

In order to improve the mineral, vitamin composition, and nutritional value of flour confectionery products, new recipes for the "Flori" and "Janet" cookies baked from organic raw materials have been devised. Fully organic raw materials are used in the formulations of both products. The composition of cookies includes spelt flour, cornflour, coconut sugar, butter, dry coconut milk, sea buckthorn oil, hemp oil, lemon balm powder. The organoleptic assessment of cookies was conducted according to a 50-point scale developed by the authors of this paper. The developed samples ranked high on the tasting score: "Flori" (48.12) and "Janet" (49.25). The fat content was decreased in both samples; in the "Flori" sample – by 0.9 g/100 g, and in the "Janet" sample – by 1.2 g/100 g. The protein content increased in the samples, especially in the "Flori" cookies – by 2.3 g/100 g. The "Janet" cookie sample demonstrated the lowest energy value of 380.50 kcal/100 g. The samples were distinguished by the low content of mercury, cadmium, and arsenic. The content of all mineral elements except for sodium increased in the developed biscuits. The potassium content increased by 2.34 times in the "Flori" biscuits and by 2.29 times in the "Janet" biscuits. The calcium content in the "Flori" cookies increased by 3.13 times, in the "Janet" cookies – by 3.64 times. The content of manganese in both samples increased noticeably. Consuming the developed organic cookies makes it possible to increase the level of meeting the human body's requirements for macro- and microelements. The Ishikawa method was used to identify the main factors affecting the safety of cookies. A flowchart of cookie production was drawn up; the critical points were identified. These include the acceptance inspection of raw materials, heat treatment. The data obtained can be used by the confectionery industry to expand the range of organic products

Keywords: cookies, organic raw materials, flour confectionery, mineral composition, vitamin composition, HACCP-plan

DEVELOPING ORGANIC COOKIES WITH IMPROVED CONSUMER PROPERTIES USING SAFETY MANAGEMENT APPROACHES

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1. Introduction

Consumer confidence in food quality is declining sharply. The main reasons include the growing environmental awareness and the increased cases of food poisoning due to Creutzfeldt-Jakob disease, dioxin, and microbiological contamination. It was found that intensive traditional agriculture can introduce contaminants into the food chain. Consumers began to prefer food products that are made under cleaner, more authentic conditions [1]. In addition, according to scientific data, organic crops contain less nitrates, nitrites, and pesticide residues. However, they typically contain more dry matter, vitamin C, phenolic compounds, essential amino acids, and total sugar than conventional

crops. Organic crops also contain statistically more minerals and demonstrate better quality during storage.

Given the above, as well as the environmental situation in the world, the introduction of organic agriculture has become especially important. This is one of the effective means for obtaining high-quality and safe products [2].

This statement is confirmed by studies into the demand for organic products among consumers. For example, 40 % of the US population consumes organic food in their diet. Among them, 37 % eat this food more often than once a day, and about 39 % eat organic food at least once a week. Only 24 % of people consume organic food irregularly [3]. Consumption of organic products is motivated by the idea of food safety, quality, and freshness. Consumers note the

better taste of organic products; preservation of the natural environment in the production process; the absence of genetically modified organisms [4]. This category of people creates the initial niche of consumers of organic products, and, therefore, influences the formation of the domestic market for such products [3]. Thus, according to [5], the global market for organic flour products is expected to grow from USD 9.5 billion to 11.61 billion by 2023; the overall average annual growth rate will reach 6.06 %. The slow growth in 2020 is mainly due to the economic slowdown in countries due to the COVID-19 outbreak and measures aimed at its containment.

The volume of organic production is increasing every year. The relevance in the development of this area is justified not only by consumer demand for safer products. One of the principles in organic agriculture is the principle of ecology. This principle assumes that production is based on natural processes and environmentally friendly processing. Support and well-being are achieved by making the production environment “greener”. Considering the increase in primary production, there is a task to find new recipes based on organic raw materials. It is established that modern consumers pay much attention to food safety indicators. That is why it is important to create new products based on organic raw materials while using safety management approaches during production.

2. Literature review and problem statement

Despite a significant body of research into the biological value of organic agricultural produce, the range of organic flour products is still not wide enough. There are data regarding the development of new recipes for muffins [6], cookies [7], cakes [8], waffles [9] based on organic raw materials. The above studies prove that flour products developed from organic raw materials have high consumer properties. However, those studies are not aimed at developing cookies from organic raw materials.

The main issue in food production is safety. According to research, the vast majority (94–100 %) of organic food does not contain pesticide residues. Organic vegetables contain much less nitrate (about half). However, organic cereals contain approximately the same level of mycotoxins compared to conventional ones [10]. The main raw material for the production of flour confectionery is flour. It should be noted that in terms of safety, organic flour is better than traditional. However, due to the limited number of published studies into the physical and chemical characteristics of organic flour, the issue related to its biological value remains unresolved [11]. All this suggests that it is advisable to conduct a study to determine the parameters of the biological value of organic flour products.

There are reported data regarding the baking properties of organic wheat flour in bread making. According to these parameters, organic flour met the requirements set by regulatory documentation. It should be noted that bread made from organic flour outperformed, in terms of its organoleptic parameters, bread made from traditional flour [12]. In the cited study, only the properties of bread were analyzed but the properties of organic confectionery were not examined.

In [13], the possibility of using lentil flour in a cookie recipe was considered. That was proved to increase its biological value, reduce the energy value, and prolong the

shelf life of finished products. Paper [14] studied the effect of natural antioxidants on the safety of cookies and proved the improvement of consumer properties of cookies due to the introduction of medicinal raw materials. However, the issues related to the impact on the biological value of cookies by organic non-traditional raw materials remain unresolved.

When developing new products, it is important not only to select raw materials but also to take into consideration the principles of food safety management, which is an important guarantee of safe products. Quite often, there are pesticide residues in the products of plant and animal origin, as well as nitrates in drinking water. There are risks associated with genetically modified organisms in foodstuffs [15]. All these facts suggest that organic foods can reduce the risks associated with food hazards. On the other hand, the main factor of food production danger is microbiological contamination [16]. That is why, to manufacture safe products, it is necessary not only to choose environmentally friendly raw materials but also to apply the principles of food safety management during production.

Finding safe functional ingredients is an important issue in food science. Food safety is the number one priority among consumers today. To reduce the risk of foodborne diseases, consumers must be prepared to change their consumer behavior. Changing this behavior is closely linked to consumers' knowledge of good food practices. At the same time, there is public awareness. However, so far, society's eating habits have not changed radically. A diet depends not only on the individual but also on social, cultural, economic, and environmental factors [17]. This statement is supported by research data [17]. There is an increase in the number of organic brands and a wider range of organic products in the world. The range is being expanded to ensure better food safety and quality. However, according to [18], consumer perception and confidence in organic food are not growing significantly. Moreover, consumers are ambivalent about the sales channels of organic products, or whether they are worth buying at all [19]. In order to answer these questions, detailed research in the field of organic nutrition is an important and relevant scientific area.

3. The aim and the objectives of the study

The study aims to develop cookies from organic raw materials with improved consumer properties using safety management approaches. That could expand the range of safe organic flour-based products.

To accomplish the aim, the following tasks have been set:

- to develop the recipes and study the organoleptic parameters of cookies;
- to study the nutritional and energy value of cookies;
- to determine the safety parameters of finished products;
- to analyze the mineral and vitamin composition of products under development;
- to compile a plan of safety management (HACCP-plan) for the production of organic cookies.

4. Materials and methods to study the nutritional values of the developed products

Fully organic raw materials were chosen to develop the recipe for the new cookies. Wheat flour, which is traditional-

ly used in flour confectionery, was replaced with spelt flour and cornflour. This choice is justified by the high biological value of these types of flour. In order to increase the protein content in the finished product, it is proposed to use coconut organic flour and coconut milk powder. It is a well-known fact that the content of unsaturated fatty acids in vegetable oils is higher than their content in confectionery fat. That is why, in order to enrich the fatty acid composition, it is proposed to replace the lipid base of cookies. A mixture of organic oil and hemp and camelina organic oil was used as the fat fraction. Lemon balm powder is added to the recipe as flavoring and antioxidant agents. We modeled the recipes based on the tasting assessment.

The study materials are organic raw materials used to develop new recipes for organic cookies.

Organic spelt flour, TM "Ekorod". Nutritional value per 100 g of product: proteins – 11.3 g; fat – 2.7 g; carbohydrates – 72.5 g; fiber – 2.2 g. Energy value (calories) per 100 g of product: 1,429 kJ (341 kcal). Certified according to Organic Standard UA-BIO-108.

Organic corn flour, TM "Ekorod". Nutritional value per 100 g of product: fats – 1.5 g; carbohydrates – 70.9 g; proteins – 7.2 g. Energy value per 100 g of product: 330 kcal (1,381 kJ). Certified according to Organic Standard UA-BIO-108.

Organic coconut flour powder. Nutritional value per 100 g of product: fats – 26.6 g, including saturated – 25.3 g; carbohydrates – 17.0 g, of which sugar – 16.7 g; protein – 14.7 g; salt – 0.82 g; dietary fiber – 30.9 g. Energy value (caloric content) per 100 g of product: 423 kcal/1,772 kJ.

Organic chicken eggs, TM "World of Bio". Nutritional value per 100 g of product: fats – 10.0 g; carbohydrates – 0.8 g; proteins – 12.0 g. Energy value (caloric content) per 100 g of product: 649.5 kJ (155 kcal). Certified according to Euro Leaf.

Organic coconut sugar. Nutritional value per 100 g of product: proteins – 1.1 g; fat – 0.4 g; carbohydrates – 93.4 g; fiber – 1.9 g. Vitamins and minerals in 100 g: vitamin C – 1.4 mg; potassium – 939 mg; sodium – 50 mg; calcium – 341 mg. Energy value (caloric content) per 100 g of product: 380 kcal/1,590 kJ.

Butter Organic Milk, organic sweet cream butter, Extra 82.6 %. Nutritional value per 100 g of product: proteins – 0.5 g; fat – 82.5 g; carbohydrates – 0.8 g. Certified according to Organic Standard UA-BIO-108. The country of origin is Ukraine.

Coconut milk powder, TM "Cocomi". The energy value is 2,815 kJ/680 kcal. Nutritional value per 100 g of product: fats – 60 g, including saturated fatty acids – 54 g; carbohydrates – 22 g; proteins – 13 g; fiber – 0.3 g.

Organic hemp oil, TM "Elitephito". Nutritional value per 100 g of product: fats – 99.9 g. Energy value (caloric content) per 100 g of product: 3,761 kJ (898.2 Kcal). The product of organic production. Certified according to Organic Standard UA-BIO-108.

Organic camelina oil, TM "Organico". Nutritional value per 100 g of product: fats – 99 g. Energy value – 3,760 kJ/896 kcal. Organic lemon balm. The country of origin is Greece.

The organoleptic assessment of the developed samples was performed on the basis of a 50-point assessment score, developed by the authors of [14]. The organoleptic assessment was performed by the sensory method according to the following indicators set by the standard: shape, surface,

color, appearance at breaking, odor, taste, as well as such indicators as "aftertaste" and "physical appearance". A maximum of 5 points was set for each quality indicator; weight factors were determined for them.

We determined the nutritional and energy value in the cookies by a calculation method.

The mineral composition of the cookies was determined by atomic absorption spectrophotometry at the C-115 PK atomic absorption spectrophotometer (Ukraine). Thiamine (vitamin B1) was determined by fluorimetry, which implies the oxidation of thiamine in an alkaline environment. Tocopherol (vitamin E) was determined by high-performance liquid chromatography. To study the content of toxic elements in the new products, we used standard procedures: copper, zinc, lead, and cadmium were determined by atomic absorption. Arsenic was determined by the colorimetric method, mercury – by the method of flameless atomic absorption [20].

A causal diagram was used to better understand the food safety standard and the food safety management implementation plan. This method allows identifying those key factors that affect the safety of cookies. A causal diagram, also known as a herringbone chart or Ishikawa chart, is an effective tool. It is used to improve food safety management [21].

The practical implementation of hazard analysis and critical control points (HACCP) in the food industry is typically a complex structured task. Our HACCP plan was compiled using 7 principles and 12 steps in accordance with the HACCP system [22].

5. Results of studying the developed organic cookies

5.1. The recipes and organoleptic values of the developed organic cookies

Consolidated formulations of the developed cookies based on the organic raw materials are given in Table 1.

Table 1

Generalized recipes of the developed organic cookies per 1 kg of the finished product

Organic raw materials	«Flori»	«Janet»
Spelt flour	420.00	–
Corn flour	–	380.00
Coconut flour	–	60
Eggs	21.1	23.1
Organic sugar	150.00	–
Coconut sugar	–	150.00
Salt	0.10	0.10
Baking soda	0.10	0.10
Butter	105.00	105.00
Coconut milk powder	25.00	22.00
Hemp oil	–	11.00
Camelina oil	12.00	–
Lemon balm powder	7.5	6.8

Packages for the developed organic cookies are shown in Fig. 1.

The developed samples demonstrated a good appearance and aroma. The detailed organoleptic assessment is given in Table 2.

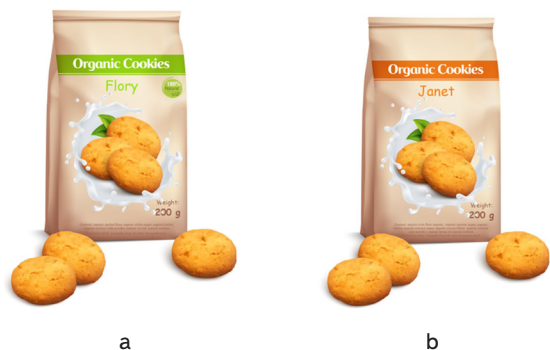


Fig. 1. Developed organic cookies: a – “Flori”; b – “Janet”

Based on the data in Table 2, it should be noted that for all parameters, except for “color”, “aftertaste”, and “consistency”, the “Janet” cookies demonstrated the highest indicators. The total score in the tasting assessment of this sample was 49.25. At the same time, the overall score of the “Flori” cookies was 48.12. On a 50-point scale, both samples can be rated as “excellent. However, the control sample scored only at 40.55 points, which corresponds to the “good” ranking. That is, the new raw material has a positive effect on the organoleptic properties of cookies.

Table 2

Results of the organoleptic assessment of cookies

No.	Parameter	Weight coefficient	Control sample	«Flori»	«Janet»
1	Shape	1	4.50	4.8	4.9
2	Surface	1	4.30	4.67	5
3	Color	1	4.60	5	5
4	Appearance	1	4.60	4.7	4.8
5	View at braking	1	4.40	4.6	4.7
6	Consistency	0.5	2.35	2.35	2.35
7	Smell	1.5	6.80	7.2	7.5
8	Taste	2	9.00	9.9	10
9	Additive intensity	0.5	0.00	2.4	2.5
10	Aftertaste	0.5	0.00	2.5	2.5
Total score including weight coefficients		–	40.55	48.12	49.25

5. 2. Results of studying the nutritional and energy value of organic cookies

The results of studying the nutritional and energy value of the developed samples are given in Table 3.

Table 3 shows that the fat content decreased in both samples. In the sample of “Flori” – by 0.9 g/100 g, and in the sample of “Janet” – by 1.2 g/100 g, compared to control. This is due to a change in the lipid base of the cookies. On the contrary, the protein content increased due to the replacement of wheat flour and the addition of coconut milk powder. The highest increase in the protein content was observed in the “Flori” cookies – by 2.3 g/100 g. There was also a decrease in carbohydrate content due to flour replacement. The sample of the “Janet” cookies had the lowest energy value – 380.50 kcal/100 g.

Table 3

Results of studying the nutritional and energy value of the developed cookies

Sample	Content, g/100 g.				Energy value, g/100 g.
	fat	proteins	carbohydrates	Moisture content	
Control sample	10.5	7.4	72.8	6.00	415.3
«Flori»	9.6	9.7	67.0	4.50	393.2
«Janet»	9.3	8.9	65.3	6.50	380.50

5. 3. Results of studying the safety parameters of organic cookies

An important step in the development of new products is the analysis of their safety indicators. The content of toxic elements in the tested samples is given in Table 4.

Table 3 shows that the content of heavy metals is lower than the normative indicators. The lead content in the sample of “Flori” is 40 % less than the content of this metal in control. The lead content in the “Janet” cookies is 44 % lower than that in control. Nevertheless, the lead content in the control sample is within permissible limits. The cadmium content in the sample of “Flori” was 0.06 mg/kg; in the sample of “Janet” – 0.04 mg/kg. These values are 40 % and 60 % lower than the normative ones, respectively. The mercury content in both samples was <0.001 mg/kg. It is worth noting that a significant amount of heavy metal salts enters the products from the soil. Such a low content of toxic elements in the organic cookies confirms the feasibility of expanding the range of organic products in terms of food and environmental safety.

Table 4

The content of toxic elements in the developed samples of cookies

Name of toxic element	Acceptable level, mg/kg, not exceeding	Control sample	«Flori»	«Janet»
Lead	0.5	0.5	0.3	0.28
Cadmium	0.1	0.1	0.06	0.04
Arsenic	0.3	0.25	0.1	3,81
Mercury	0.02	0.01	<0.001	<0.001
Copper	10.00	9.5	9.1	9.1

5. 4. Results of studying the vitamin and mineral composition of organic cookies

Mineral elements, and, in particular, macronutrients, are the chemical elements necessary for living organisms, in addition to the elements present in ordinary organic molecules. Dietary fiber and minerals are important for the healthy functioning of the human body. Mineral nutrition is an important aspect, and its key role in human life is to ensure healthy growth [23].

The analysis of the mineral composition of cookies is illustrated in Fig. 2.

The data in Fig. 2 show that in the developed cookie recipes the content of all mineral elements, except for sodium, increased. The potassium content in the “Flori” cookies increased by 2.34 times, in the “Janet” cookies – by 2.29 times. The calcium content in the “Flori” cookies increased by 3.13 times, in the “Janet” cookies – by 3.64 times. The ratio of calcium to phosphorus in food is important, which should equal (1:1.5–2)

so that both elements are better absorbed. The ratio of these macronutrients is close to ideal in the sample of “Flory” – 1:1.2. According to some studies, the ratio of calcium, magnesium, and phosphorus is important, which should equal 1:0.3:1 [24]. Such a ratio fits the sample of “Janet” better. Calcium and phosphorus are the main part of mineralized human tissues. Therefore, sufficient consumption of both is extremely important for maintaining the health, functioning, and preservation of teeth and bones. Calcium and phosphorus are the main part of mineralized human tissues. Therefore, adequate consumption of both is crucial for maintaining the health, functioning, and preservation of teeth and bones. Calcium fortification has been also shown to help maintain and improve oral health [25].

The content of microelements was also measured in the studied samples of cookies (Fig. 3).

One of the most important microelements in the human body is iron. This trace element is involved in the formation of hemoglobin in the blood. Iron is also involved in the synthesis of thyroid hormones, in protecting the body from bacteria. Iron is needed for the formation of cells that protect the immune system. However, the growth in this trace element was not significant. An increase of only 1.25 times in this microelement was demonstrated by the sample of “Flori”. In the “Janet” sample, the growth was even less significant. However, a marked increase in manganese content in both samples was observed.

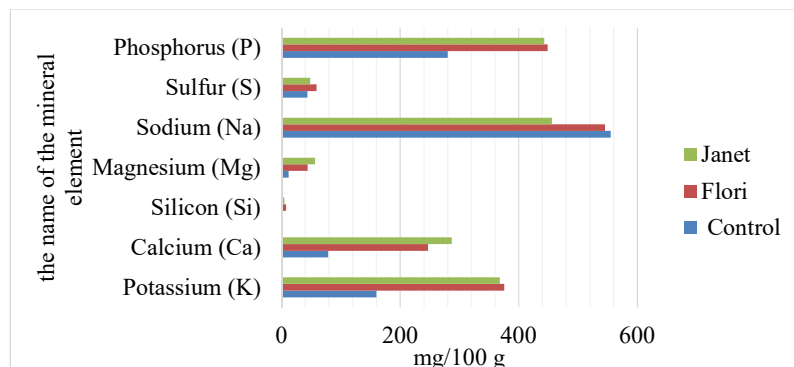


Fig. 2. Analysis of the mineral composition of organic cookies

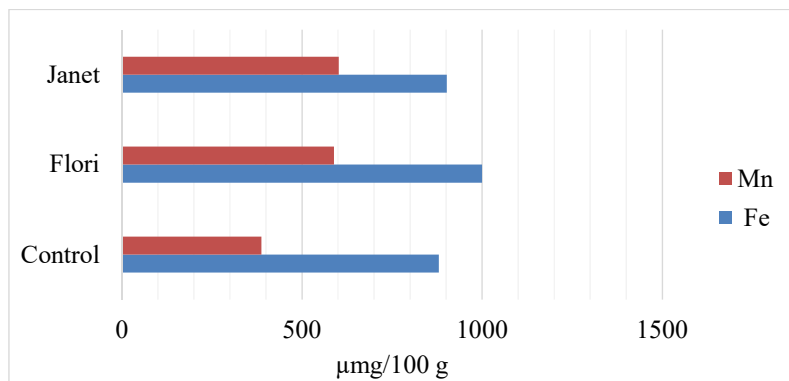


Fig. 3. Microelements content

The level of meeting the daily human need in minerals during the consumption of the developed samples of cookies is given in Table 5.

Table 5 shows that due to the consumption of the developed organic cookies, it becomes possible to increase the level of meet-

ing the needs of the human body in macro- and microelements. In particular, the developed samples significantly meet the daily need in calcium – 30.88% (a sample of “Flory”), 35.88% (a sample of “Janet”). The level of meeting the daily need in phosphorus and manganese in both samples also increased.

Table 5

Meeting the daily human need in minerals when consuming 100 g of cookies

No.	Name of mineral element	Daily need, mg	Control	«Flori»	«Janet»
Macroelements					
1	Potassium (K)	2500	6.40	15.03	14.72
2	Calcium (Ca)	800	9.85	30.88	35.88
3	Silicon (Si)	30	5.33	24.33	16.00
4	Magnesium (Mg)	500	2.40	8.76	11.30
5	Sodium (Na)	1,300	42.70	41.97	35.06
6	Sulfur (S)	1,000	4.36	5.90	4.85
7	Phosphorus (P)	1,600	17.50	28.04	27.69
Microelements:					
8	Iron (Fe)	15	5.87	6.67	6.01
9	Iodine (I)	0.15	0.00	1.53	3.00
10	Manganese (Mn)	2	29.45	29.45	30.10
11	Selenium (Se)	55	9.90	8.73	8.45

The content of vitamins in the daily diet is equally important. The content of thiamine and tocopherol in the developed samples is given in Table 6.

Table 6

Vitamin composition of the new sugar cookies, mg %

Vitamin	Control	«Flori»	«Janet»
Thiamine	0.05	0.15	0.16
Tocopherol	0.26	0.78	0.57

Table 6 shows that the thiamine content increased in both samples by 3 times. The tocopherol content also increased by 3 times in the “Flori” cookies and by 2 times in the “Janet” cookies. This is due to the content of vegetable oils in the recipe of the products.

5. 5. Results of studying the management system of food safety during the development of organic cookies

HACCP is a food safety management system by analyzing and controlling biological, chemical, and physical hazards throughout the food chain. It is necessary to adhere to the principles of food safety management during the production of raw materials, procurement, and processing of raw materials, production, selling, and consumption of finished products [26].

For the structured analysis, the Ishikawa method was used, which is represented in the form of a causal diagram, which is represented in the form of a causal diagram. The algorithm for constructing cause-and-effect relationships based on the diagram involved stating the problem of “cookie safety”. The analysis is shown in Fig. 4.

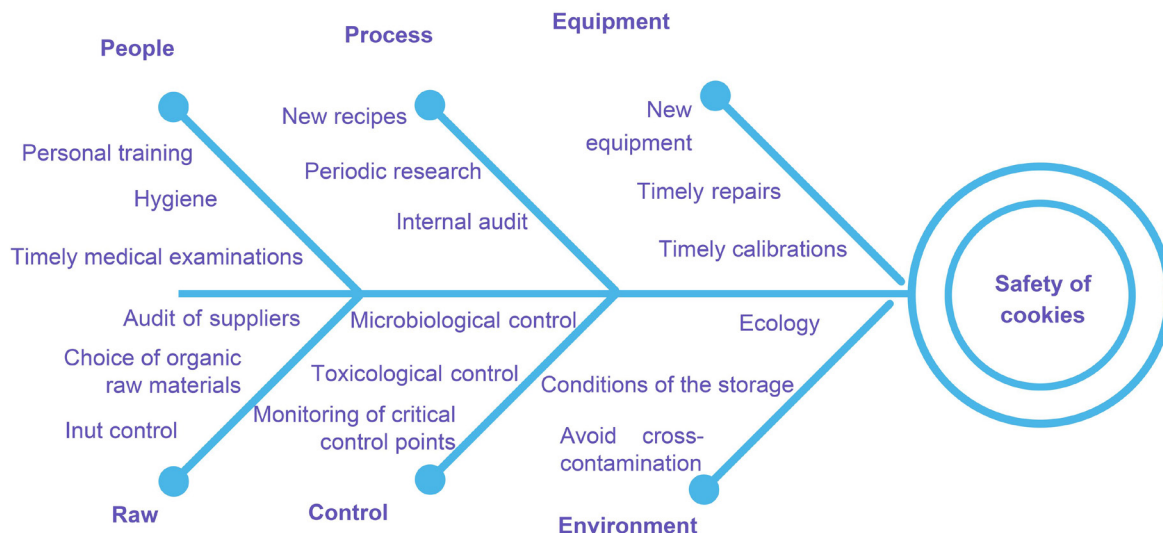


Fig. 4. Causal Ishikawa diagram

Owing to the Ishikawa method, it was possible to identify the main factors affecting the safety of cookies. These include staff training, hygiene, timely medical examination. The choice of raw materials, supplier audit, and acceptance inspection are also important. Adherence to the formulation and timely inspection of the equipment is of great importance for the safety of cookies. It is mandatory to pay attention to the ecology of the production environment and avoid cross-contamination.

A block diagram of cookie production was constructed to analyze dangerous factors and determine critical control points (Fig. 5).

Our analysis of harmful factors has revealed that the most significant risks may arise during the acceptance of products and heat treatment. During the acceptance control, it is important to check the availability of accompanying documents, conduct organoleptic assessment, and control samples. It is necessary to control the temperature inside the product during baking. It is important that pathogenic microorganisms are destroyed. Therefore, compliance with cooking technology and technical inspection of equipment has a significant impact. Because the product is made from organic raw materials, the content of heavy metals and agrochemicals will not be a significant danger factor. However, given the fact that organic raw materials are not subject to

chemical treatment, microbiological risks can be significant. That is why we propose 2 critical control points when making cookies: the acceptance of raw materials (input control) and baking. Our HACCP plan is given in Table 7.

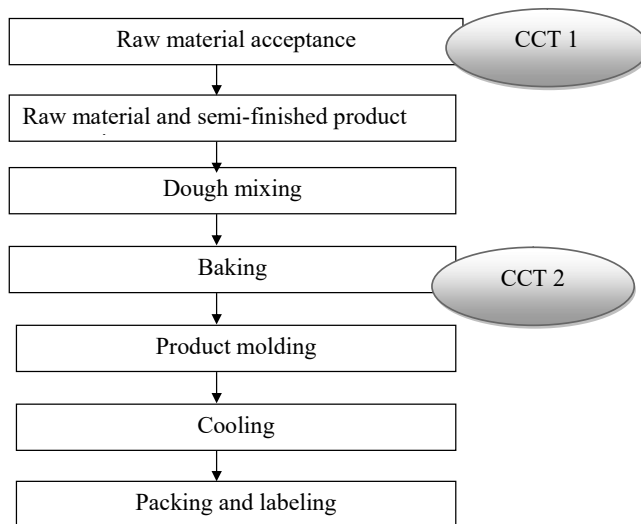


Fig. 5. Block diagram of cookie production

Table 7

HACCP-plan to produce organic cookies

CCT No.	Step No.	Critical limits	CCT monitoring system			
			What	How	How often	Who
CCT 1	Raw material acceptance	Organoleptic characteristics of raw materials meet the standards. The content of microbiological substances does not exceed the allowed. Availability of an organic certificate.	1. Organoleptic indicators 2. The content of microbiological substances 3. Organic certificate	1. Input organoleptic control 2. Input microbiological control 3. Input documentary control	1. Each batch of organic raw materials 2. Selected batch of organic raw materials 3. Each batch of organic raw materials	Person responsible for input control
CCT 2	Baking	Temperature and time of baking. Temperature inside the product	Temperature and time of baking. Temperature inside the product	Time and temperature control inside the product	Each batch of organic raw materials	Baker

The devised HACCP plan allows controlling the safety of organic cookies. CCT 1 is set at the stage of acceptance of raw materials. It is important that the person responsible for control checks the accompanying documents of each batch of raw materials and conducts the organoleptic assessment. Microbiological control is extremely important but it requires reagents and laboratory equipment, so it cannot be applied to every batch. The frequency of such control can be determined by an enterprise. CCT 2 is set at the stage of baking. The cookies do not contain fillings but there are eggs in the recipe. Therefore, compliance with temperature and time during baking is important from the point of view of food safety.

6. Discussion of results of studying the devised organic cookies

This study is a continuation of scientific work in the field of safety and quality management of flour confectionery made from organic raw materials. The authors of [27–29] made a significant contribution to the development of new types of cookies. However, a limited number of works address the development of organic confectionery.

Our study indicates the feasibility of using organic raw materials in the production of flour confectionery in terms of nutritional value and safety indicators. The developed samples of the cookies “Janet” and “Flori” demonstrated high organoleptic characteristics. This is indicated by the results given in Table 2. On a 50-point scale, both samples are rated “excellent”. At the same time, the control sample was evaluated as “good”.

The introduction of non-traditional raw materials in the cookie recipe helped improve consumer properties. According to the results in Table 2, the fat content decreased in both samples, the protein content increased. That was influenced, first, by the replacement of the lipid base of the cookies with a mixture of butter and hemp oil and butter and camelina oil. The increase in protein content was due to the introduction of coconut processing products into the recipe and the replacement of wheat flour with cornflour and spelt flour. This confirms the data reported in study [27] on the positive effect of non-traditional raw materials on the nutritional value of flour confectionery. The data from [14] also indicate a positive effect of non-traditional oils on the nutritional value of cookies. However, information on the fatty acid composition of cookies developed in this article is not sufficient, which shows prospects for further research.

The data in Table 3 indicate that the content of toxic elements in organic cookies is lower than set by regulatory requirements. Studies [6–8] also found a lower content of heavy metal salts in products made from organic raw materials. Thus, we can conclude about the effectiveness of the use of organic raw materials to improve the safety of finished products. However, the issue of microbiological safety indicators, as well as changes in safety indicators during storage, remains unexplored. That is why the further area of research is to study the impact of packaging and storage regimes on product safety.

The data in Table 5 indicate that the consumption of the developed organic cookies can increase the level of meeting the needs of the human body in macro- and micronutrients. In particular, the developed samples significantly meet the daily requirement in calcium, by 30.88 % (a sample of “Flori”), 35.88 % (a sample of “Janet”). Meeting the daily need for phosphorus and manganese in both samples also increased.

Table 6 shows the thiamine content increased in both samples by 3 times. The tocopherol content also increased by 3 times in the “Flori” cookies, and by 2 times in the “Janet” cookies. The improvement in consumer properties was due to the introduction of non-traditional raw materials. This proves the prospects for the use of vegetable oils, alternative types of flour in the production of flour products. However, the issue of comparing the nutritional value of organic and conventional raw materials remains unexplored. This will serve as a basis for further research.

The application of safety management approaches reduces the risks of hazardous food production. The implementation of the HACCP system is not only an effective tool for food safety but also a legal requirement in many countries. That is why this article considers approaches to food safety management in the production of developed organic cookies. The main factors affecting the safety of cookies have been identified: staff training, hygiene, timely medical examination. It was found that the selection of raw materials, audit of suppliers, and input inspection are important. Based on the analysis of dangerous factors, a HACCP plan was compiled. These results can be used by the confectionery industry in their everyday practice.

7. Conclusions

1. To improve the mineral, vitamin composition, and nutritional value of flour confectionery, new recipes for the “Flori” and “Janet” cookies, made from organic raw materials, have been created. The recipes of both products use fully organic raw materials. The cookies are made from spelt flour, cornflour, coconut sugar, butter, coconut milk powder, camelina oil, hemp oil, lemon balm powder, eggs. An organoleptic assessment of the developed samples was performed based on a 50-point assessment that we developed. The highest score in the tasting assessment of our sample was 49.25 for the “Janet” cookies. At the same time, the total score in the tasting assessment of the cookies “Flori” was 48.12. On a 50-point scale, both samples can be rated “excellent.”

2. In the sample of “Flory”, the fat content is 0.9 g, and, in the sample of “Janet”, is 1.2 g less compared to control. This is due to a change in the lipid base of the cookies. The protein content increased due to the replacement of wheat flour and the addition of coconut milk powder. The highest protein content increase was observed in the “Flori” cookies, by 2.3 g/100 g. A sample of the “Janet” cookies had the lowest energy value, 380.50 kcal/100 g. A sample of the “Flori” cookies had an energy value of 393.2 kcal/100 g.

3. The lead content in the “Flori” cookies was 44 % lower than that in control. However, the lead content in the control sample is within permissible limits. The cadmium content in the sample of “Flori” was 0.06 mg/kg; in the sample of “Janet” – 0.04 mg/kg. The mercury content in both samples was <0.001 mg/kg.

4. The thiamine content in both samples increased by 3 times. The tocopherol content also increased by 3 times in the “Flori” cookies and by 2 times in the “Janet” cookies. This is due to the content of vegetable oils in the recipe of the products. The growth in this trace element was not significant. The trace element increased only by 1.25 times in the sample of “Flori”. In the “Janet” sample, the growth was even less significant. However, there was a marked increase in manganese content in both samples. The developed cookies have a high content of all mineral elements, except for

sodium. The content of potassium in the “Flori” cookies increased by 2.34 times, in the “Janet” cookies, by 2.29 times. The calcium content in the “Flori” cookies increased by 3.13 times, in the “Janet” cookies, by 3.64 times.

5. Using the Ishikawa method has made it possible to identify the main factors affecting the safety of cookies. These include staff training, hygiene, timely medical examination. Also, the choice of raw materials, supplier audit, and input control are important. Our developed HACCP plan allows controlling the safety of organic cookies. Two critical control points were set: input control, baking (heat treatment).

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