flour. The experimental samples were prepared with different amounts of hazelnut flour that replaced an equivalent amount of wheat flour. These types of flour have different chemical and granular compositions. Therefore, it was necessary to assess the quality of wheat and hazelnut flour used to produce shortbread cookies. The results obtained are presented in Table 1 and 2.

Table 1

Quality indicators of wheat flour (*n*=3)

Indicator	Value
Moisture content, %	13.3
Acidity, degrees	0.08
Raw gluten content,%	24.02
Dry gluten content, %	9.16
Hydrating capacity of gluten,%	162.37
Gluten quality:	
- H_{dif}, device units of IDK-1;	37
- Extensibility, cm	9.3
- Moisture content, %	61.89

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Continuation of Table 1

Water-binding capacity, %	184
Fat-binding capacity, %	65.45
Ash content, %	0.46

Table 2

Quality indicators of defatted hazelnut flour (*n*=3)

Indicator	Value
Moisture content, %	6.37
Acidity, degrees	0.70
Water-binding capacity, %	110
Fat-binding capacity, %	99.10
Ash content, %	4.57

As experimental research shows, the moisture content of wheat flour was higher than that of hazelnut flour. Hazelnut flour had a higher acidity. Hazelnuts contain natural organic acids, such as oleic and linoleic [27]. During the processing of nuts into flour, these acids can partially pass into the final product, increasing its acidity. Hazelnuts were also roasted before grinding. During roasting, complex chemical processes occur that can lead to the formation of additional acids or an increase in the concentration of existing ones.

The water-binding capacity of wheat flour was higher than that of hazelnut flour, which can be explained by the fact that the particle size of hazelnut flour was larger than that of wheat flour. The fat-binding capacity of hazelnut flour was higher than that of wheat flour, due to the fact that it contains a larger amount of fiber than wheat flour (the fiber content of hazelnut flour is 8–10 %, and that of wheat flour is 0.2–0.5 %) [28]. Fiber has a porous structure, which contributes to better absorption of fats.

Ash content in hazelnut flour was 10 times higher than that of wheat flour. This was due to differences in the chemical composition of these products, particularly, the mineral content. Hazelnuts were a rich source of minerals such as potassium, magnesium, phosphorus, iron, etc [29]. Hazelnut flour is often made from the nuts ground with the skin. The skin contains more minerals than the interior of the kernel. This increases the total ash content.

Effect of hazelnut flour on gluten quantity and quality

As is known, the leading role in the formation of dough with its inherent properties of elasticity, plasticity, and viscosity belongs to the flour proteins. Hydrated proteins form a spongy "framework" in the dough, which largely determines the specific physical properties of the dough: its extensibility and elasticity. This spongy structural protein frame is called gluten. The flour used when making dough for shortbread cookies should be "weak" or "medium" in strength [30]. This type of flour is used because the rheological properties of the dough should be viscous-plastic. The dough for its preparation was characterized by a sour cream-like consistency. It should easily accept and retain the shape that was given to it. Such flour absorbs relatively little water when making dough of normal consistency. Therefore, it was advisable to investigate how hazelnut flour added to the dough affects the quantity and quality of gluten.

The results of the research are presented in Table 3.

Table 3

Effect of hazelnut flour on the quantity and quality of flour gluten (*n*=3)

Indicators	Hazelnut flour amount, %			
	0	15	30	45
Raw gluten content, %	24.02	18.52	-	-
Extensibility, cm	9.3	7.0	-	-
Hydration capacity, %	162.37	149.93	-	-
Elasticity, device units of IDK-1	37	29	-	-

As can be seen from the data obtained, the used wheat flour belongs to group II in terms of gluten quality: the gluten was satisfactory and strong. This explanation is provided in accordance with the results of table 1, which is a technological factor.

The experimental data shows, that in the sample with 15 % of wheat flour replaced with hazelnut flour, the amount of gluten was reduced by 23 % compared to the control sample. In the samples with 30 % and 45 % hazelnut flour, gluten was not formed, which can be explained by the fact, that hazelnut flour does not contain proteins that form the gluten framework (gliadin and glutenin), which is the basis of the wheat dough structure. Therefore, partially replacing of wheat

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flour with hazelnut flour reduces the total amount of proteins that are capable of forming gluten. Gluten is an insoluble protein in water, and with a wheat flour content of 70 and 55 %, they are not enough to form gluten.

Due to the decreased amount of raw gluten in samples with a higher content of hazelnut flour, the hydration capacity in the test samples also decreases.

The gluten extensibility in the sample containing 15 % of hazelnut flour decreased by 25 %, which can be explained by the disruption of the integrity of the gluten framework due to the distribution of hazelnut flour particles between wheat flour particles.

Determination of technological parameters of dough mixing

The dough was kneaded according to the methodology. The resulting dough pieces of cookies are shown in Fig. 2, and the technological parameters of dough mixing are shown in Table 4.

Control **15 % hazelnut flour** **30 % hazelnut flour** **45 % hazelnut flour**

Fig. 2. Samples of cookie dough with hazelnut flour and 30% of butter replaced

Table 4

Technological parameters of dough and finished product preparation

Indicators	Hazelnut flour amount, %, with 30 % butter replaced			
	Control	15 %	30 %	45 %
Preparation time, min	20	23	25	25
Dough temperature, °C	22.0	22.0	22.0	22.0
Baking time, min	10	10	12	12
Baking temperature, °C	200	200	200	200

Since the article is of a technological nature, it is important for technologists to describe the results presented in the table.

As can be seen from the experimental data, when replacing wheat flour with an increased amount of hazelnut, the duration of dough preparation increases. Thus, the preparation time was 20 min for the control sample, 23 min when adding 15 % hazelnut flour, and 25 min for samples with 30 and 45 % hazelnut flour. The increased duration of dough preparation for shortbread cookies when adding hazelnut flour was due to its physical and chemical properties that affect the structure of the dough. Firstly, hazelnut flour contains a significant amount of vegetable fats that cover the starch and protein particles of the dough, creating a barrier for their interaction. This reduces the formation of gluten framework and requires additional time to achieve dough homogeneity. Secondly, the particle size of hazelnut flour was larger than that of wheat flour. Therefore, this requires additional mechanical action to integrate these particles into the dough structure and obtain a homogeneous dough mass. The temperature of dough preparation of all samples was 22 °C. When the temperature was increased, a denser, more elastic dough was obtained due to the increased hydration of gluten proteins and its decreased plasticity. In this case, the finished products were deformed, with a cracked surface, and insufficiently porous.

In addition, the baking time of the sample with 15 % hazelnut flour does not differ from the control, unlike the samples with 30 % and 45 %, which increases it. This can be explained by the fact that adding hazelnut flour increases the density of the dough, which slows down the baking process. Therefore, increasing the amount of hazelnut flour increases the baking time. Also, the baking time is affected by the fiber of hazelnut flour, which has the ability to retain moisture, which leads to increased baking time required for its evaporation from the dough.

Determination of physical and chemical parameters of the dough

We investigated the change in moisture content and density of the dough depending on the hazelnut flour content.

Dough moisture content is an important indicator that determines the quality of the finished product, it is a key parameter in the dough preparation process, which affects its structure, mechanical properties, and behaviour during baking, as well as the quality of the final product.

The change in dough moisture content with different amounts of hazelnut flour is shown in Fig. 3.

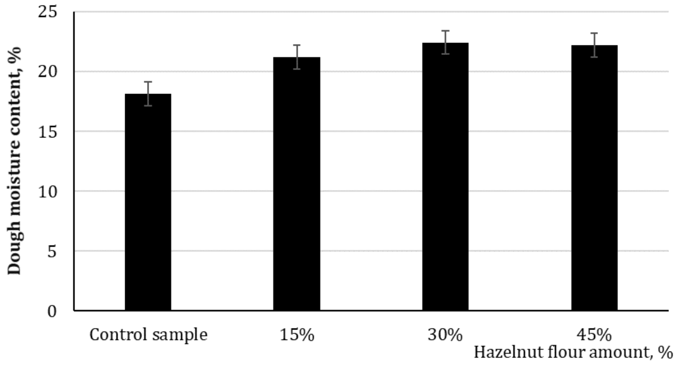

Fig. 3. Dough moisture content depending on the amount of hazelnut flour with 30% butter replaced

As can be seen from the obtained results, with an increased amount of hazelnut flour, the moisture content of the dough increases. The amount of gluten in the dough decreases, when replacing part of the wheat flour with hazelnut flour, which leads to a decrease in the elasticity of the dough and an increase in the amount of free moisture in its structure. Hazelnut flour also contains a high amount of fiber (about 8–10 %), which has the ability to retain water [28].

Dough density is an important parameter to consider when making shortbread cookies. It determines the structure, volume, and taste of the finished product. By controlling dough density, you can ensure high product quality and meet consumer demands.

The change in the density of the dough for shortbread cookies is shown in Fig. 4.

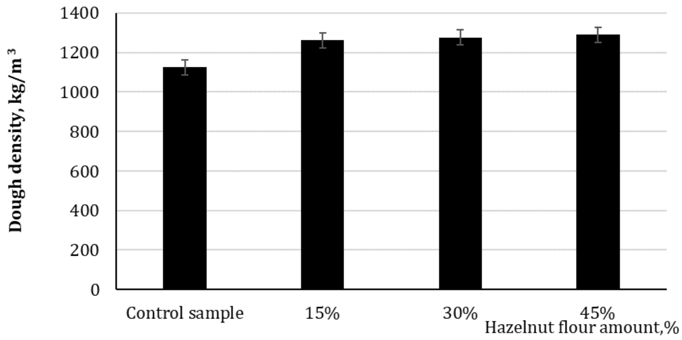

Fig. 4. Dough density depending on the amount of hazelnut flour with 30% butter replaced

Experimental data shows that adding hazelnut flour to shortbread cookies affects their density by changing the properties of the ingredients and the structural and mechanical characteristics of the dough. This can be explained by several factors: hazelnut flour has a high fat content (approximately 40–60 %) [31], which reduces the hydrophilicity of the dough, which contributes to an increase in dough density, since the amount of water actively bound to proteins and starch decreases. Hazelnut flour also does not contain gluten and when it was added to the dough, the structure of the gluten framework of wheat flour was partially broken, which lead to a less elastic structure and an increase in dough density., which is consistent with the results obtained by scientists [32].

Determination of structural and mechanical properties of dough

Considering that, in the experimental dough samples, wheat flour and butter were partially replaced with hazelnut flour, it was advisable to investigate the change in the structural and mechanical properties of the shortbread cookies. The structural and mechanical properties of the dough play a decisive role in creating high-quality shortbread cookies. These properties characterize the behavior of the dough during various technological processes, such as mixing, shaping, and baking, and directly affect the quality of the finished products.

The physical and mechanical properties of the pastry dough are characterized by the shear stress limit of penetration of the penetrometer cone into the dough. It is an objective characteristic that reflects the resistance of the material to crushing and shear. Therefore, the penetration properties of the material are related to its structural strength, which can be quantitatively estimated by the shear stress limit τ_0.

The effect of hazelnut flour on the strength of the dough was studied depending on the amount of hazelnut flour (Fig. 5).

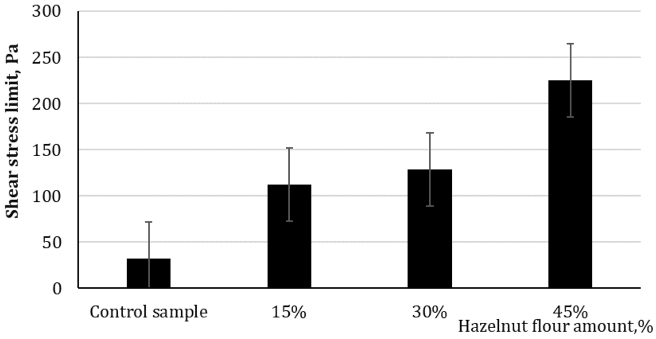

Fig. 5. Shear stress limit τ_0, Pa, depending on the amount of hazelnut flour

The experimental data shows that the strength of the test samples was significantly increased [33]. Thus, in samples with 15, 30 and 45 % of hazelnut flour and 30 % butter replaced, the strength increased by 3.5; 4 and 7 times, respectively, compared to the control sample. This increase in the shear stress limit may be due to several reasons: firstly, hazelnut flour contains more fiber and dry matter compared to wheat flour, which contributes to the formation of a denser dough matrix that resists shear deformations; secondly, the structure of hazelnut flour has larger and stiffer particles compared to wheat flour, which significantly affects the physical properties of the dough, creating more points of resistance to external forces; thirdly, the amount of fat in the recipe decreases. As is known, fats reduce friction between dough particles, and replacing 30 % of butter with hazelnut flour reduces the fat fraction of the dough, which increases shear stress. Thus, partially replacing butter and wheat flour with hazelnut flour leads to the dough becoming thicker and more resistant to mechanical stress. In order to obtain the dough with the necessary properties, water was added to the recipe.

According to the technological process, after mixing, the dough mass is shaped. This process takes place on a molding machine, where contact occurs between the dough mass and the surface of the working parts of the machine. Therefore, it was necessary to determine the adhesive properties of the dough in the experimental samples compared to the control sample.

The formation of an adhesive bond between dough biopolymers and the surface of the equipment's structural materials was decisively influenced by the rheological properties of the dough, the roughness of the contacting surface, the duration and tension of the previous contact, the temperature of the dough mass and the surface, and the method and speed of separation. [34].

As the enclosing surface, a steel plate St. 3 with category R_Z 6.3 finish and a plate made of fluoroplastic were used. The temperature of the plate surface was 18 ± 2 °C in all experiments.

The results of studying the changes in the specific force of separation of the T plate from the dough with different amounts of hazelnut flour are shown in Fig. 6.

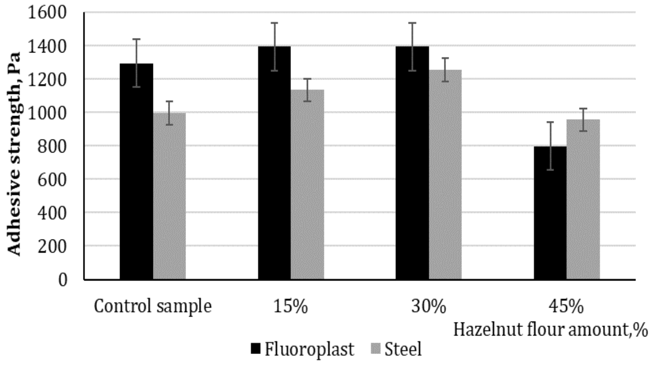

Fig. 6. Adhesive strength, Pa, depending on the amount of hazelnut flour

As can be seen from the results, in samples with 15 % and 30 % hazelnut flour and 30 % butter replaced, the specific tear strength increases. This was probably due to the fact that in these samples

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the moisture content was higher than in the control sample, the dough had a more liquid consistency and therefore was in stronger contact with the enclosing surface. And in the sample with 45 % hazelnut flour and 30 % butter replaced, the adhesive strength decreased due to the fact that dough strength was significantly increased, by 7 times, thus it became denser and therefore there was less contact with the enclosing surface.

Taking into account the structural, mechanical, and adhesive characteristics of the dough allows adjusting the parameters of the molding machines, which will help improve the quality of the final product. The best structural and mechanical properties were observed in samples with 30 % butter and 15 % and 30 % wheat flour replaced with hazelnut flour. The higher content of hazelnut flour makes the dough excessively dense, which can affect the technological process of molding and the quality of the final product. It is not clear what to explain if the justification for the results is given

The obtained results were important for optimizing the recipe and technological process of shortbread cookie production, which allows drawing a reasonable conclusion about the feasibility of using hazelnut flour in shortbread cookie technology by partially replacing wheat flour and butter. They can be used in the development of new types of pastries and be the basis for developing a shortbread cookie recipe with a reduced gluten and fat content and recommended for consumers who adhere to a "healthy diet." Sensory evaluation is performed for finished products, not semi-finished products. Sensory evaluation will be provided for finished products made from these types of dough.

Conclusions

As a result of the conducted research:

1. The feasibility of using defatted hazelnut flour to partially replace wheat flour and butter in the recipe of shortbread cookies was substantiated.

2. The quality of wheat and hazelnut flour was studied and it was found that adding hazelnut flour to the dough lead to a decrease in the total gluten content. In the sample with 15 % of wheat flour replaced with hazelnut flour, the amount of gluten was reduced by 23 % compared to the control sample. In the samples with 30 % and 45 % hazelnut flour, gluten was not formed.

3. The technological parameters of preparing different dough samples were experimentally determined. It was discovered that increased amount of hazelnut flour increased the duration of dough preparation.

4. The change in dough moisture content and density depending on the amount of hazelnut flour was investigated. It was discovered that increased amount of hazelnut flour lead to increased moisture content and density of the dough.

5. It was determined that adding hazelnut flour to the dough for shortbread cookies and partially replacing wheat flour and butter with it significantly affected the structural and mechanical properties of the dough. The strength of the dough increased with an increase in the amount of hazelnut flour, which was confirmed by an increase in the shear stress limit. When adding 15 % and 30 % hazelnut flour and replacing 30 % butter, an increase in the adhesive strength of the dough to the enclosing surfaces was observed. However, when replacing 45 % wheat flour and 30 % butter, the adhesive strength decreased due to a significant increase in dough density.

The results of this study indicate the feasibility of using defatted hazelnut flour as a partial replacement for wheat flour and butter in the production of butter cookies.

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