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RESEARCH OF RATIONAL CONCENTRATION OF OILSEED CROPS MEALS IN THE SANDY DOUGH SEMI-FINISHED PRODUCT

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Abstract

The work studies the rational concentration of meals of soya, sunflower and milk thistle in a sandy dough semi-product for improving healthy properties of ready products (biological value, stomach peristalsis, metabolism, saturation with vitamins and mineral substances). Analytic studies were conducted and advantages of using meals in dough products were determined. The chemical composition of meals was determined, and the optimal composition for satisfying the human need that is in ratio 3:4:3 was calculated. The quality of meals was estimated, and their organoleptic parameters were analyzed. The sensor analysis of sandy semi-products of oilseed crops meals was realized. It was established, that adding of the meal composition instead of flour in amount 20 % is an optimal solution for using in a sandy dough semi-product.

There was established the influence of meals of oilseed crops on organoleptic parameters of developed sandy semi-products. Advantages and defects of using the aforesaid meals were established. Ways of improving the outlook and consistence of shortcakes were offered. Ways of further studies were established.

Keywords: sandy dough semi-product, meals of oilseed crops, dough deformation, meals composition.

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1. Introduction

It is urgent today to provide health of all people throughout the world. For this it is necessary to improve the ration at the expense of consuming healthy and relatively cheap food [1]. This task is usually provided by different methods. One of which is to add to food healthy elements that provide the essential improvement of a food value of products [2].

Bakery products occupy an important place among products, continuously consumed because of their small cost and fast saturation of the organism. But modern dough products have low healthy indices because of different causes [3]. It is possible to eliminate this shortcoming at the expense of adding healthy microelements, one of which is meals.

Meals are side products of oilseed crops grains processing after getting oils from them [4]. Such biologically active supplements are characterized by the powder-like structure and increased content of cellulose, protein, mineral substances and vitamins of B group [5]. There are distinguished flax, sesame, walnut, sunflower meals. Their use provides the daily need of the organism in proteins, mineral substances and macro- and microelements [6, 7].

Meals, comparing with other vegetable raw materials and supplements, are characterized with relatively high protein content – from 20 g to 45 g for 100 g of a supplement [8, 9]. They contain fat as 4 g – 10g for 100 g. Carbohydrates are from 9g to 39 g for 100 g of meals [10]. At that the main part of them is food fibers [11, 12].

Soya meal [13–15] is distinguished by the highest content of such microelement as cobalt – 31,2 mcg. It stimulates formation of hemoglobin and erythrocytes, growth processes, it activates the effect of muscular and bone phosphatase. The human daily need is 100 mcg.

Sunflower meal has the highest fat content among other ones – 12 g, and also sodium – 160 mg. Fat as a plastic material participates in cells construction, their especially high content is in membranes. It participates in hormones synthesis, is a high-energetic resource of the organism. The daily need in fat is 80 g. Sodium supports an optimal balance between extracellular and tissue liquids in the organism [16, 17]. It participates in acids neutralization, muscles contraction and blood pressure regulation, gives tissues endurance. Its daily need is 1,3 g.

Milk thistle meal has the highest selenium content. It is a powerful antioxidant. It provides the extremely reliable protection of erythrocytes and cellular membranes from free radicals [18]. Selenium increases the organism's resistance to diseases, increases leucocytes production and protects them from free radicals. The daily need in selenium is 70 mcg.

Thus, it is urgent to study the rational concentration of oilseed crop meals in a sandy dough semi-product, as one of most spread at manufacturing sandy products in Ukraine. It allows to establish an optimal ratio between dough and meals and favors production of shortcakes with increased food characteristics.

The aim of the research is to study the rational concentration of meals of soya, sunflower and milk thistle in a sandy dough semi-product for synchronously providing the human daily need in proteins, mineral substances, macro- and microelements.

2. Materials and Methods

The material was meals of soya, sunflower and milk thistle, produced by “PE Myroslav” (Ukraine).

The dough elasticity was determined on the Tolstoy elastoplastometer (Ukraine). Test models of study [16] and rheological research methods for raw materials of study [17] were used in the experiments. All raw materials (sandy dough and its ingredients) and materials (meals as a supplement) corresponded to requirements of actual normative documents (SSU 3781:2014) by quality and safety parameters, and also to the quality of firms-producers and are permitted for using by the Health Protection Ministry of Ukraine.

For studying the chemical composition of meals and dough semi-product, there were used existing standard research methods, namely– SSU ISO 771:2006 and SSU 4910:2008. According to SSU ISO 771:2006, there was determined the content of moisture and volatile substances, according to SSU 4910:2008 – methods of determining mass particles of moisture and dry substances for confectionary products [19].

Organoleptic parameters of sandy dough were determined by testing using a ten-point scale, according to SSU 5024:2008 [20]. The material for the studies was soya, sunflower and milk thistle meals (**Fig. 1**), corresponding to TC U 10.4-38667335-002:2014 [21]. Just they were used in further for creating the composition.



Fig. 1. Meals, used in the experiment: *a* – soya; *b* – sunflower; *c* – milk thistle

The research object was one composition of soya, sunflower and milk thistle meals. Using the mathematical modeling method, there was determined the optimal ratio between three types of meals in the composition that was further used for following studies.

A dough sandy semi-product, which main components were flour, eggs, sugar, salt, soda, ammonium (fluffier), cream butter was selected as a control.

The obtained composition with the ratio of soya, sunflower and milk thistle as 3:4:3 was introduced in sandy dough with its replacement in amount 10 %, 20 % and 30 % instead of flour in the recipe of sandy dough. The recipe No. 8 (sandy semi-product No. 8 from the collection of recipes of confectionary products [22]) was used at correspondent experiments No. 1 (10 %), No. 2 (20 %) and No. 3 (30 %). For that 4 samples of sandy dough were used with wheat flour of the highest sort and sesame, nut, flax meals that created sandy dough semi-products.

2. Experimental procedures

Before conducting the main studies, there were realized preliminary experiments for determining the chemical composition of samples with adding the aforesaid meals. They allowed to outline limits of further experiments. After that, the chemical composition of meals was calculated that is presented in **Table 1**.

Table 1

Chemical composition of soya, sunflower and milk thistle meals (for 100 g)

Parameters	Name of meals		
	Soya meal	Sunflower meal	Milk thistle meal
Protein, g	44,7	40	20
Fat, g	–	–	5,5
Carbohydrates, g	17,6	39	25,2
Including cellulose, g	2,6	8	35
Potassium, mg	1600	647	920
Calcium, mg	217	367	1660
Magnesium, mg	200	317	420
Sodium, mg	5	160	4
Phosphorus, mg	603	860	960
Iron, mg	9	6,1	8
Iodine, mcg	8,2	22,5	9
Cobalt, mcg	31,2	32	10
Manganese, mcg	200	8	10
Copper, mcg	30	2,8	116
Selenium, mcg	18	53	129

Table 1 allows to make conclusions that it is necessary to determine such meals concentration, at which the developed composition will satisfy the daily need in necessary nutrients the best.

At calculating the optimal composition there was firstly taken the ratio of soya, sunflower and milk thistle meals as 3:4:3. At that there was calculated satisfaction of the daily need in such substances as fat that is 0,2 %, carbohydrates – 0,5 %, phosphorus – 8,44 %, iodine – 0,4 %, cobalt – 1,18 %, manganese – 3,15 %, copper – 3,25 %. In total satisfaction of the daily need in the composition equals 17,10 %.

At the following calculation of the composition, there was taken the ratio of soya, sunflower and milk thistle meals as 4:4:2 and 2:4:4. At that satisfaction of the daily need of such substances as fat is 0,15 % and 0,19 %, carbohydrates – 0,56 % and 0,47 %, phosphorus – 8,45 % and 8,43 %, iodine – 0,34 % and 0,46 %, cobalt – 1,37 % and 0,98 %, manganese – 3,05 % and 3,24 %, copper – 3,18 % and 3,33 %. In total satisfaction of the daily need in the composition equals 17,05 %.

At the ratio of soya, sunflower and milk thistle meals as 4:3:3 satisfaction of the daily need in the correspondent substances is totally 14,80 %. The ratio of the aforesaid meals in amount 3:3:4

and 4:2:4 provides the daily need totally by 14,80 % and 12,50 %. In other meal ratios a value of the human daily need in necessary nutrients decreased even more.

Formula (1) was used for determining the necessary concentration of meals in the composition:

$$Y=A_1X_1+A_2X_2+A_3X_3+\dots+A_nX_n, \quad (1)$$

where A_1, A_2, A_3 – amount of a correspondent meal in the composition (soya, sunflower and milk thistle) %; $X_1, X_2, X_3, \dots, X_n$ – relative content of components in meals (fat, carbohydrates, protein, Phosphorus, iodine, cobalt, manganese, copper, sodium, iron) % of mass.

The conducted calculations and studies allowed to establish that the best composition of soya, sunflower and milk thistle meals for satisfying the daily need is 3:4:3 ratio.

3. Results

For conducting the studies, the meals quality was estimated. Organoleptic parameters of the quality soya, sunflower and milk thistle meals were analyzed (**Table 2**).

Table 2

Quality estimation of soya, sunflower and milk thistle meals

Meal type	Characteristic			
	Color	Smack	Concentration	Smell
Milk thistle meal	Light-chocolate	Nut		Absent
Soya meal		Absent	Homogenous, brittle, powder-like	
Sunflower meal	Light-brown	Typical for walnuts		Typical nut

It was noted, that the taste and smell of the studied meals is absent or typical nut that can influence the quality of ready cakes positively. The consistence of meals is homogenous, brittle, powder-like that makes it possible to use them in the sandy dough technology. The color of meal samples is determined from light-chocolate to light-brown that can influence the coloration of ready products. The obtained data confirm the assumption about a possibility of using the chosen meals in the sandy dough technology.

The organoleptic estimation of dough sandy semi-products with the meal composition was studied. The technology of shortcakes by the recipe collection was chosen as a control. Sandy dough, consisted of different ingredients (flour, eggs, sugar, salt, soda, ammonium (fluffier), cream butter) was added with 10 %, 20 % and 30 % of the composition of soya, sunflower and milk thistle meals instead of flour (experiment No. 1, experiment No. 2, experiment No. 3).

The organoleptic estimation in the developed products was realized by the gustatory commission by existing methods [23, 24]. It consisted of experts, who made gustatory acts and put marks of the organoleptic parameters – outlook, smell, consistence, color, porosity. 7 testing specialists took part in the studies. 5-point scale for the organoleptic estimation was developed. The highest mark is 5 points. Each organoleptic parameter was given a ponderability coefficient, and gustatory acts were created. Ponderability coefficients were given to each organoleptic parameter by the individual expert commission.

The main parameters of sandy dough that influence the quality of ready cakes are consistence, smell, outlook. So, they get more ponderability coefficient, comparing with other ones. In sum it equals 1. Different descriptors are also used (**Table 3**).

After that there was conducted the sensor analysis of sandy semi-products of soya, sunflower and milk thistle meals. Each estimation criterion received a point mark and the best result for all experiments was determined. The research results are given in **Table 4**.

Table 3

Parameters of sensor analysis of sandy semi-products of soya, sunflower and milk thistle meals

Parameter	Ponderability coefficient	Characteristic	Ponderability coefficient
Outlook	0,2	Cracks presence	0,2
		Surface evenness	0,1
		Surface condition	0,3
		Clots absence	0,2
		Form stability	0,2
		Saturation	0,2
Porosity	0,2	Expressiveness	0,25
		Raw material correspondence	0,2
		pureness	0,25
		Homogeneity	0,1
Smell	0,25	naturalness	0,3
		saturation	0,25
		Raw material correspondence	0,25
		pureness	0,2
Consistence	0,25	Plasticity	0,25
		elasticity	0,3
		homogeneity	0,2
		Fine-dispersion	0,25
		Saturation	0,23
Color	0,1	Expressiveness	0,25
		Raw material correspondence	0,2
		Homogeneity	0,25

Thus, according to the research results (**Table 4**), the wheat flour replacement in the technology of flour confectionary products by soya, sunflower and milk thistle meals in the amount from 10 % to 30 % unessentially influences the organoleptic parameters of the developed sandy semi-products. The samples of the experiments are inferior to the control one by the unessential value. It testifies to the effectiveness of using meals in dough semi-products.

At adding meals instead of flour in amount 10 % there takes place the unessential worsening of the outlook, consistence and color. The surface evenness, color saturation worsen, plasticity, elasticity and homogeneity decrease.

At adding meals instead of flour in amount 20 % there also takes place the unessential worsening of the outlook, consistence and color. Namely the surface evenness worsens, plasticity, elasticity and homogeneity and also color expressiveness decrease.

At adding meals instead of flour in amount 30 % there takes place the most worsening of the outlook, consistence and color. The surface evenness, smell naturalness decrease noticeably, plasticity and elasticity also decrease. Worst indices of sandy semi-products are observed for such meal concentration.

The outlook and consistence of a control sample of sandy dough is always better than an experimental one. At adding the meal composition, the color changes unessentially, but the dough

consistence worsens at decreasing flour cellulose. Thus, as far as at adding the meal composition instead of flour in amount 20 % the organoleptic mark of sandy semi-products changes unessentially, so it is an optimal solution to add 20 % of the composition of soya, sunflower and milk thistle meals. At adding the meal composition more than 20 % dough grows darker and is badly mixed that negatively influences the quality of ready products.

Table 4

Results of the sensor analysis of sandy semi-products of soya, sunflower and milk thistle meals

Parameter	Characteristic	Shortcake with replacement of flour by meals of oilseed crops			
		Control	Experiment No. 1 (10 %)	Experiment No. 2 (20 %)	Experiment No. 3 (30 %)
Outlook	Cracks presence	5,0	5,0	5,0	4,8
	Surface evenness	5,0	4,9	4,9	4,8
	Surface condition	4,9	4,9	4,9	4,7
	Clots absence	5,0	4,9	4,9	4,7
	Form stability	5,0	5,0	4,9	4,7
	Saturation	5,0	4,9	4,9	4,9
	Expressiveness	4,9	5,0	4,9	4,7
Porosity	Raw material correspondence	5,0	5,0	5,0	4,7
	pureness	5,0	4,9	4,9	4,8
	Homogeneity	4,9	4,9	4,9	4,7
	naturalness	5,0	5,0	5,0	4,7
Smell	saturation	5,0	5,0	4,9	4,8
	Raw material correspondence	5,0	5,0	5,0	4,7
	pureness	4,9	4,9	4,9	4,9
Consistence	Plasticity	5,0	4,9	4,9	4,8
	elasticity	5,0	5,0	4,9	4,7
	homogeneity	5,0	4,9	5,0	4,7
	Fine-dispersion	5,0	5,0	5,0	4,7
	Saturation	5,0	5,0	4,9	4,7
Color	Expressiveness	5,0	4,9	5,0	4,7
	Raw material correspondence	4,9	4,9	5,0	4,7
	Homogeneity	5,0	4,9	5,0	4,7

For improving the outlook of sandy cakes, it is promising to use different pastes, namely cream, strawberry, sour-cream, caramel and so on. For improving the consistence, it is expedient to use lecithin. The offered solutions need confirmation by the experimental method that is a promising task.

4. Conclusions

The studies are devoted to establishing the rational concentration of meals of soya, sunflower and milk thistle in a sandy dough semi-product. The chemical composition of correspondent meals was determined, and the optimal composition that is in ratio 3:4:3 was calculated. The quality esti-

mation of meals was conducted, and their organoleptic parameters were analyzed. A possibility of using meals of soya, sunflower and milk thistle in the sandy shortcake technology was explained.

The sensor analysis of sandy semi-products of soya, sunflower and milk thistle meals was conducted. It was established, that the replacement of wheat flour in the flour confectionary products by meals in amounts from 10 % to 30 % unessentially influences the organoleptic parameters of developed sandy semi-products. Experimental samples are inferior to the control one by the unessential value. It has been determined, that it is rational for using in a sandy dough semi-product to add the composition of soya, sunflower and milk thistle meals in amount 20 %.

The advantage of using soya, sunflower and milk thistle meals in a sandy dough semi-product is the improvement of healthy properties of ready products. Among shortcoming there must be noted the unessential influence of meals on the organoleptic indices of developed sandy semi-products with the partial worsening of the outlook, color and consistence.

The conducted studies allow to use oilseed crop meals at producing sandy cakes. It will essentially improve their healthy properties and positive effect for the human organism. In further it is necessary to study ready sandy products for establishing their quality. It is also urgent to verify a possibility of using meals of other crops in sandy dough.

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