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DEVELOPMENT OF CHICKEN LIVER PÂTÉ WITH BUCKWHEAT AND OATMEAL

The main strategies for the development of meat products include enriching them with nutrients, reducing fat and caloric content and lowering production costs. These objectives can be achieved by partially replacing meat with plant-based ingredients, provided that the quality of the final product is not compromised. The aim of this study was to develop a combined pâté using chicken liver, vegetables, oatmeal and buckwheat, and to determine its physicochemical and sensory properties, nutritional value and caloric content. The pâté samples were prepared using the recommended heat treatment methods for the ingredients. Standard techniques were used to determine the physicochemical properties of the pâté, while an expert sensory evaluation method was used to analyse the taste, smell, colour and consistency of the pâté. Using the expert method, the weighting coefficients of the sensory properties of the combined pate compositions and the complex quality index were also determined. The nutritional value and caloric content of the pâté samples were calculated. The developed pâté containing 10% oatmeal and 10% cooked buckwheat was recommended for production as it received the highest sensory ratings from the panel of experts. The developed combined pâté has a delicate, slightly sweet taste of liver and a pleasant liver aroma with a hint of roasted vegetables. The consistency of the pâté is dense and uniform, and its colour is light brown with bright orange flecks, caused by the addition of carrots to the recipe. Experts believe that taste is the most crucial sensory characteristic of pâtés. The developed pâté contains 53.4% moisture, 1.33% total ash 11.6% protein, 6.5% fat, and 6.5% carbohydrates. The caloric content of the pâté is 130.9 kcal. The density of the pâté is 1063.8 kg/m3 and its water-binding capacity, expressed as a percentage of the pâté, is 42.9%. Combined pâté, made from chicken liver, vegetables, oatmeal, and buckwheat, is enriched with nutrients from plant-based ingredients. Its cost is also lower than that of traditional pâté, due to the partial replacement of meat ingredients with vegetable ones.

***Keywords: combined** pâté, pâté recipe, pâté sensory attributes, pâté nutritional value, pâté water binding capacity, low-calorie pâté, pâté quality index.*

Statement of the problem and its relevance. Chicken liver pâté is a spreadable poultry product made from chicken meat, chicken liver, fat, spices and other optional ingredients [30]. It has a rich gastronomic tradition and is widely recognised for its nutritional and organoleptic qualities. Various types of liver pâté are an important source of high-quality proteins, vitamins (such as B1, B12, and folic acid), and heme iron, which enhances the appeal of these meat products [17]. The main ingredient of liver pâté is liver, which is rich in protein (approximately 20 g of protein per 100 g of liver), relatively affordable, and highly nutritious as a source of dietary iron [34]. Liver pâté, like most emulsified meat products, has a high fat content, which affects its texture, juiciness, mouthfeel and taste [28]. At the same time, the high fat content of pâté is a disadvantage, as the consumption of traditional meat-based products high in saturated fat has been linked to heart disease, cancer and obesity [15]. As a result, consumers increasingly prefer low-fat and low-calorie foods.

The meat industry is evolving to meet growing consumer demand for healthier foods with reduced levels of undesirable ingredients. As noted by P. Skwarek and M. Karwowska [31], innovative processing strategies are being developed to improve the nutritional value of meat products by limiting additives (e.g., salt, nitrites), minimising harmful compounds, and incorporating bioactive-rich plant ingredients. A promising direction in the development of new foods is to reduce calories and partially replace animal-based ingredients with plant-based ones to maximise nutrient density [2]. M. Calderón-Oliver and L. López-Hernández [9] proposed the development of healthier functional foods by using agro-industrial residues as preservatives, substitutes and/or fat mimetics that can improve the sensory qualities and texture of foods and extend their shelf life. Agro-food by-products can be used to enrich meat products, reducing harmful compounds and contributing to increased fiber and polyphenol content [22]. Thus, the creation of combined pâtés with both meat and plant-based ingredients is a growing trend in the low-calorie meat product market.

Analysis of recent research and publications. Liver and meat pâtés can be made functional by fortifying them with natural (non-modified) ingredients and by adjusting the recipe using technological or biotechnological methods, including the addition, removal, or modification of components [12]. Reformulation strategies for meat products include reducing the total fat content, which can be achieved by replacing animal fat with plant-based ingredients [6]. According to L. Borsolyuk and S. Verbytskyi [7], it is essential for combined meat products to have high biological value, achieved by combining meat with plant-based ingredients that are characterized by pronounced functional properties. Furthermore, the replacement of meat ingredients with plant-based alternatives is driven by the expanding global population and growing environmental concerns about livestock-based meat production [32].

To improve nutritional value without compromising sensory and textural characteristics, it has been proposed to partially replace animal fat in pâtés with unsaturated fatty acids from seeds, pulses, and marine oils, and to incorporate non-meat products with bioactive compounds, such as edible mushrooms [11]. Hemp, amaranth and linseed can be used to produce poultry pâté with added value due to their rich nutritional composition [5]. B. Assenova et al. [3] developed meat pâté with wheat germ. Oatmeal and buckwheat can also be used as ingredients in chicken liver pâté.

Oats are widely used in the food industry due to their high protein content (12–20%), excellent digestibility (90–94%), and significant dietary fiber content (4–8% β-glucan) [37]. The amino acid composition of oats is more favourable than that of other cereals, due to its higher content of essential amino acids, including lysine, methionine, threonine, tyrosine, leucine, valine, and phenylalanine [21]. Oats also provide significant levels of other bioactive compounds, such as phenolic acids, tocols, sterols, avenacosides, and avenanthramides [27]. Oats are used in the production of various foods, including oat flakes, breakfast cereals, biscuits, muesli bars, plant-based milks, etc. [25]. Oat-based foods are an important component of a healthy diet around the world [1]. As an excellent natural source of bioactive compounds, oats have broad application prospects for the development of functional and health foods [35].

M. Zenkova [40] noted that buckwheat is mainly used for the production of buckwheat groats and flour. Buckwheat is a rich source of protein, dietary fibers, vitamins, minerals, and bioactive compounds, including flavonoids, and is gluten-free, making it suitable for the production of gluten-free foods [39]. The bioactive compounds in buckwheat include flavonoids (such as rutin, quercetin, orientin, isoorientin, vitexin, and isovitexin), fatty acids, polysaccharides, proteins, amino acids, iminosugars, dietary fiber, fagopyrins, resistant starch, as well as various vitamins and minerals [19]. Interest in buckwheat-based foods will grow because buckwheat can be used to produce a variety of gluten-free products, including bakery products (bread, biscuits, and cookies), noodles, tea, and extruded products, all with good organoleptic quality [33].

Objectives of the article. The aim of this study is to develop chicken liver pâté with buckwheat and oatmeal and evaluate its sensory and physicochemical properties, nutritional value, and caloric content.

Summary of the main research material.

Preparation of pâté samples. All pâté ingredients were purchased from a local supermarket in Lutsk, Ukraine. For the pâté samples, the vegetables were prepared according to the recipe in Table 1. The onion was peeled and chopped, and the carrot was grated. First, the onion was fried in sunflower oil until golden brown (for about 10 min), then the grated carrot was added and fried for another 5 min. Sugar dissolved in boiled water was added to the fried vegetables, and frying continued for up to 15 min. The fried vegetables were then cooled.

The chicken fillet was boiled for 40 min in water and then cooled. The buckwheat was rinsed under cold water to remove any dust or impurities. The buckwheat was cooked in water until soft for 20 min and then cooled. About 2 cups of water were used for every 1 cup of buckwheat. The oat flakes were boiled for 4 min in water and cooled. About 1.5 cup of water were used for every 1 cup of oat flakes.

The fried chicken livers were prepared according to the recipe in Table 1. The chicken livers were rinsed under cold water to remove any blood or impurities. Any visible connective tissue or fat was trimmed. The chicken livers were fried in sunflower oil for 25 min. Cow's milk, salt, and ground black pepper were added to the chicken livers, and the livers were simmered for a further 8 min. Butter was then added to the chicken livers and simmered until it melted. The simmered chicken livers were cooled. The meat-vegetable mixture was prepared according to the recipe in Table 2. Semi-finished products, such as simmered chicken liver, boiled chicken fillet, and fried vegetables, were minced in a meat mincer and then mixed, resulting in a meat-vegetable mixture. The cooked buckwheat and oatmeal were chopped separately in a blender.

According to the pâté recipe options (PR) presented in Table 3, the semi-finished products were combined and mixed until a homogenised mass was obtained. Prior to

Table 1 – Ingredient composition of the simmered chicken livers and fried vegetables

Ingredients	Quantity, g
Simmered chicken livers	
Chicken livers	1000.0
Cow's milk (2.0% fat)	150.0
Butter (unsalted)	100.0
Sunflower oil	36.0
Salt	5.0
Ground black pepper	1.0
Fried vegetables	
Onion	300.0
Carrot	300.0
Sunflower oil	24.0
Sugar	5.0
Boiled water	100.0

Source: compiled by the authors

Table 2 – Content of semi-finished products in the meat-vegetable mixture

Semi-finished products	Quantity, %
Simmered chicken livers	50.0
Fried vegetables (onion and carrot)	33.0
Boiled chicken fillet	17.0

Source: compiled by the authors

Table 3 – Content of semi-finished products in the pâté samples

Semi-finished products	Quantity, %				
	PR1	PR2	PR3	PR4	PR5
Meat-vegetable mixture	100.0	80.0	70.0	60.0	50.0
Cooked buckwheat groats	–	10.0	15.0	20.0	25.0
Cooked oatmeal	–	10.0	15.0	20.0	25.0

Note: PR1 – pâté without cooked buckwheat groats and cooked oatmeal (control sample); PR2, PR3, PR4, PR5 – pâté with varying amounts of cooked buckwheat groats and cooked oatmeal.

Source: compiled by the authors

testing, the pâté samples were stored in an airtight container at a temperature of 5ºC.

Determination of moisture content. The moisture content of the pâté was determined by the direct drying method in a drying oven according to ISO 1442:2023 "Meat and meat products – Determination of moisture content – Reference method". A test portion of the pâté was dried for 2 h in an oven set at 103ºC. The moisture content of the pâté was calculated as a percentage of the pâté mass.

Determination of total ash content. The total ash content of the pâté was determined by the dry ash method in a muffle furnace according to ISO 936:1998(E) "Meat and meat products – Determination of total ash". A test portion of the pâté was dried, carbonised, and then incinerated at a temperature of (550±25)ºC. The ashing process was continued at (550±25)ºC in a muffle furnace for 5 to 6 h until the ash appeared grey-white. After cooling, the mass of the residue was measured. The mass fraction of the total ash was then expressed as a percentage.

Determination of density. A sample of pâté was placed in a calibrated sample chamber of known volume and weight. The calibrated chamber filled with pâté was then weighed. The density of the pâté samples was determined by dividing the mass of the pâté by its volume.

Determination of water-binding capacity. The water-binding capacity (WBC) of the pâté was determined by the pressing method [8]. A 0.3 g sample of the pâté was placed on an ashless filter paper and pressed for 10 minutes under a 1 kg load. The area of the wet spot was determined as the difference between the total area of the spot and the area formed by the pâté itself. The WBC of the pâté was calculated using the equations [3]:

$$WBC_p = \frac{(M - 8.4S)\cdot 100\%}{m}, \quad (1)$$

$$WBC_m = \frac{(M - 8.4S)\cdot 100\%}{M}, \quad (2)$$

where WBC_p is the mass fraction of bound water in the pâté expressed as a percentage of the pâté, %; WBC_m is the mass fraction of bound water in the pâté expressed as a percentage to total water in the pâté, %; M is mass of water in the pâté sample, mg; m is mass of the pâté sample, mg; S is wet spot area, cm^2; 8.4 is mass of water absorbed by 1 cm^2 of ashless filter paper, mg/cm^2.

Sensory analysis of pâté samples. The sensory analysis of the pâté samples was performed with 7 trained tasters. The pâté samples were randomly numbered, and the evaluation took place in a room without individual booths. For the sensory analysis, 40 g of each sample were provided [24]. A glass of water was provided to rinse the oral cavity between tastings. The taste, smell, colour, and consistency were evaluated using a five-point hedonic scale with the extremes 1 ("I dislike it very much") and 5 ("I like it very much"). Based on the results, an average score was calculated for the sensory attributes of the pâtés. In addition to the scores, the tasters provided verbal descriptions of the sensory attributes of the pâté samples.

The complex quality index of pâté based on sensory attributes was calculated using the following equation:

$$Q = \sum_{i=1}^{4} m_i \frac{P_i}{P_{\max i}}, \quad (3)$$

where Q is the complex quality index of the pâté; m_i is the weighting coefficient for the sensory attributes of the pâté (taste, smell, colour, and consistency); P_i is the average score of the sensory attributes of the pâté; $P_{\max i}$ is the maximum score (5 points) of the sensory attributes of the pâté.

A weighting coefficient is defined as a numerical value that expresses the relative importance of the sensory attributes of the pâté based on the experts' preferences. The sensory attributes were ranked by the experts on a scale of 1 to 4, with the most important attribute being ranked 4 and the least important attribute being ranked 1. The weighting coefficients were calculated using the following equation:

$$m_i = \frac{t_i}{\sum_{i=1}^{k} t_i}, \quad (4)$$

where t_i is the sum of the ranks assigned to the pâté attribute; k is the number of sensory attributes of the pâté ($k = 4$).

Caloric content calculation. Caloric content of the pâté samples was calculated by equation:

$$E = 4P + 9F + 4C \quad (5)$$

where E is the caloric content of the pâté, kcal/100 g; 4, 9, and 4 are the energy values for protein, fat, and carbohydrate, respectively [10], kcal/g; P, F, and C are the content of protein, fat and carbohydrates, respectively, per 100 g of pâté, g/100 g.

Laboratory equipment. During the study, the following laboratory equipment was used: Muffle Furnace SNOL 8.2/1100; Drying Oven SESH-3M; Laboratory Balances FEN-V2003; Blender Braun MQ 3038; Meat Mincer Zelmer ZMM4050B; Induction hob Laretti. The study was conducted in the laboratory of the Lutsk National Technical University (Ukraine).

Statistical analysis. All analyses were performed in triplicate and data reported as mean ± standard deviation (SD). Statistical analysis and calculations were conducted using the Mathcad 14 software.

The results of the determination of the physical and chemical characteristics of the chicken liver pâté with buckwheat and oatmeal are presented in Table 4. The moisture content of the pâté is an important parameter that influences both its shelf life and sensory properties, in particular its consistency. The moisture content is affected by the ingredients used and the preparation method. In the pâté samples, the moisture content ranged from 49.1% to 58.4% (Table 4). Sample PR1, which did not contain buckwheat and oatmeal, had the lowest moisture content (49.1±0.1%). As the content of plant-based ingredients (cooked buckwheat groats and oatmeal) in the pâté increased, the moisture content also increased. Sample PR5 had the highest moisture content at 58.4±0.3%.

Table 4 – Physical and chemical characteristics of the pâté

Indicator	Pâté samples				
	PR1	PR2	PR3	PR4	PR5
Moisture content, %	49.1±0.1	53.4±0.2	54.3±0.3	56.7±0.1	58.4±0.3
Total ash content, %	1.38±0.02	1.33±0.01	1.08±0.04	0.90±0.04	0.76±0.04
Density, kg/m3	1035.9±2.9	1063.8±6.8	1065.4±4.4	1098,5±5.4	1106.9±2.5

Source: compiled by the authors

The total ash content of the pâté samples ranged from 0.76% to 1.38% (Table 4). The lowest total ash content was observed in the pâté sample PR5, which had the highest moisture content, at 0.76±0.04%. As the proportion of plant-based ingredients in the pâté samples decreased, the total ash content increased. The highest total ash content was found in the sample PR1, at 1.38±0.02%.

The densities of the pâté samples ranged from 1035.9±2.9 kg/m³ to 1106.9±2.5 kg/m³ (Table 4). As the content of plant-based ingredients increased, the density of the pâté samples also increased. The lowest density was observed in the pâté sample PR1, while the highest density was found in the sample PR5. This pattern can be explained by the fact that the sample PR1 had a fine-grained consistency and greater porosity compared to the smoother and denser pâtés containing cooked oatmeal and buckwheat.

The water-binding capacity (WBC_p) of the pâté samples ranged from 38.1% to 47.7% (Fig. 1). As the amount of oatmeal and buckwheat in the pâté increased, the WBC_p value also increased. This indicates that the mass fraction of bound water in the pâté, expressed as a percentage of the total pâté mass, was higher in samples with a higher oatmeal and buckwheat content. Increasing the content of oatmeal and buckwheat in the pâté samples to 20%, 30%, 40% and 50% resulted in increases in WBC_p of 12.6%, 15.0%, 20.2% and 25.7%, respectively, compared to the control sample PR1. This can be explained by the fact that oatmeal is known for its ability to absorb moisture due to the presence of soluble fiber, which has water-binding properties. These properties of soluble fiber help to thicken oatmeal when cooked, contributing to its creamy texture [14]. In addition, even small amounts of buckwheat flour in semi-smoked sausage samples (up to 10.0% by weight of unsalted raw material) were found to increase the moisture-binding capacity of the control sample by 1.1–1.8% [38]. The percentage of bound water relative to the total water content in the pâté samples increased with higher amounts of cooked oatmeal and buckwheat. Consequently, the WBC_m value was lowest for the control pâté sample PR1 at 77.6%, while the highest WBC_m value, 81.9%, was observed for the pâté sample PR5 (Fig. 1). Compared to the control sample PR1, increasing the content of cooked oatmeal and buckwheat in the pâté samples to 20%, 30%, 40% and 50% resulted in an increase in WBC_m of 3.7%, 4.0%, 4.1% and 5.5%, respectively. The addition of oat flour to meat pâtés improved their moisture retention capacity [3]. Specifically, with the addition of 7% oat flour, the water binding capacity (WBC_m) of the meat pâté was 73%.

The taste of pâté samples PR4 and PR5 was rated by the experts with the lowest score of 4.3 (Fig. 2), while samples PR2 and PR3 received a score of 4.6. The highest taste score of 4.7 was awarded to the control pâté sample PR1. However, all the pâté samples received high scores. The experts described the taste of pâté sample PR2, as well as the control sample PR1, as a delicate, slightly sweet liver flavour (Table 5). As the content of cooked oatmeal and buckwheat in the pâté increased, the liver and vegetable flavours in the pâté samples became more pronounced. In addition, pâté sample PR5 had a flavor with a distinct hint of buckwheat.

According to the experts, the best smell was found in pâté sample PR3, which received 4.9 points for this indicator (Fig. 2), a higher score than the control pâté sample PR1, which received 4.7 points. Pâté samples PR2 and PR4 also received high scores for smell (4.7), while the smell of sample PR5 was rated the lowest (4.1). In addition, most of the pâté samples had a pleasant aroma with a hint of liver

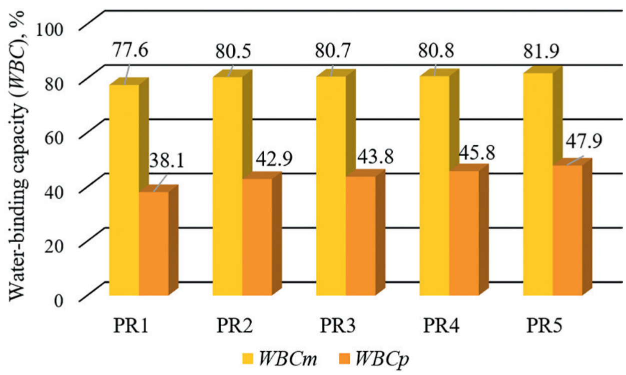

Figure 1 – Water-binding capacity (WBCm and WBCp) of the pâté samples

Source: compiled by the authors

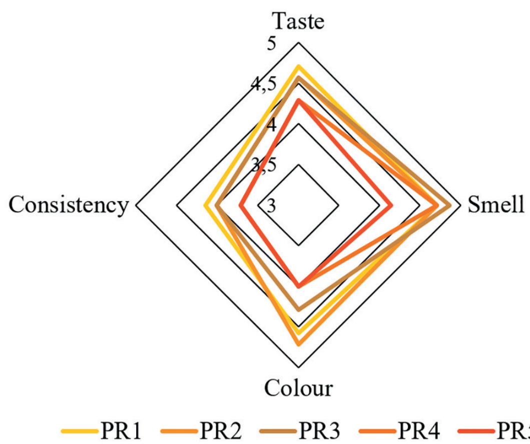

Figure 2 – Results of the evaluation of the sensory attributes of pâté samples

Source: compiled by the authors

and a slight scent of roasted vegetables (Table 5), whereas samples PR4 and PR5 had a pronounced scent of buckwheat.

The colour of pâté sample PR2 received the highest score of 4.7 compared to the other samples (Fig. 2). The colour scores for the other pâté samples were as follows: PR1 – 4.6, PR3 – 4.3, PR4 – 4.0, and PR5 – 4.0. The colour of the pâté samples was light brown with orange inclusions due to the addition of carrots (Fig. 3). In addition, as the content of oatmeal and buckwheat in the pâté samples increased, the colour became lighter.

The consistency of the control sample PR1 was rated by the experts at 4.1 points (Fig. 2). This sample had a dense, slightly heterogeneous consistency, while remaining fine-grained and containing noticeable vegetable particles (Table 5). Pâté samples PR2 and PR3 scored 4.0 points for this sensory attribute. Pâté sample PR2 was dense and homogeneous, with vegetable particles, whereas pâté sample PR3 was smooth and homogeneous, also containing vegetable particles. The lowest score for consistency, 3.7, was given to pâté samples PR4 and PR5. These samples had a smooth, homogeneous consistency with a slightly sticky texture. The addition of oatmeal resulted in a softer texture in meat products, such as meat sausages [36].

The experts rated the importance of the sensory attributes of the pâté and the corresponding weighting coefficients were calculated: taste m_1 = 0.40, smell m_2 = 0.19, colour m_3 = 0.15 and consistency m_4 = 0.26. According to the experts, taste is the most important sensory attribute for pâtés, followed by consistency, while smell and colour are the least important sensory attributes. Based on the results of the sensory evaluation of the pâté samples and the weighting coefficients of the sensory attributes, a complex quality index for the pâté samples was calculated. The complex quality index ranged from 0.813 to 0.908 (Fig. 4). The highest value of the index (Q = 0.908) was obtained for the control pâté sample PR1, which served as a reference for comparison. As the content of oatmeal and buckwheat in the pâté samples increased, the complex quality index decreased: sample PR2 – Q = 0.894, PR3 – Q = 0.887, PR4 – Q = 0.835, and PR5 – Q = 0.813. Furthermore, the addition of more than 20% oatmeal or more than 20% cooked buckwheat resulted in a significant deterioration of the sensory properties of the pâté.

The nutritional values of the ingredients and semi-finished products of the pâté are shown in Table 6. Chicken liver and chicken fillet are the sources of protein in the pâté samples, as these semi-finished products contain 25.0% and 23.8% protein after heat treatment, respectively. Cooked buckwheat, fried vegetables (carrots, onions) and oatmeal are the sources of carbohydrates in the pâté samples, containing 19.6%, 12.1% and 10.7% carbohydrates, respectively. Among the

Table 5 – Characterisation of pâté sensory attributes

Sensory attributes	Pâté samples				
	PR1	PR2	PR3	PR4	PR5
Taste	A delicate, slightly sweet liver flavour	A delicate, slightly sweet liver flavour	A delicate, slightly sweet flavour of liver and vegetables	A delicate, slightly sweet liver flavour combined with the taste of oatmeal and buckwheat	A delicate, slightly sweet, faint liver flavour with a distinct hint of buckwheat
Smell	A pleasant smell with hints of liver and a light scent of roasted vegetables	A pleasant smell with hints of liver and a light scent of roasted vegetables	A pleasant smell with hints of liver and a light scent of roasted vegetables	Pleasant, with a hint of liver and the aroma of buckwheat	Pleasant, with a noticeable aroma of liver and a pronounced scent of buckwheat
Colour	Light brown with orange flecks	Light brown with orange flecks	Light brown with orange flecks	Light brown with orange flecks	Light brown with orange flecks
Consistency	Dense, slightly heterogeneous and fine-grained, with vegetable particles	Dense and homogeneous, with vegetable particles	Smooth, homogeneous, with vegetable particles	Smooth, homogeneous and slightly sticky	Smooth, homogeneous and sticky

Source: compiled by the authors

PR1 PR2 PR3 PR4 PR5

Figure 3 – Appearance of the pâté samples

Source: compiled by the authors

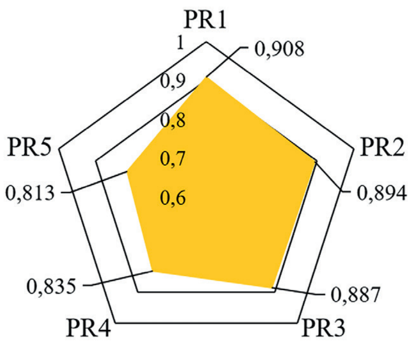

Figure 4 – A complex quality index Q of pâté samples

Source: compiled by the authors

Table 6 – Nutritional value and caloric content per 100 g of pâté semi-finished products

Semi-finished products	Protein, g	Fat, g	Carbohydrates, g	Calories, kcal
Cooked oatmeal	2.6	0.9	10.7	61.3*
Buckwheat groats, roasted (kasha), cooked	3.6	0.6	19.6	98.2*
Chicken liver, simmered (without milk and butter)	25.0	5.0	Tr.	145.0*
Fried vegetables (onion and carrot)	1.6**	4.8**	12.1**	98.0*
Boiled chicken fillet	23.8	4.3	Tr.	133.9*
Cow's milk (2.0% fat)	3.3	2.0	4.9	50.8*
Butter (unsalted)	0.9	81.4	Tr.	736.2*

Note: Tr. – traces; * – data calculated according to equation (5); ** – data calculated as average for a mix of fried carrots and onions.

Source: prepared on the basis of data by S. Gebhardt and R. Thomas [16]

pâté ingredients, butter has the highest fat content (81.4%) and the highest caloric content (736.2 kcal).

The nutritional value and caloric content of the pâté samples are shown in Table 7. The protein content of the combined pâté samples (PR2–PR5) ranged from 11.6 to 8.2% and decreased with increasing plant-based ingredient content in the pâté. These values are lower than the protein content of the control sample PR1 by 12.8 to 38.3%. The fat content of the pâté samples with plant-based ingredients (PR2–PR5) was also lower compared to the control sample PR1 by 17.7–45.6% (Table 7). The lowest fat content of 4.3% was found in the pâté sample PR5. The carbohydrate content of the pâté samples increased as the content of plant-based ingredients increased. In the combined pâté samples (PR2–PR5), the carbohydrate content ranged from 6.5% to 9.7% (Table 7), which is 51.2% to 125.6% higher than in the control sample PR1. The caloric content

Table 7 – Nutritional value and caloric content per 100 g of pâté samples

Pâté samples	Protein, g	Fat, g	Carbohydrates, g	Calories, kcal
PR1	13.3	7.9	4.3	141.5
PR2	11.6	6.5	6.5	130.9
PR3	10.2	5.8	7.6	123.4
PR4	9.2	5.0	8.6	116.2
PR5	8.2	4.3	9.7	110.3

Note: A loss of 28% was assumed for chicken liver during heat treatment.

Source: compiled by the authors

of the control sample PR1 was 141.5 kcal, while the caloric contents of the samples PR2–PR5 were as follows: PR2 – 130.9 kcal, PR3 – 123.4 kcal, PR4 – 116.2 kcal and PR5 – 110.3 kcal. Thus, an increase in the percentage of plant-based ingredients in the pâté resulted in a decrease in its caloric content from 7.5% to 22.0%.

A meat-vegetable mixture containing carrots and onions was used as a basis for developed pâté samples. The use of vegetables, especially carrots and onions, in the recipe of poultry pâtés enriches them with nutrients [23]. Vegetables offer nutritional and health benefits and are considered essential to the human diet as they are rich sources of protein, vitamins, minerals, and fiber [26]. Other plant-based ingredients, such as oatmeal and buckwheat, are also included in the pâté recipes developed. The effectiveness of using these plant-based ingredients to reduce the fat content of meat products and increase the nutritional value has been studied by scientists. In particular, H. Jalal et al. [20] proposed the use of oatmeal as a fat replacer in a fat-rich emulsion-based meat product, while Z. Atambayeva et al. [4] developed a new meat product blended with germinated green buckwheat.

The chicken liver content in the developed pâté is 40%. The liver content in pâtés on the market is between 20–45% [15]. The chicken meat content in the chicken liver pâté is around 10% [18], while in the developed pâté it is slightly higher at 13.6%. The salt content in chicken liver pâtés was 0.6–0.9%, while in the proposed pâté it was 0.7% [29].

The water content of chicken liver pâté ranges from 64% to 70%, while the moisture content of the developed pâté is 53.4% [13]. The nutritional value of chicken liver pâté, which is as follows (per 100 g of pâté) [29]: protein 13.5–17.4%, fat 8.5–10.3%, carbohydrates 0.2–1.3%, and ash 1.8–1.9%. The developed combined pâté has the following nutritional composition: protein 11.6%, fat 6.5%, carbohydrates 6.5%, and ash 1.33%. Therefore, the new pâté has lower protein, fat, and ash content, but a higher carbohydrate content compared to traditional chicken liver pâté, probably due to the inclusion of vegetable ingredients in the recipe.

Conclusions. The developed chicken liver pâté with oatmeal and buckwheat is low in fat and calories, with a delicate, slightly sweet liver flavour and a pleasant smell, featuring hints of liver and a subtle scent of roasted vegetables. The consistency of the pâté is dense and homogeneous, with vegetable particles. Adding 10% oatmeal and 10% buckwheat to the chicken liver pate recipe reduces the protein content by 12.8% and fat by 17.7%, while increasing the carbohydrate content by 51.2%. The caloric content of the new combined pâté is 130.9 kcal. Adding plant-based raw materials to the pâté enriches it with the nutrients they contain.

Plant-based ingredients in chicken liver pâté cause an increase in its moisture content and density, and at the same time a decrease in the total ash content. In particular, the moisture content of the developed pâté is 53.4%, and the water-binding capacity, expressed as a percentage of the pâté, is 42.9%. The water-binding capacity, expressed as a percentage of the total water in the pâté, is 80.5%.

As oatmeal and buckwheat are cheaper than chicken liver and chicken fillet, adding these plant-based ingredients to the recipe makes the finished product cheaper. Accordingly, such a pâté will have an affordable price for consumers.

Studies to determine the shelf life of the developed combined pâté are promising. Further research on the mineral and vitamin content of the pâté is also important.

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РОЗРОБЛЕННЯ ПАШТЕТУ З КУРЯЧОЇ ПЕЧІНКИ З ГРЕЧКОЮ ТА ВІВСЯНКОЮ

Основні напрями розвитку м'ясних продуктів передбачають їх збагачення поживними речовинами, зниження жирності та калорійності, а також зменшення собівартості. Це можна досягти шляхом часткової заміни м'яса рослинними інгредієнтами, за умови, що якість кінцевого продукту не погіршується. Метою дослідження було розробити комбінований паштет з курячої печінки, овочів, вівсяних пластівців та гречаної крупи, а також визначити його фізико-хімічні та органолептичні властивості, харчову цінність й калорійність. Композиції паштету готували з дотриманням рекомендованих режимів термічного оброблення інгредієнтів. Для визначення фізико-хімічних показників паштету використовували стандартні методики, а для аналізування його смаку, запаху, кольору та консистенції використовували метод експертного сенсорного оцінювання. Харчова цінність та калорійність зразків паштету були визначені розрахунковим методом. Експертним методом були визначені коефіцієнти вагомості органолептичних властивостей композицій комбінованого паштету та було обчислено комплексний показник якості паштету. До впровадження рекомендовано паштет із вмістом вівсяних пластівців 10% та гречки 10%, оскільки він отримав найвищі оцінки за органолептичні властивості від експертної групи. Розроблений комбінований паштет має ніжний, злегка солодкуватий смак печінки та приємний печінковий запах з ароматом смажених овочів. На думку експертів, смак є найважливішою сенсорною характеристикою паштетів. Консистенція паштету щільна та однорідна, а колір – світло-коричневий з яскраво-помаранчевими вкрапленнями, що спричинені додаванням моркви в рецептуру. Розроблений паштет має масову частку: вологи 53,4%, загальної золи 1,33%, білків 11,6%, жирів 6,5%, вуглеводів 6,5%. Калорійність розробленого паштету становить 130,9 ккал. Густина паштету становить 1063,8 кг/м³, а вологозв'язуюча здатність у відсотках до маси паштету 42,9%. Комбінований паштет, виготовлений з курячої печінки, овочів, вівсяних пластівців та гречки, збагачено поживними речовинами, що містяться в рослинній сировині. Його собівартість також менша порівняно з традиційним паштетом внаслідок часткової заміни м'ясних інгредієнтів на рослинні.

Ключові слова: *комбінований паштет, рецептура паштету, органолептичні властивості паштету, харчова цінність паштету, вологозв'язуюча здатність паштету, низькокалорійний паштет, показник якості паштету.*

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