

## ТЕОРІЯ ТА ПРАКТИКА ТОВАРОЗНАВСТВА ХАРЧОВИХ ПРОДУКТІВ

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### PATENT SEARCH – A DIRECTION FOR THE DEVELOPMENT OF INNOVATIVE APPROACHES TO IMPROVING SHORTBREAD DOUGH TECHNOLOGIES

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**Abstract.** Conducting a patent search on a selected topic provides impetus for scientific research, confirms its relevance and prospects, allows avoiding duplication during research, and makes it possible to identify a range of unexplored issues and thereby deepen and expand planned research. The article is devoted to improving the technology of making shortbread cookies by using new recipe components that positively affect the nutritional and biological value of finished products, improve their taste and organoleptic characteristics, and make it possible to reduce the fat content in their composition. The use of hazelnut flour in shortbread cookie technology was studied with the aim of developing new recipes that take into account consumer taste preferences.

Based on the patent search, we looked at how nut flour is used in shortbread dough and found that there aren't any patented innovations in this area. **The purpose** of the article is to improve the technology of shortbread cookies based on a patent search for innovative technologies using hazelnut flour in its composition to improve the biological value and taste properties of finished products. The object of the study is the technology for producing shortbread dough using hazelnut flour, and the subject of the study is hazelnut flour, shortbread dough, shortbread cookies, and the organoleptic and physicochemical quality indicators of shortbread dough products.

The quality of wheat flour and hazelnut flour was assessed, and it was found out that hazelnut flour has a higher energy value than wheat flour and is a valuable source for increasing the biological value of shortbread cookies.

The possibility of replacing wheat flour with hazelnut flour was investigated. Based on experimental studies, it was determined that replacing 30% of wheat flour with hazelnut flour is feasible. It was found out that using hazelnut flour in the recipe for shortbread dough reduces the fat content by 25%. The organoleptic and physicochemical indicators of shortbread cookies made according to the developed recipe indicate an improvement in quality compared to cookies made from wheat flour. Shortbread cookies with the addition of hazelnut flour have a higher nutritional, biological, and energy value.

**Key words:** patent search, intellectual creativity, wheat flour, hazelnut flour, shortbread dough, shortbread cookies, moisture content, wettability, alkalinity, friability, nutritional value, energy value.

**General description of the problem.** Flour-based baked goods account for the largest share of the domestic confectionery market (55.6%): cookies, waffles, cakes and pastries, and sweetened bakery products [1]. The main global trends in the confectionery market are an increase in the consumption of products made from plant-based rather than animal-based ingredients. Taking into account these trends and the practice of making flour baked goods mainly from local raw materials; it is relevant to use nut flour in confectionery technology as an alternative to animal protein [2]. Nut flour contains important micronutrients, vitamins, healthy fats, and easily digestible proteins. Hazelnut flour, which is used as an additive to all types of dough, has similar characteristics. In

particular, it is used in the preparation of vegan or vegetarian dishes, desserts, and confectionery products. The flour is made from oil cake and nut meal, which are waste products of oil production, which also contributes to the introduction of resource-saving technologies in the food industry.

Nut flour is widely used in cooking in various countries, adding a special flavor and texture to desserts. In France, light pastries with various fillings are made, where the main ingredient is almond flour. Small rectangular pastries (financiers) are also baked from almond flour, which have a delicate texture and nutty aroma. In Turkey and the Middle East, a popular dessert is made from layers of filo pastry soaked in honey or syrup, filled with chopped nuts and hazelnut

or almond flour. Germany is famous for its well-known dessert *shtollen*, a Christmas cake made with nut flour, dried fruit, and spices [3]. The use of nut flour in dessert recipes emphasizes its importance in the culinary traditions of different peoples around the world and adds a unique taste and texture to dishes.

**Analysis of key research and publications.** After conducting a patent search on shortbread dough technology and the use of hazelnut flour in food production, we found out that the development of new shortbread cookie recipes is quite popular.

Numerous studies have confirmed that by-products from the processing of vegetables, fruits, and berries, which are mainly used in the food industry in the form of powders, purees, pastes, pomace, pulp, and meal, are a valuable and promising source of enrichment for flour confectionery products.

Thus, in the technology of shortbread cookies,  $\beta$ -carotene, pectin, and phenolic substances are used to improve nutritional value: carotene-containing filler "Carrot Honey" [4, 5], raw carrot puree [6], powder from dried black chokeberry fruits [7], rowanberry flour [8], polymalt extract "Polysol" [9, 10], powder from the pulp and peel of prickly hawthorn fruit [11], pumpkin processing products [12, 13], sea buckthorn [14], and others.

To prevent the oxidation of polyunsaturated fatty acids, it is recommended to add milk thistle oil, which contains the synthetic antioxidant selenopiran, which prevents the oxidation of polyunsaturated fatty acids in linseed oil [15]. Inulin and soy protein isolate are commonly used as sugar substitutes [16].

Recently, the use of nut flour, in particular hazelnut flour, as an additive to all types of dough has become quite popular in confectionery production.

It is known that hazelnut and almond flour have a low glycemic index, which makes them suitable for diabetics or people who choose low-carbohydrate diets. These types of flour can be used in the preparation of gluten-free desserts for people suffering from celiac disease or gluten intolerance, as well as for people who follow vegan and ketogenic diets.

The use of hazelnut and almond flour not only enriches confectionery products with beneficial substances, but also opens up opportunities for creating innovative desserts for healthy eating enthusiasts.

The next area of research was the use of nut flour obtained from meal, which is a promising source of non-traditional raw materials for the production of dietary flour products. The results of the research confirmed that enriching butter cookies by adding sunflower oil and nut meal (cedar and walnut) is characterized by an increased protein content (1.8 and 1.6 times), a 14.7 and 12.8% decrease in carbohydrate content, carbohydrate content, and significant enrichment of products with non-starch polysaccharides (4.7 and 2.9 times, respectively). The mineral composition of products (iron, potassium, magnesium

content) and vitamin E content are significantly increased [17–19].

A method has been developed for making shortbread cookies, where 20% of the flour weight is replaced by a mixture of walnut and sesame meal [20–22]. The result is a new shortbread cookie with increased nutritional and biological value, enriched with proteins, dietary fiber, and minerals, and improved structural, mechanical, and organoleptic properties.

The effect of walnut fiber on the quality indicators of dough semi-finished products and finished products was studied. The analysis of finished products shows that the addition of walnut fiber to the recipe composition of products affects their organoleptic indicators, gives them a pleasant taste and aroma, slows down the staling process, and extends the shelf life of the product. The optimal proportion of walnut fiber is considered to be 5% of the flour weight [23].

An analysis of information sources shows that there is no comprehensive study of shortbread dough technology using hazelnut flour in Ukraine, which confirms the relevance of the research conducted.

**Formulation of the article's objectives (setting the task).** The aim of the research is to improve the technology of shortbread cookies based on a patent search for innovative technologies using hazelnut flour to improve its biological value and taste properties.

**Materials and methods.** During the research, wheat flour was used in accordance with TU U 10.6-31435947-001:2014 "Wheat flour. Classic. Highest grade" produced by "RIVNE-BOROSHNO" and hazelnut flour (from unpeeled hazelnuts) produced by FOP "Kudriavtseva A. O." Flour from unpeeled hazelnuts produced by Ukrainian manufacturers dominates the domestic market.

Experimental studies were conducted using standard analysis methods to evaluate the quality indicators of raw materials and finished products based on organoleptic and physicochemical indicators: DSTU 4619:2006 "Confectionery products. Acceptance rules, sampling and sample preparation methods", DSTU 4683:2006 "Confectionery products. Methods for determining organoleptic quality indicators, dimensions, net weight and components", DSTU 4910:2008 "Confectionery products. Methods for determining the mass fractions of moisture and dry substances", DSTU 5060:2008 "Confectionery products. Methods for determining the mass fraction of fat", DSTU 4672:2006 "Confectionery products. Methods for determining ash and metallic magnetic impurities", DSTU 5023:2008 "Flour confectionery products. Method for determining wetting ability", DSTU 5024 "Confectionery products. Methods for determining acidity and alkalinity".

In order to determine the results of experimental studies, statistical processing methods were used with standard Microsoft Office software packages.

### Presentation of the main research material with full justification of the scientific results obtained.

At the initial stage of the research, the quality of wheat flour and hazelnut flour (Fig. 1) used for the production of shortbread products was assessed.



Sample 1 – wheat flour    Sample 2 – hazelnut flour

**Fig. 1. Wheat flour and hazelnut flour selected for the study**

The organoleptic indicators of the flour samples studied are shown in Table 1.

In terms of physical and chemical indicators, wheat flour has half the energy value of hazelnut flour (334.0 kcal vs. 693.0 kcal). The fat content in wheat flour is 1.1%, while in hazelnut flour it is 62.3%; the protein content in wheat flour is 10.3%, while in hazelnut flour it is 15.6%. There is a significant difference in carbohydrate content: the proportion of carbohydrates in wheat flour exceeds that in hazelnut flour by 15.5 times, and hazelnut flour has significantly lower starch content – 9.4 times lower.

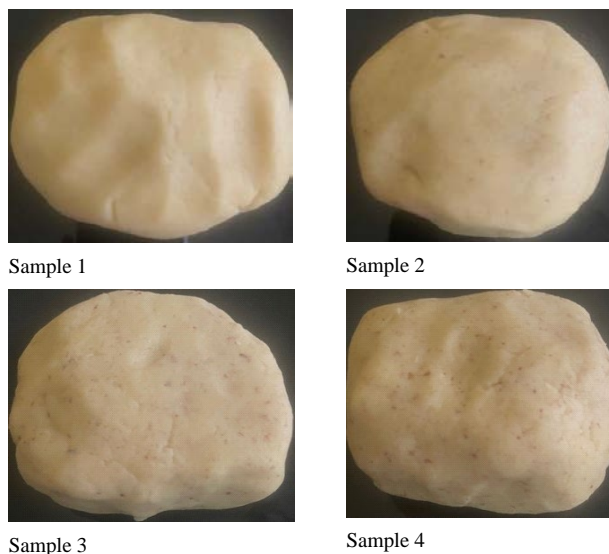
When studying the titrated acidity of flour, it was found that the acidity of wheat flour is 2.0 degrees, hazelnut flour is 4.8 degrees, and a mixture of wheat flour and hazelnut flour is 2.8 degrees.

For experimental research, wheat flour was replaced with hazelnut flour. Four experimental samples were obtained: sample 1 – dough made from wheat flour (control sample); sample 2 – dough made from 90% wheat flour and 10% hazelnut flour; sample 3 – dough made from 80% wheat flour and 20% hazelnut flour; sample 4 – dough made from 70% wheat flour and 30% hazelnut flour.

The appearance of the dough samples obtained is shown in Fig. 2.

The results of experimental studies (Fig. 2) show that the dough obtained has a soft, plastic consistency, but with an increase in the proportion of hazelnut flour, gluten swelling was minimized. However,

given the amino acid composition of hazelnut flour, it can be argued that it was enriched with proteins and amino acids, which has a positive effect not only on its nutritional value but also on its biological value.



**Fig. 2. Dough blanks of the obtained shortbread dough samples:**

Sample 1 – 100% wheat flour (control); Sample 2 – 90% wheat flour and 10% hazelnut flour; Sample 3 – 80% wheat flour and 20% hazelnut flour; Sample 4 – 70% wheat flour and 30% hazelnut flour.

The absence of gluten in hazelnut flour contributes to a reduction in its overall content in shortbread dough, reduces its hydration capacity, which leads to a decrease in free moisture in the dough system and ensures better quality indicators for shortbread products, since shortbread dough is a fat emulsion and a reduction in total moisture contributes to obtaining higher quality finished products.

Increasing the proportion of hazelnut flour worsens the color of shortbread dough, but gives it a pleasant nutty aroma and taste, improving the overall organoleptic assessment of the samples studied.

The experimental samples of shortbread dough had a smooth surface without lumps or traces of unmixed ingredients. Their color was slightly darker than the control sample (light brown with a yellowish tint), but they had a pleasant nutty aroma. The moisture content of the dough samples was between 18.5 and 19.5%.

Table 1

### Organoleptic indicators of the studied samples of premium wheat flour and hazelnut flour

Name of indicator	Sample 1 – wheat flour	Sample 2 - hazelnut flour
Appearance	Loose mass	Loose mass
Color	White, white with a yellowish tint	Light brown
Smell	Characteristic of wheat flour, odorless, not musty, not moldy	Pleasant, characteristic of nuts
Taste	Characteristic of wheat flour, without extraneous tastes, not sour, not bitter	Moderate, nutty
Consistency	Crumbly, homogeneous, powdery	Crumbly, homogeneous, powdery



A further increase in the proportion of hazelnut flour in the dough recipe (more than 30%) leads to a significant change in color and increases the fat content of the finished products, which affects consumer health and reduces the shelf life of the finished products. Therefore, it is advisable to determine the rational proportion of hazelnut flour in the shortbread dough recipe as 30%, which will reduce the proportion of carbohydrates by 18.4% (Table 2) and at the same time increase the protein content by 15.4%. The total energy value of the dough will also increase by 11.0%.

Given the significant fat content in hazelnut flour, it is predicted that the fat content in shortbread dough recipes could be reduced.

The next stage of research studied the effect of hazelnut flour on the fat component in shortbread dough recipes. Determining the effect of hazelnut flour on the fat component involved calculating the recipe's fat content in shortbread cookies and, based on the calculations, conducting experimental studies (Fig. 3).



**Fig. 3. Dough blanks of experimental samples of shortbread dough with a reduced proportion of margarine: sample 1 – addition of 30% hazelnut flour and 100% margarine according to the recipe; sample 2 – addition of 30% hazelnut flour and 75% margarine according to the recipe; sample 3 – addition of 30% hazelnut flour and 50% margarine according to the recipe**

For the study, dough with 30% wheat flour replacement but with 100% margarine addition using classic

technology (sample 1) was selected as the control sample. The experimental samples were samples with the addition of 30% hazelnut flour and a 25% reduction in margarine content (sample 2), as well as a 50% reduction in margarine (sample 3).

The results of the studies showed that when the fat content is reduced by 25% (sample 2), the dough mixes well, achieves an elastic structure, and has a pleasant color and smell. When reducing the fat content by 50% (sample 3), the duration is extended (by 2.0 – 2.5 times) and the dough mixing process becomes more complicated. The dough structure becomes too brittle, which negatively affects the process of forming baked goods. An attempt to reduce the fat content by 75% had a negative effect on the dough kneading process.

The results obtained from the effect of changing the fat component of the shortbread dough recipe on the nutritional and energy value of the products are shown in Table 3.

The results of experimental studies show that the use of hazelnut flour affects the fat content in shortbread dough recipes, and it can be concluded that it is advisable to reduce the fat component (margarine) by 25% of the recipe amount.

The optimization of the process of manufacturing a flour product from shortbread dough was carried out using the method of mathematical modeling, the result of which is a regression dependence for the process of manufacturing a flour product from shortbread dough with the addition of hazelnut flour, with a reduced proportion of fat:

$$y = 130,375 - 0,775X_1 - 3,625X_2 - 2,175X_1X_2$$

- where  $y$  is the coded value of the optimality criterion for each process;
- $X_i$  – the coded values of factors for the analyzed processes.

**Table 2**  
**The effect of hazelnut flour on the nutritional and energy value of shortbread dough (n=3, p=0.95)**

Indicators	Samples	Prototypes		
	Control 1	sample 1	sample 2	sample 3
Proteins, %	5,07	5,32	5,59	5,85
Fats, %	23,5	26,5	29,51	32,52
Carbohydrates, %	52,4	49,2	45,97	42,75
Energy value, kcal	430,98	446,74	462,64	478,53

**Table 3**  
**The effect of changing the fat content in the recipe for shortbread dough with the addition of hazelnut flour on its nutritional and energy value (n=3, p=0.95)**

Indicators	Samples	Prototypes	
	Control 2	Sample 1	Sample 2
Proteins, %	5,85	6,37	7,0
Fats, %	32,52	29,18	25,18
Carbohydrates, %	42,75	46,57	51,14
Energy value, kcal	478,53	465,07	448,95

The input parameters are the proportion of hazelnut flour and the proportion of margarine ( $X_1$ ,  $X_2$ ). The output parameters of the system include the wettability index ( $y$ ).

A profile diagram of the process of manufacturing a flour product from shortbread dough with the addition of hazelnut flour was constructed, which is shown in Fig. 4.

Accordingly, a rational recipe for shortbread dough has been established, containing 70% wheat flour, 30% hazelnut flour, and 25% less margarine. According to organoleptic and physicochemical indicators, shortbread cookies made according to this recipe have better taste characteristics (Table 4) and physicochemical quality indicators (Table 5) compared to cookies made from wheat flour.

The organoleptic indicators (Table 4) of the finished shortbread cookies show that shortbread cookies with the addition of hazelnut flour have a pleasant taste characteristic of shortbread cookies with a

nutty flavor; the aroma also has a distinct nutty flavor; the texture of the product is crumbly and brittle; in appearance, it has a uniform shape, slight porosity, no spots or burnt areas; it is uniform, light brown in color, with visible hazelnut shell fragments.

The results obtained for the physical and chemical indicators (Table 6) of sand cookies correspond to the normative indicators.

The wettability index of the experimental sample of a flour product made from shortbread dough, where 30% hazelnut flour was added to the recipe and the fat content was reduced by 25%, was higher than that of the control sample, because reducing the fat content increases its water absorption capacity. The brittleness of the products also decreases.

Shortbread cookies made with hazelnut flour have a higher protein content (by 15.0%) and higher calorie content than traditional cookies due to the lipid and protein composition of hazelnut flour, but they contain fewer carbohydrates.

Table 4

Organoleptic indicators of shortbread quality

Organoleptic indicators	Shortbread dough samples	
	control sample – K1	experimental with hazelnut flour – sample 2
Form	correct, uniform, without damage	
Color	yellow-brown	homogeneous, light brown, with visible hazelnut skin flecks
Taste and smell	characteristic of shortbread cookies	characteristic of shortbread cookies, with a nutty flavor; fresh, with a distinct nutty aroma
Surface	porous, without spots or burnt areas	
View in the rift	well-baked, no crumbs, crumbly	

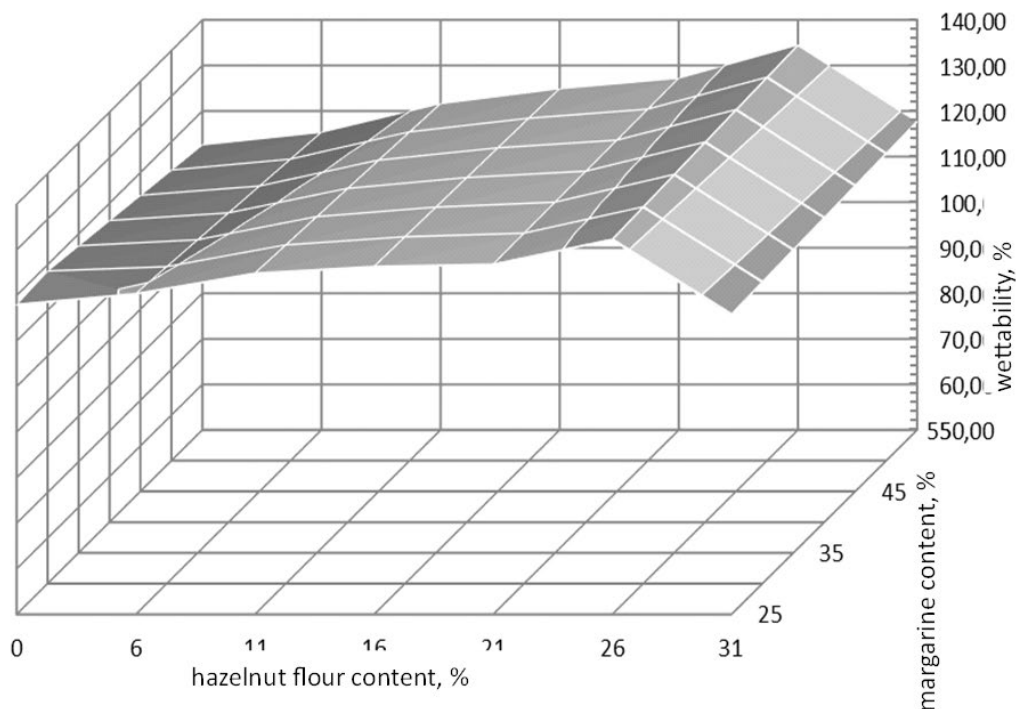


Fig. 4. Profile diagram of the process of making a flour product from shortbread dough using hazelnut flour

Table 5

**Physical and chemical indicators of shortbread cookie samples (n=3, p=0.95)**

Sample name	Mass fraction, %			
	humidity	wettability	alkalinity	brittleness
Control	5,0	129,7	1,4	48,7
Experimental with hazelnut flour	5,4	132,6	0,8	47,5

According to microbiological indicators, all tested cookie samples met the requirements of DSTU 3781:2014. All samples were free of *Escherichia coli* bacteria and pathogenic microorganisms, including *Salmonella* bacteria, as well as spoilage agents such as mold and yeast. The amount of MAFAnM in 1 g of shortbread cookies did not exceed the norm –  $5 \times 10^3$  either at the beginning of storage or

after 3 months. Thus, shortbread cookies with the addition of hazelnut flour are a competitive product.

**Conclusions.** The results of the study confirm the feasibility of using hazelnut flour in the recipe for shortbread cookies, which has a positive effect on the organoleptic properties of the finished products, increases their nutritional, biological, and energy value, and can be recommended for implementation in production.

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**Анотація.** Проведення патентного пошуку за обраною тематикою дає поштовх для проведення наукових досліджень, підтверджує їх актуальність та перспективність, дозволяє уникнути повторів під час проведення досліджень, дає можливість виявити коло недосліджених питань і тим самим поглибити й розширити заплановані дослідження.

Стаття присвячена удосконаленню технології виготовлення пісочного печива за рахунок використання нових рецептурних компонентів, які позитивно впливають на харчову й біологічну цінність готових виробів, покращують їхні смакові й органолептичні показники, дають можливість зменшити в їхньому складі жиркову складову. Досліджено використання в технології пісочного печива горіхового борошна з фундука, що спрямоване на розроблення нових рецептур з урахуванням смакових уподобань споживачів.

Відповідно до проведеного патентного пошуку було проведено аналіз стану використання горіхового борошна в технології пісочного тіста і встановлено відсутність запатентованих інновацій в цьому напрямку. Метою статті є удосконалення технології пісочного печива на основі проведеного патентного пошуку щодо наявності інноваційних технологій з використанням фундукового борошна в його складі для поліпшення біологічної цінності та смакових властивостей готових виробів. Об'єктом дослідження обрано технологію виробництва пісочного тіста з використанням борошна з фундука, а предмет дослідження – борошно з фундука, пісочне тісто, пісочне печиво, органолептичні, фізико-хімічні показники якості виробів з пісочного тіста.

Проведена оцінка якості пшеничного борошна й борошна з фундука та встановлено, що фундукове борошно має вищу енергетичну цінність в порівнянні з пшеничним борошном, є цінним джерелом для підвищення біологічної цінності пісочного печива.

Досліджено можливість заміни пшеничного борошна на фундукове. На підставі експериментальних досліджень визначено доцільність заміни 30 % пшеничного борошна на борошно з фундука. Встановлено, що використання в рецептурному складі пісочного тіста борошна з фундука дозволяє зменшити жиркову компоненту на 25 %. Органолептичні та фізико-хімічні показники пісочного печива за розробленою рецептурою свідчать про підвищення показників якості порівняно з печивом із пшеничного борошна. Пісочне печиво з додаванням борошна з фундука має вищу харчову, біологічну та енергетичну цінність.

**Ключові слова:** патентний пошук, інтелектуальна творчість, пшеничне борошно, борошно з фундука, пісочне тісто, пісочне печиво, вологість, намоочуваність, лужність, крихкість, харчова, енергетична цінність.



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