

STUDY OF THE INFLUENCE OF BUCKWHEAT FLOUR AND FLAX SEEDS ON CONSUMPTION PROPERTIES OF LONG-STORED BAKERY PRODUCTS

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Abstract

Rusk and ring-shaped bakery products relate to the group of long-stored ones. For today it is urgent to use ingredients that give products functional properties in food technologies. The important source of food fibers, full-value protein, unsaturated fatty acids, mineral substances and vitamins are grain and oil-bearing crops. Buckwheat and flax seeds are separated among them due to the valuable chemical composition and positive effect on the human organism.

The aim of the work was to establish the influence of buckwheat flour and flax seeds on the technological process course and quality of long-stored bakery products.

Buckwheat flour of green and dark buckwheat of TM "Organic-Eco-Product" (Ukraine) is used in the rusk technology. For producing ring-shaped products (ring-shaped crackers), gold flax seeds were used.

Research results testify that good quality parameters of bread for producing rusks from it, were achieved at dosing green buckwheat seeds as 20 % and dark ones as 15 % instead of the flour mass.

It has been established, that rusks with adding green buckwheat flour have quality parameters, corresponding to requirements of normative documents.

It has been proven, that it is not expedient to use dark buckwheat flour in the rusk technology, because ready products have the increased water share and soaking index. It is connected with the influence of the operation of hydrothermal processing of grains that dark buckwheat flour is produced of, its high water-absorbing and water-retaining capacities.

For the technology of ring-shaped crackers, enriched with flax seeds, it is recommended to dose flax seeds as 15 % of the flour mass. At such dosage bakery products got the highest number of points by the complex quality parameter and corresponded to requirements of normative documents.

Keywords: rusks, ring-shaped products, green buckwheat flour, dark buckwheat flour, gold flax seeds.

DOI: 10.21303/2504-5695.2019.00973

1. Introduction

With the development of nutrition culture, the population demand for products, balanced by the content of main nutritive substances, with the increased food value, increases. Rusk and ring-shaped products occupy an important place among bakery products due to their taste and nutritive properties. These products have a low mass share of moisture, so they are bakery “tinned food” that can be stored for a long time and transported at long distances. It conditions the continuous demand of the population for this kind of products.

Today it is urgent to use ingredients that give products functional properties in food technologies. Scientists are interested in substances that come in the gastrointestinal tract with food products and interact with mutagens, decreasing their negative effect. They include food fibers that regulate processes in digestive organs, provides prophylaxis of many human decreases, first of all, so-called “civilization” ones (diabetes mellitus, atherosclerosis, ischemic heart disease, cancer diseases) [1–3].

The important source of food fibers, full-value protein, unsaturated fatty acids, mineral substances and vitamins are grain and oil-bearing crops [4–7].

One of most valuable products of grain crops processing by food and biological value is buckwheat flour. The protein content in buckwheat is within 13.0–15.0 %, that is essentially lower than in other crops (rice – 7.0 %, millet – 12.0 %, oats – 11.3 %). Its protein is of the high value, is characterized by the balanced amino acid composition and high content of soluble fractions, well-assimilated by the organism [8, 9].

Buckwheat flour is produced of buckwheat peeled grains. Due to the fact that at peeled grains production a part of a buckwheat bud is in the endosperm and is not separated at peeling, the essential amount of vitamins and mineral substances remain in peeled grains. Buckwheat flour is a source of vitamins of E, B, P and PP. It contains in 5–7 times more vitamins of B group, than other peeled grains. Buckwheat contains potassium, phosphorus, magnesium, sodium, copper, iodine, zinc, and it prevails over other peeled grains by the content of calcium and iron. At that, buckwheat flour is rich in food fibers (near 6 %), organic acids – lemon and apple. Buckwheat is a single grain crop that contains rutin that increases the strength of blood vessels and prevents cardiovascular diseases [10–14].

Among oil-bearing crops, scientists’ attention is paid to flax seeds because of their composition of nutritive food substances, able to improve the human health status. The value of flax seeds is in fact that they are a source of such physiological-functional ingredients as unsaturated fatty acids, especially, food fibers and lignins [15].

Flax seeds are a vegetable source of vitally important fatty acids – linoleic (omega-6) and α -linolenic (omega-3). In certain flax sorts the content of α -linolenic acid may reach 70 %. These essential acids raise the immunity, strengthen walls of blood vessels, increasing their elasticity, so they are used for treating and preventing atherosclerosis and intestinal diseases. Experimental studies on rats proved that α -linolenic acid of flax seeds has the important influence in treating and preventing hearth arrhythmias [16].

Researchers of work [17] established that the arterial pressure decrease was favored by the daily consumption of 30 g of whole flax seeds in the composition of a bakery product by patients with the pulmonary arterial disease and increased arterial pressure.

Food fibers of flax seeds are characterized with prevailing water-soluble fractions. Water-soluble food fibers of flax form slimes with a high water-retaining capacity that gives them properties of a structure-creator and thickener of food systems [18].

Medical studies proved that slimes of flax seeds favor the improvement of the intestinal microbiota [19].

Flax seeds are a source of vegetable phytoestrogens, phenol compounds, especially lignans (pinosresinol and larisiresinol) with high antioxidant properties. Scientific data prove that lignans of flax seeds have the anti-allergic activity and strong antioxidant effect. Just these their properties are a background of using flax seeds at correcting atherosclerosis and coronary failure [20].

Taking into account such strong physiological properties of flax seeds components, their use in bakery products recipes will favor the improvement of their functional properties.

Among the assortment of bakery products, flax seeds are mainly used in the bread technology [21–23]. There are not enough data about using flax seeds and their processing products in the ring-shaped products technology.

The aim of the work was to establish the influence of buckwheat flour and flax seeds on the technological process course and quality of long-stored bakery products. It allows to produce long-stored bakery products, corresponding to requirements of normative documents and having the increased food value, healthy properties as a result of enrichment with components of buckwheat flour and flax seeds.

For attaining the set aim, the following tasks were formulated:

- to establish the optimal dosage of buckwheat flour in simple rusks production for getting products with good consumption properties;
- to establish the optimal dosage of gold flax seeds in ring-shaped crackers production for getting products with good consumption properties.

2. Materials and Methods

Buckwheat flour of green and dark buckwheat of TM “Organic-Eco-Product” (Ukraine), according to TC U 15.6-2110615276-002:2010 is used for producing rusks. The quality parameters of buckwheat flour are presented in **Table 1**.

Table 1
Quality parameters of buckwheat flour

Name of parameter	Characteristic
Color	Green buckwheat – creamy with a light grey tint; Dark buckwheat – light brown
Smell	Inherent to buckwheat flour, without side smells, not musty, not mouldy
Taste	Inherent to buckwheat flour, without side smacks, not sour, not bitter
Consistence	Crackle is not felt at chewing
Mass share of moisture, %	Green buckwheat – 11.6 Dark buckwheat – 8.9
Acidity, degrees	Green buckwheat – 5. 4; Dark buckwheat – 5.8 degrees.

At preparing ring-shaped products, gold flax seeds of “Biorostoropsha” LTD (Ukraine), according to SSU 4967:2008 were used. The quality parameters of gold flax seeds are presented in **Table 2**.

For producing rusks and ring-shaped products, where was used wheat flour of the first sort, made by “Kyivmlyn” OSC (according to SSU 46.004–99), kitchen salt of the first sort TM “Artem-sil” (according to SSU 3583–2015), pressed yeast of TM “Lviv yeast” (according to SSU 4812:2007), white sugar by TM «Aro» (SSU 4623–2006).

Table 2
 Quality parameters of gold flax seeds

Name of parameter	Characteristic
Outlook	Powdery product, consisted of a mixture of whole kernels
Color	Bright, light-yellow
Smell and taste	Inherent to flax seeds, without side smacks and smells, signs of must or mould
Mass share of moisture, %	7.0
Titrated acidity, degrees	3.0

Dark buckwheat flour is obtained by comminuting peeled grains after hydrothermal processing using steam at pressure 0,25...0,30 Pa. This flour belongs to ones of special destination, used in child and dietary nutrition.

Green buckwheat flour is obtained of buckwheat peeled grain without thermal processing. This flour has a lighter color, comparing with dark buckwheat one. Its technological properties are little studied, but there is information that its food and biological value exceeds one of dark buckwheat flour due to the absence of hydrothermal processing.

For getting simple rusks and determining their quality parameters, laboratory baking of formed bread of flour mixtures of wheat and buckwheat flour were realized. Experimental samples were added with green and dark buckwheat flour in 15, 20, 25 % instead of the wheat flour mass. The control was a sample of wheat flour without adding buckwheat one. Thus, there were obtained 6 experimental samples (No. 2, 3, 4 with adding green buckwheat flour and No. 5, 6, 7 – dark buckwheat flour). The control (sample № 1) for these experimental samples was a sample of wheat flour without adding buckwheat one. The recipe of the control sample: wheat flour of the first sort – 100 g, yeast – 3 %, salt – 1.0 %.

Bread was cooled during 8 hours, cut in pieces with thickness 15 mm. The obtained pieces were dried at temperature 180 °C during 30–45 min.

Dough was prepared without preliminary with mass share of dough 42...43.6 % depending on the amount of replacement of wheat flour by buckwheat one and, correspondingly, water-absorbing capacity of wheat mixtures. Dough was mixed in two-speed dough-mixing machine Escher (Italy). Dough was processed by hands, dough semi-products were kept in the thermostat at temperature (38±2) °C and relative humidity (78±2) % up to readiness. The products were baked in the chamber stove Sveba-Dahlen at temperature 220...240 °C.

For getting rusks, bread pieces were dried in the chamber stove Sveba-Dahlen at temperature 180 °C.

For preparing ring-shaped products, gold flax seeds were used. Gold flax seeds were dosed in the experimental samples as 5, 10, 15, 20 % of the flour mass. The control was a sample with the recipe: wheat flour of the first sort – 100 g, yeast – 3 %, salt – 1.0 %.

Dough was mixed in two-speed dough-mixing machine Escher (Italy) during 20 min at the first speed. Mixed dough was left for 20 min for laying, after that it was rubbed with the following laying of dough. Dough semi-products were formed by hands and kept in the thermostat at temperature (38±2) °C and relative humidity (78±2) % up to readiness. Before baking they were oiled in hot water with adding white sugar. The products were baked in the chamber stove Sveba-Dahlen at temperature 230 °C.

The quality control of the semi-products by humidity and acidity was realized by conventional methods [24].

The bread quality was estimated by the physical-chemical parameters (specific volume, form stability, acidity) [24].

The quality of rusks and ring-shaped products was estimated by the organoleptic parameters (outlook, surface state, porosity structure, color, taste, smell) and physical-chemical ones (mass share of humidity, acidity, soaking, swelling coefficient) [24].

The experimental research results were processed, using calculating methods of statistical reliability of measuring results. Approximation of empirical data was conducted by e-tables MS-Excel (version of 2010).

3. Results

For establishing the influence of buckwheat flour on the technological process and quality of rusk products, at the beginning of the studies, there was investigated the influence of different dosages of green and dark buckwheat flour on the bread quality parameters, because simple rusks are obtained just of it after cutting and drying.

The analysis of the test laboratory baking results for making rusks of bread demonstrated (**Fig. 1, Table 3**) that adding dark buckwheat flour needs increasing the moisture mass share of dough. It is conditioned by the high water-absorbing capacity of flour.

Introduction of flour of both green and dark buckwheat increases both initial and final acidity of dough and crumble of the products. It is connected with the chemical composition of flour that contains acid-reacting substances in its composition.

It has been established, that the specific weight of bread increases with increasing the dosing amount of green buckwheat flour. But at introducing 25 % it decreases abruptly.

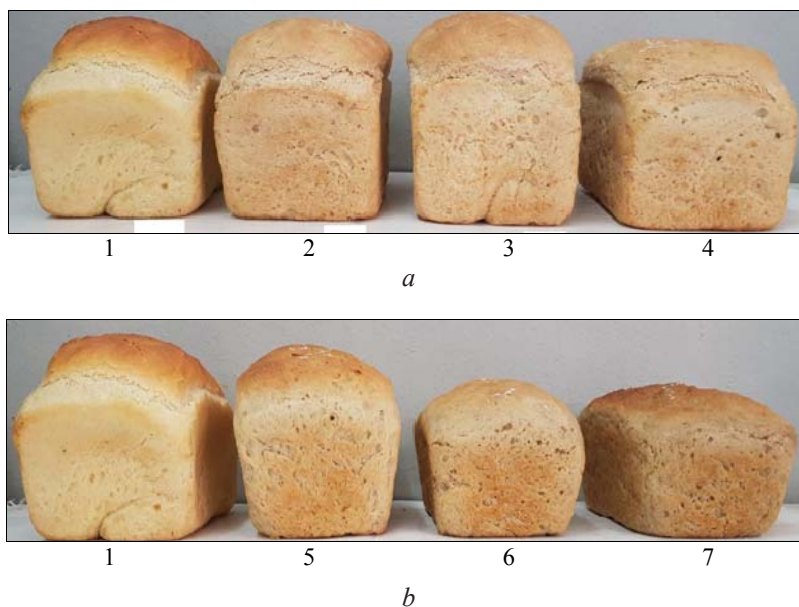


Fig. 1. Ready studied samples with replacement by flour of green (a) and dark (b) buckwheat: 1 – control; 2 – with replacement by 15 % of green buckwheat flour; 3 – with replacement by 20 % of green buckwheat flour; 4 – with replacement by 25 % of green buckwheat flour; 5 – with replacement by 15 % of dark buckwheat flour; 6 – with replacement by 20 % of dark buckwheat flour; 7 – with replacement by 25 % of dark buckwheat flour

Introduction of dark buckwheat flour more than 15 % instead of the mass of flour one essentially worsens the volume of the products and porosity index.

Taking into account the research results, we can make conclusion, that the best indices are inherent to the samples with introducing green buckwheat flour in amount 20 %, and the maximally permitted dosage of dark buckwheat flour is 15 % instead of the flour mass.

The further studies of the quality of rusks, obtained of baked bread, were conducted with the aforesaid dosage of buckwheat flour.

It has been established (**Table 4**), that simple rusks with dark buckwheat flour need much more time for drying.

Table 3

Parameters of the technological process and quality of bread of wheat flour of the highest sort with adding dark and green buckwheat flour

Parameters	Control (without replacement)	Samples with replacement of % of wheat flour by					
		green buckwheat flour			dark buckwheat flour		
		15	20	25	15	20	25
Dough							
Mass share of humidity, %	42.4	42.2	42.0	41.7	42.5	43.0	43.6
Titrated acidity, degrees:							
– initial	1.6	2.0	2.2	2.2	2.4	2.6	2.6
– final	2.0	2.6	2.8	3.0	2.6	2.8	2.8
Ready products							
Specific volume, cm ³ /g	3.18	3.30	3.58	3.00	3.02	2.22	2.19
Mass share of humidity, %	41.8	41.7	41.5	41.3	42.0	42.6	43.1
Porosity, %	73	74	75	72	72	70	70
Acidity, degrees	1.2	1.6	1.6	1.8	1.4	1.4	1.6

Table 4

Technological parameters of preparing simple rusks

Parameter	Control	20 % of green buckwheat flour	15 % of dark buckwheat flour
Duration of keeping bread, hours	8	8	8
Thickness of pieces, mm	12	12	12
Drying temperature, °C	180	180	180
Drying duration, min	30	30	45

The analysis of ready rusks demonstrated (**Table 5, Fig. 2**), that the sample with green buckwheat flour has a creamy color with a light grey tint, inherent to this type of flour, one with dark buckwheat flour – brown. The control porosity is fine, thin-walled, even; with green buckwheat flour – middle, thin-walled, even; with dark buckwheat flour – fine, thin-walled, even.

Table 5

Organoleptic quality parameters of simple rusks

Parameter	Control	Samples with replacement of wheat flour by	
		20 % of green buckwheat flour	15 % of dark buckwheat flour
Outlook:			
form	Pieces, correspondent to the form of bread, which a rusk is dried of		
surface	Without through cracks, with developed porosity, without unmixed spots, mould and pollution signs		
color	Light-brown	Dark-brown	
Inherent to this type of rusks			
Taste	Inherent to this type of rusks, without side smacks	With a buckwheat smack	With a brightly expressed buckwheat smack
Smell	Inherent to this type of rusks, without side smells		

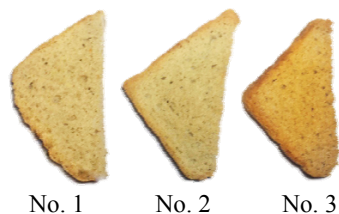


Fig. 2. Rusk products, produced of bred with adding buckwheat flour:
1 – control, 2 – with replacement by 20 % of green buckwheat flour; 3 – with replacement by 15 % of dark buckwheat flour

According to the data of **Table 6**, the humidity of the control sample and the one of the sample with green wheat buckwheat is within the standard. Rusks with adding dark buckwheat flour have higher humidity (14.0 %).

The duration of soaking rusks with adding dark buckwheat flour is 6 min 40 s that is in 4 times longer, than in the sample with green buckwheat flour and almost trice, than in the control sample (it is recommended no more 4 min).

The most swelling coefficient is in the control sample, the least one – in the sample with green buckwheat flour. It is probably connected with sizes and thickness of crumble pores and their possibility to absorb water.

Table 6

Physical-chemical parameters of simple rusks with adding buckwheat flour

Parameter	Control	20 % of green buckwheat flour	15 % of dark buckwheat flour
Mass share of moisture in rusks, %	12.0	11.7	14.0
Acidity, degrees	2.2	3.4	4.0
Soaking, min	2:30	1:40	6:40
Swelling coefficient	7.2	4.8	5.1

So, by the parameters of moisture mass share and swelling, rusks with adding green buckwheat flour correspond to requirements of normative documents. Rusks with dark buckwheat flour need 1,5 times longer drying duration.

The results of enriching ring-shaped crackers with gold flax seeds testify that the products with 5 % to the mass of flax seeds had a bit unpleasant smack of raw seeds. The dosage increase of seeds favors the formation of a pleasant original smack of fried seeds in products. Ready products with flax had inclusions of seeds on the surface. At the dosage increase of flax seeds, ready products get more intensive coloration of the surface and become more crumbling, comparing with the control. At dosage 20 % of flax seeds to the flour mass, their chewing capacity a bit worsens together with forming pleasant taste properties.

According to the organoleptic estimation results of the ready products, the complex quality index was calculated. The complex quality index it is a total sum of points, obtained by an experimental sample at its analysis. For its calculation, each of organoleptic parameters of a product (outlook, crust color, crumble state, taste, smell) was estimated by the five point scale, taking into account the ponderability coefficient, established for each parameter by the method of expert estimation. That is a number of points, given to a parameter was multiplied on the ponderability coefficient. Then, the sum of obtained values was found. The maximal possible quality mark is 100 points. The more number of points is obtained by an experimental sample at the calculation, the better its organoleptic parameters are [25]. The expert commission included three doctors of technical sciences, five candidates of technical sciences, two PhD applicants and twelve higher education applicants of the speciality “Food technologies”.

The results of calculating the complex quality index of the control and experimental samples demonstrated (**Fig. 3**), that the sample with dosage 15 % of flax seeds of the flour mass got most points. It allows to state that the dosage of flax seeds together with enriching a product with physiological-functional ingredients will favor the formation of the organoleptic parameters that satisfy a mass consumer.

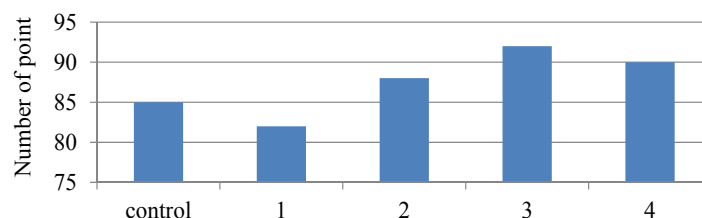


Fig. 3. Complex quality index of products with adding gold flax seeds: 1 – 5 % of the flour mass; 2 – 10 % of the flour mass; 3 – 15 % of the flour mass; 4 – 20 % of the flour mass.

The analysis of products by the physical-chemical parameters testified (**Table 7**) that introduction of flax seeds doesn't influence the acidity of ready products. The humidity of products at increasing the seeds dosage a bit decreases, probably, as a result of higher water-absorbing capacity of seeds.

Table 7

Physical-chemical parameters of ring-shaped crackers with adding flax seeds

Parameter	Control	Samples with adding flax seeds, % of the flour mass			
		5	10	15	20
Mass share of moisture of rusks, %	12.5	12.3	12.0	11.4	11.0
Acidity, degrees	1.6	1.6	1.5	1.5	1.5
Swelling coefficient	4.3	4.0	3.8	3.5	3.0

It is noted, that the swelling coefficient of ring-shaped crackers with flax decreases corresponding to the dosage growth. It is probably connected with the fact that in ready products of the equal mass at the flax dosage growth, the flour content decreases at increasing the flax mass share.

4. Conclusion

The research results testify that the good quality parameters of bread for producing rusks were attained at green buckwheat flour dosage 20 % and dark buckwheat 15 % instead of the flour mass.

It has been established, that rusks with adding green buckwheat flour have the quality parameters, correspondent to requirements of normative documents.

It has been proven, that it is not expedient to use dark buckwheat flour in the rusk technology, because ready products have the increased water share and soaking index. It is connected with the influence of the operation of hydrothermal processing of grains that dark buckwheat flour is produced of, its high water-absorbing and water-retaining capacities.

Taking into account, that the rusk products with adding dark buckwheat flour had pleasant organoleptic parameters, it is necessary to continue the study as to establishing optimal parameters of their drying (temperature and duration) for attaining their physical-chemical parameters, correspondent to requirements of normative documents.

In the drying technology, enriched by flax seeds, it is recommended flax seeds dosage 15 % of the flour mass. The products of such dosage obtained the maximal amount of points by the complex quality index and correspond to requirements of normative documents. In further it is expedient to conduct studies as to selecting the rational method and parameters of preparing dough

for this product that allows to improve the products quality and to decrease technological losses for the production.

The results of these studies allow to produce long-stored bakery products with the increased food value and healthy properties. Its practical importance is in widening the assortment of long-stored bakery products with healthy properties.

For confirming the status of these products of just healthy destination, it is necessary to calculate the chemical composition of the experimental samples and to compare it with the control one as to providing with important physiological-functional ingredients (food fibers, unsaturated fatty acids, mineral substances and vitamins).

In further it is also necessary to study changes of the organoleptic and physical-chemical parameters of the enriched products during the normative term of their storage.

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Received date 19.06.2019

Accepted date 15.07.2019

Published date 31.07.2019

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STUDY OF QUALITY AND SAFETY PARAMETERS OF LIVER PASTES WITH AUBERGINE POWDER

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