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SUBSTANTIATION OF THE USE OF THE ENRICHED FLOUR MADE FROM LEGUMES IN THE PRODUCTION OF SAUSAGES

Об'єктом дослідження є варено-копчені ковбаси, виготовлені із використанням борошна із пророщених зерен сої збагачених йодом та борошна із пророщених зерен нута збагачених селеном. Однією із проблем сьогодення є дефіцит надходження у організм людини разом з їжею йоду та селену в органічно доступних формах. У зв'язку з цим розробка нових рецептур, які є носіями органічних форм мікроелементів із звичними для споживача органолептичними характеристиками є важливою задачею.

В ході дослідження встановлено, що доцільно використовувати 10 % збагаченого борошна бобових у співвідношенні 1:1, за рахунок зменшення м'ясної сировини у рівних частках, а саме яловичини, свинини та шпику свинячого. За даних співвідношень рецептурних інгредієнтів досягається комплексний показник якості – 0,96. У виробах, виготовлених за новою рецептурою, збільшується кількість білка від 13 до 24 % та зменшується масова частка жиру від 45 до 35 %, порівняно з контролем. Встановлено, що використання збагаченого борошна бобових під час виробництва варено-копчених ковбас впливає на вологість готових виробів у бік її зменшення від 48 до 39,9 %. Виготовлені за розробленою рецептурою варено-копчені ковбаси збагачені на йод та селен 25 та 26 мкг, відповідно. Завдяки сумісному використанню збагаченого борошна бобових при споживанні 100 г варено-копчених ковбас у організм людини надходить від 6 до 36 % добової потреби в йоді та від 34,6 до 86 % добової потреби в селені.

У порівнянні з аналогічними відомими способами збагачення продуктів на мікроелементи, це забезпечує такі переваги, як звичні для споживача органолептичні показники та органічну форму мікроелементів, що виключає можливість передозування та накопичення в організмі.

Ключові слова: *борошно бобових, варено-копчені ковбаси, йод-дефіцит, селен-дефіцит, зерна сої, зерна нуту.*

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1. Introduction

In the structure of nutrition, there is insufficient consumption of trace elements [1, 2]. Deficiency of iodine and selenium is recognized by the UN (United Nations), WHO (World Health Organization, WHO) and UNICEF (United Nations Children's Fund, UNICEF) as a global problem [3]. This was the reason for the inclusion of Ukraine, Belarus, Lithuania, Latvia, Estonia and Moldova in the UNICEF and WHO program for the control of iodine and selenium deficiency [4]. In this regard, the development of new formulations that are carriers of organic forms of trace elements with organoleptic characteristics familiar to consumers is an important task. Performing this task will solve the important social problem of maintaining the health of the nation by overcoming iodine and selenium deficient conditions [5, 6].

The meat industry is one of the largest segments of the food market. According to analysts, the total consumption of sausages per person in Europe is 19.7 kg per year. Cooked smoked sausages occupy up to 51 % of products by meat processing enterprises [7]. It is rational to develop boiled-smoked sausages enriched with iodine and selenium. So, *the object of research* is cooked-smoked sausages made using flour from germinated soybean grains enriched with iodine and flour from germinated chickpea grains enriched with selenium. *The aim of research* is to justify the feasibility of using enriched soybean and chickpea flour in the production of cooked smoked sausages. The obtained scientific laws will allow the development of new formulations carriers of organic forms of trace elements and will allow to preserve the health of the nation due to the correction of iodine and selenium deficiency states.

2. Methods of research

During the study, cooked smoked sausages made using well-known technology [8], using flour sprouted legumes [9, 10]. Flour from germinated soybean grains in accordance with TU U 10.6-02071205-001:2019 is a carrier of 50 μg of iodine in 100 g of flour. Flour from germinated chickpea grains in accordance with TU U 10.6-02071205-002:2019 is a carrier of 52 μg of selenium in 100 g of flour. The rational ratio of the components of the formulation was determined using experimental statistical modeling, with which the condition was fulfilled: $X+Y+Z=100$ %. The recipe ingredient, which is assigned the value X, is veined beef and veined pork, bold (1:1). Prescription ingredient Y –

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flour from soybean KI sprouted in a solution and flour from chickpea seed germinated in a $NaHSeO_3$ solution (1:1). *Z* – pork fat. Statistical data processing was performed using the Statistical 10.0 software environment. Organoleptic indicators were determined according to DSTU 4591:2006 «General specifications for cooked smoked sausages». Products were evaluated according to verbal and ballroom systems of tasting ratings. The mass fraction of moisture was determined on a Chyzhov device (Olis LLC, Ukraine) by drying. Mass fraction of protein was determined according to GOST 25011 by the Kjeldahl method. The mass fraction of fat was determined according to GOST 23042 by the refractometric method. The mass fraction of iodine and the mass fraction of selenium were determined using an Ecotest-VA voltammetric analyzer (Burevestnik, Russia) using the «inverse-voltammetry» method.

3. Research results and discussion

Table 1 shows the results of a study of the organoleptic characteristics of cooked smoked sausages for different variations of the recipe components.

Table 1 shows that the best organoleptic indicators are products of test No. 4, where the ratio of prescription ingredients $X:Y:Z=1/2:1:1/2$.

The recipe ingredient, which is assigned the value *X* (1/2), is beef and pork in a ratio of 1:1. Using 650 g/kg of the above raw materials, the maximum quality indicator is achieved. The recipe ingredient that is assigned the value *Y*(1) is soy flour enriched with iodine and chickpea flour enriched with selenium in a ratio of 1:1. It has been experimentally established that it is rational to use 100 g/kg. The values of *Z* (1/2) are accepted pork fat, it was found that it is rational to use it in an amount of 150 g/kg. With these ratios of prescription ingredients, a comprehensive quality score of 0.96 is achieved.

The results of the study allowed to develop a rational recipe for cooked smoked sausages using enriched legume flour. The results are shown in Table 2.

The developed recipe for sausages differs from the control one in that 10 % of flour from sprouted soybean and flour from sprouted chickpea are added to meat raw materials due to a decrease in raw meat.

Table 2

Recipe for cooked smoked sausages using enriched legume flour

No.	Prescription ingredients	Mass of prescription ingredients, %
Unsweetened ingredients		
1	Veined beef, grade 1	32.5
2	Veined beef, semi-fat	32.5
3	Pork fat	15
4	Sprouted soya flour enriched with iodine	5
5	Sprouted chickpea flour enriched with selenium	5
6	Flour hydration water	10
TOTAL unsalted ingredients, kg		100
Spices		
6	Salt	2.15
7	Sugar sand	0.2
8	Black pepper	0.2
9	Fresh garlic	0.3
10	Nutmeg	0.04
11	Food phosphate	0.3
12	Fermented rice	0.05
13	Drinking water	4
TOTAL ingredients, spices, kg		107.24
The output of the finished product, kg (%)		101.88

The proposed recipe does not require a change in the traditional sequence of stages or special technological equipment and can be implemented at any enterprise that manufactures cooked smoked sausages.

The comparative organoleptic, physicochemical parameters of products manufactured according to the control and developed recipe are also investigated. It was established that cooked smoked sausages made according to the control recipe have a pleasant, slightly sharp, moderately salty taste, with a pronounced aroma of smoking without extraneous taste and smell, which does not differ from products made according to the new recipe. In terms of color, the control sample has a dark red color, which differs from the sample made according to the new formulation, which has a yellow-pink color. However, the color change of the prototype is within the norm of the current DSTU 4591, according to which a color change from dark red to pink is allowed. The consistency in the two prototypes was elastic. The structure of the products in the thickness of the loaves, both control and prototype was uniformly mixed without cavities. Pieces of lard of pork, beef and pork vein were observed. The appearance of the surface of the loafs, both control and prototype, was clean, dry, without spots, from linden, damage to the shell and influx of minced meat.

Table 1

Organoleptic characteristics of cooked smoked sausages according to different variations in the recipe components

No. of test	Ratio	Weight ratio					Comprehensive quality score (CQS)
		0.3	0.2	0.2	0.2	0.1	
	X:Y:Z	taste, smell	color	consistency	structure	cut surface	
1	1:0:0	5	5	2	3	2	0.74
2	0:1:0	4	3	3	2	3	0.50
3	0:0:1	5	4	5	4	5	0.92
4	1/2:1:1/2	5	4	5	5	5	0.96
5	0:1/2:1/2	5	5	4	4	4	0.90
6	1/2:0:1/2	4	5	4	4	5	0.86

Note: 1/2 – average amount of the prescription component; 0 – minimum amount of prescription component; 1 – maximum amount of prescription component

Having studied the physicochemical parameters of cooked smoked sausages, a pattern was established – the use of enriched legume flour by reducing beef, pork and pork fat affects the humidity of the finished products in the direction of its decrease from 48 to 39.9 %. In new products, the amount of protein increases from 13 to 24 % and the mass fraction of fat decreases from 45 to 35 %. Developed boiled-smoked sausages are enriched with iodine and selenium 25 and 26 μg, respectively.

Based on the international requirements of UNICEF and WHO and the requirements of the Ministry of Health of Ukraine [11, 12] in numerical values for the enrichment of food products in iodine and selenium in organic form, it was found that the developed formulation satisfies 36 % of the daily iodine requirement for schoolchildren and 6 % for adults. The developed formulation satisfies 86.6 % of the daily requirement of selenium for schoolchildren and 34.6 % for adults and seniors.

4. Conclusions

It is found that it is advisable to use 10 % of legumes enriched in flour in a ratio of 1:1, due to the reduction of raw meat in equal proportions, namely beef, pork and pork fat. With these ratios of prescription ingredients, a comprehensive quality score of 0.96 is achieved. In products manufactured according to the new recipe, the amount of protein increases from 13 to 24 % and the mass fraction of fat decreases from 45 to 35 % compared with the control. It is established that the use of enriched legume flour in the production of cooked smoked sausages affects the humidity of the finished products in the direction of its reduction from 48 to 39.9 %. Cooked smoked sausages made according to the developed recipe are enriched with iodine and selenium 25 and 26 μg, respectively.

With the consumption of 100 g of cooked smoked sausages made according to the developed recipe, 36 and 6 % of the daily iodine requirement for adults and school-age children, respectively, enters the human body. As well as 34.6 and 86 % of the daily need for selenium for adults and schoolchildren. The developed products for the content of iodine and selenium in accordance with the requirements of UNICEF and WHO can be classified as food products for therapeutic purposes.

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