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GERIATRIC DIETARY MEAT-BASED PRODUCTS

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The contemporary nutrition pattern referring to different age groups of the population does not meet quantitative and qualitative requirements. In Ukraine the manufacture of geriatric meat-based dietary products is underdeveloped. Therefore, the development of healthy and functional foods is the priority objective for the food industry. The research is devoted to considering the possibility of using quail meat, wheat germ flakes and walnut oil in the production process of the sausages for older and elderly people nutrition. Functional and process properties of wheat germ flakes were studied, since they are crucial for the meat products processing – fat retention, moisture retention and the critical gelling concentration. The tests conducted on model minced meat showed that it is feasible to include 10 % wheat germ flakes and 9 % walnut oil as the ingredients of meat products. Organoleptic indicators of finished products meet the regulatory standard requirements. It was found that the combination of raw materials of animal and vegetable origins enables to obtain food finished products, containing significant quantity of essential nutrients, and reduces the risk of developing nutritional diseases.

Key words: quail meat; sausages; geriatric dietary meat products

ГЕРОНТОЛОШКО-ДИЕТЕТСКИ ПРОИЗВОДИ ВРЗ ОСНОВА НА МЕСО

Современото ниво на исхрана на населението од различни старосни групи не одговара на потребите ниту според квантитативните ниту според квалитативните показатели. Во Украина пазарот на геронтолошко-диететски производи врз основа на месо е недоволно развиен, затоа развојот на прехранбени производи кои може да имаат позитивно влијание врз системите и функциите на организмот претставува примарна задача на прехранбената индустрија. Трудот се занимава со истражување на можноста за користење на месо од потполошка, снегулки од пченични никулции ореово масло во технологијата на виршли за исхрана на постари возрасни групи. Истражени се функционално-технолошките својства на снегулки од пченични никулци кои имаат првостепено значење во технологијата на производството на месните производи – способност за задржување на маста, способност за задржување на влажноста и критичка концентрација за образување на желе. Во извршените експерименти врз примероци од мелено месо е утврдено дека е полезно во составот на месните производи да се внесува 10 % снегулки од пченични никулци и 9 % масло од орев. Органолептичките карактеристики на готовите производи одговараат на барањата на нормативната документација. Утврдено е дека комбинацијата на суровини од животинско и растително потекло овозможува да се добие готов производ кој содржи значително количество на хранливи материи и го намалува ризикот од развој на болести поврзани со исхраната.

Клучни зборови: месо од потполошка; виршли; геронтолошко-дитететски месни производи

INTRODUCTION

According to the forecasts [1] by 2050 the gap between the older and elderly age group and the total population in Ukraine will constantly increase reaching the rate of over 32 %. It is common knowledge that with time there develop functional and morphological changes in a human body. They include slower metabolic processes, weaker resistance to environmental adverse effects, poorer regeneration abilities, as well as reduced physical and motor activity.

However, in Ukraine insufficient attention has been paid to the older and elderly people nutrition,

though it is well known that nutrition may ensure physical and mental longevity for the elderly and slowdown in the development of age-related pathologies. The range of these foods is very limited and frequently they considerably contradict standards and requirements to the geriatric dietary foods.

In accordance with the suggestions of the leading nutritionists, studying nutrition patterns of the older age groups, the following requirements were set:

– the principle of energy-balanced nutrition;

– correspondence of food chemical composition to the age specific features of the human body;

– prevention and treatment orientation;

– good balance of the dietary intake by all essential ingredients;

– sensible 4–5 meal nutrition with digestible foods and dishes;

– alkaline diet;

– normalization of the ageing body gut microflora;

– food enrichment with nutrients, having hetero-protective properties;

– inclusion in the diet of the foods, moderately encouraging secretory and motor functions of the digestive system [2].

Recommended rates of the daily demand for proteins, fat and carbohydrates are given in Table 1.The specific feature of the diets is their limited nutritive value since the low-caloric diet slows down ageing processes.

Table 1

Recommended rates of the daily macronutrients intake for older and elderly people [3]

Sex	Age, years	Energy, kcal	Proteins, g	Fat, g	Carbohydrates, g
Men	60 – 74	2000	65	60	300
	75 and over	1800	53	54	270
Women	60 – 74	1800	58	54	270
	75 and over	1600	52	48	240

Meat is a unique food product and it is widely used for the production of consumer products as well as for the production of dedicated geriatric dietary foods.

While developing process flows for new meat products the primary and most important stage is to select recipe components, which may assist in correcting the product ingredients to comply with geriatric dietary requirements. First of all, any supplements must be natural, not lowering food nutritive properties, be good for health, and above all, be safe in terms of the well-balanced diet. Useful properties of supplements shall be evidence based.

Another aspect to be taken into account when building – enriching the product with the ingredients, whose deficit is the highest in a specific region or in specific groups of population.

In our work on building the foods for elderly people it was offered to use quail meat, wheat germ flakes and vegetable walnut oil *Juglans regia*.

Special attention should be paid to the use of quail meat for this purpose. One of the most dynamically developing segments of poultry industry in Ukraine is quail farming, which is feasible and has quite a short return on investment period. Quail meat is characterized by high biological and nutritional value. It is soft, juicy and appealing in terms of its taste qualities. It has significant protein and low fat content. The general quail meat formulation: moisture content – 70.2 %; protein content – 22.0 %; fat content – 6.8 %; ash – 1.0 %.

Quail meat is rich in minerals (iron, calcium, potassium) and vitamins (retinol, tocopherol, riboflavin etc.), i.e. its nutritional value is not lower than that of other kinds of meat.

Quail meat protein substances are characterized by the optimal content of essential amino acids, with maximum proximity to the benchmark. Limiting amino acids are unavailable. The shown data confirms that 100 g quail meat meet the average daily human need in animal proteins by 44 % and meet the body need in essential amino acids by 28–48 %.

Quail meat contains such essential amino acids as alanine, histidine, glycine meeting the formula of the well-balanced diet by 39–55 % [4].

Quail meat has low fat content, consequently, recipes of meat processed geriatric dietary products should provide recommended protein and fat ratio of 1:0.8. It is also necessary to ensure the standard fat content in the developed recipes, therefore, additional fats are to be introduced as ingredients. It is optimal to meet the requirements of the well-balanced diet by consuming multi-ingredient products based on meat and vegetable materials. To enrich with fat we suggested using walnut oil. This oil is a record setter by vitamin E content. It also

contains macro-, microelements, phytosterols, sphingolipids, phospholipids and vitamins. The oil is dominated by unsaturated fatty acids, prevailingly by linoleic acid.

The nut oil is able to accelerate and promote protein digestion owing to its lysine content, whereas nearly optimal ratio of the polyunsaturated fatty acids of classes ω-6 and ω-3 (5:1) enables to refer it to the natural remedy for the prevention of cardiovascular diseases (especially atherosclerosis) and normalization of metabolism [5].

The work also provides for the use of another vegetable component – wheat germ flakes. The germ is characterized by the high content of vitamins, especially vitamin E – tocopherol. It is 8.6 times more than in grains and 7.4–13.9 times more than in flour. Therewith, it is found there in its active form. The wheat germ contains 18 amino acids, including 10 essential ones. The wheat germ contains food fibres, which are recommended for the diet to prevent gastrointestinal diseases [6]. During the germ development, different enzymes get activated. Dissolution of all the high-molecular compounds of protein starch starts under their impact and they transit to the low-molecular substances. Under the impact of enzymes starch turn into maltose, glucose, fructose, maltotriose, maltodextrins; proteins are hydrolyzed to the water-soluble proteins and amino acids; hemicellulose and gum-based substances are hydrolyzed to water soluble polysaccharides and sugars. All these substances are digestible in human body [7].

In this connection the goal of our study was to find possibility to use meat of quails, cereal wheat germ and walnut oil in the technology of meat production for people of elderly and extreme old age.

MATERIALS AND METHODS

The use of any supplements in meat food products is possible only provided their compatibility with meat material. Considering the fact that these substances notably differ from the meat raw material in terms of their chemical and physical properties, their processability and interaction with the meat material were first studied, as these are directly related to the specifics of consumer's perception of the finished product.

Among a large number of technological factors, determining the quality of finished products, an important role is played by the functional and engineering properties (FEP) of the supplement, since they largely influence the outcome, stable consistency formation and other organoleptic indicators. The value and stability of these indicators, if possible, shall be close to those of the meat material characteristics.

At the initial stage of the research the key FEP sof the wheat germ flakes were studied: moisture retention, fat retention and gelling property [8].

An important quality indicator when a consumer assesses a new product is the overall organoleptic properties perception. In order to study the influence of adding supplements on the appearance, taste, odour and texture a series of tests was carried out to find changes of organoleptic indicators of model minced meat systems [9]. The organoleptic analysis was performed by tasting experimental samples by an expert committee. This committee included the meat, fish and seafood process department teaching staff of Odessa National Academy of Food Technologies. While tasting each expert was given a tasting list, an assessment scale, samples to be tested.

For the purpose a series of model minced material was made, where quail meat was replaced with the wheat germ flakes by up to 15 % with the interval of 3 %, and vegetable walnut oil was introduced too. It was added by partially replacing animal fat (back fat). At the same time it was taken into consideration that traditional meat products contain up to 30 % fat. Therefore, when modeling up to 9 % fat was added to the total recipe weight at the interval of 1.8 %.

Possible combinations of additives in preparation of model minced meats are shown in Table 2.

Model minced meats with quail meat were prepared according to the traditional technological scheme: preparation of raw meat by a chopper (lattice size is 2–3 mm) → mixing with NaCl (concentration of NaCl 2 %) → maturing in a salt solution (during 8–12 hours) → composition of minced meat in a laboratory cutter → stuffing a natural casing with the minced meat → heat treatment (up to the temperature in the center of 72 ± 1 °C) → cooling with water (up to the temperature in the center of 19–20 °C) → cooling with air (up to the temperature in the center of 10–12 °C). Flakes of wheat germ were put into the cutter before putting of raw fat material, while vegetable walnut oil was added at the last stage of chopping. After bringing to culinary readiness the model minced meats were evaluated by organoleptic indices. A nine-point scale was used for evaluation. The results are shown in Fig. 1. A 9-point scale was used for assessment.

Table 2

Supplement combination options

Combination option	Ingredients used	Ratio, %
Control	Quail meat : wheat germ flakes : walnut oil	100 :0 :0
1	Quail meat : wheat germ flakes : walnut oil	95,2:3:1,8
2	Quail meat : wheat germ flakes : walnut oil	90,4:6:3,6
3	Quail meat : wheat germ flakes : walnut oil	85,6:9:5,4
4	Quail meat : wheat germ flakes : walnut oil	80,8:12:7,2
5	Quail meat : wheat germ flakes : walnut oil	76:15:9

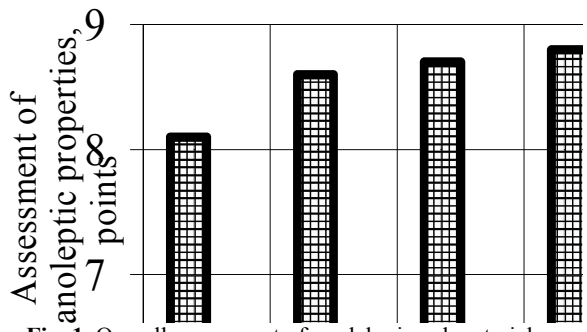

Fig. 1. Overall assessment of model minced material organoleptic properties

The performed organoleptic studies allowed to determine that the model minced meat composition No. 5 had the highest organoleptic indices, on its basis a recipe of cooked sausage products (sausages) with gerontological purpose was developed. According to the developed recipe (quail meat – 60%, bacon – 21 %, wheat germ flakes – 10 %, walnut oil – 9 %, salt – 1.5 %, a mixture of spices – 0,1 %, sodium nitrite – 7 mg per 100 g, ice water – 15 %) a test batch of products was produced.

Sausages were produced according to the traditional scheme: Preparation of meat quails → grinding in a chopper (of the lattice size of 2–3 mm) → mixing with NaCl (concentration of NaCl 2 %) → maturing in a salt solution (duration 8–12 hours) → preparation of minced meat in a laboratory chopper → stuffing a natural casing with the model minced meat → heat treatment (drying 30 minutes at 40°C, smoking 20 minutes at 80 °C, boiling 50 minutes at 75 °C until the temperature at the center of the product reached 72±1°C) → cooling with water (to the temperature at the center of 19–20°C) → cooling with air (up to the temperature at the center of 10–12°C).

A general chemical composition, energy value and biological effectiveness of the fat fraction were determined in the finished product (Tables 3–5).

The following procedures [8] were used to determine the functional and technological properties (FTP) of cereal wheat germ. Determination of water-holding capacity (WHC). A sample of the additive of 2 g was hydrated in distilled water at a ratio of 1:5 for 1 hour in glass beakers. Then the beakers were placed in the incubator at the temperature of 74–76°C and held there for 15 minutes. The contents of the beakers were transferred to centrifuge bags with sieve inserts and centrifuged for 15 min at 1000 rev/min (OC-6M centrifuge, Russia) to separate unbound water. Contents of the sieve inserts were weighed and water-holding capacity was calculated:

$$\text{WHC} = (M_g - M_d)/M_d, \quad (1)$$

Where M_g is mass of a hydrated sample;

M_d is mass of a dry sample.

Table 3

Chemical formula of sausages for geriatric nutrition

Parameters	Sausages for geriatric nutrition
Moisture content, %	56.88
Protein content, %	11,12
Fat content, %	25.63
Carbohydrates content, %	0.28
Including:	
Fibres	0.20
Starch	0.08
Ash content, %	2.32
Output, %	112.3
Energy value, kJ (kCal)	1145.5 (272.7)

Table 4

Specification of lipids in sausages for geriatric nutrition

Fatty acid	Sausages for geriatric nutrition
Total lipids, %	26.63
Triglycerides, %	26.41
Including:	
cholesterol, %	0.027
phospholipids, %	1.51
Fatty acids (total), %	25.81
Including:	
saturated	7.84
– capric($C_{10:0}$)	0.025
dodecanoic($C_{12:0}$)	0.004
myristic($C_{14:0}$)	0.029
palmitic($C_{16:0}$)	5.04
stearinic($C_{18:0}$)	2.60
arachic($C_{20:0}$)	0.14
– monounsaturated	9.27
palmitoleic($C_{16:1}$)	0.52
oleic ($C_{18:1}$)	8.75
– polyunsaturated	8.69
linoleic ($C_{18:2}$), ω-6	7.37
linolenic($C_{18:3}$), ω-3	1,22
arachidonic ($C_{20:4}$), ω-6	0.105

Table 5

Calculation of fat fraction biological effectiveness of sausages for geriatric dietary nutrition

Parameter	Recommended value, [14]	Fat in the control sample
Animal/vegetable fat ratio, %	30:70	30:70
Fatty acid content, %:		
– saturated (SA), up to	30	30.37
– monounsaturated (MUFA), up to	50–60	35.94
– polyunsaturated (PUFA), up to	45	33.66
SA:MUFA:PUFA ratio, %	1.0:2.0:1.5	1.0:1.2:1.1
ω-6:ω-3 ratio	5.0–10.0:1.0	6.0:1.0

Determination of fat-holding capacity (FHC). In the glass centrifuge test tubes of 30 cm^3 2 g of the tested specimen were put and from 1 to 6 g of vegetable oil with an interval of 0.5 g was added. The content of test tubes was mixed during 10 min, then the tubes with suspensions of the specimen were incubated for 15 minutes in the thermostat at the temperature of 74–76 °C continuing to mix it. After incubation the test tubes were cooled with cold water to room temperature and centrifuged in a centrifuge OC-6M (Russia) at 1500 rev/min for 15 min.

For the value of FHC the maximum amount of added oil was taken, at which a separation of an oil phase was not observed during the test, in terms of the calculated amount of 1 g of the specimen; FHC was evaluated in grams of oil per gram of specimen.

Determination of a critical gelation concentration (CGC). A series of 10 specimen suspensions in distilled water with a 1 % interval of concentration was prepared. The suspensions were mixed thoroughly until homogenous consistence and transferred to glass test tubes of 10 cm^3 (about 10 g of suspension in each). The tubes were closed with rubber stoppers, placed in the thermostat and held there for 15 minutes at the temperature of 74–76 °C. After heating the test tubes were cooled with cold water to room temperature, placed in the refrigerator, where they were held for 16–18 hours at the temperature of 4–6 °C. Lead balls with the average weight of 0.53 g were placed on the surface of the suspension and kept for 2 hours at 4–6°C.

The concentration of specimen corresponding to the sample, in which there was no destruction of the gel under the pressure of the lead ball, was taken for a critical gelation concentration at 4°C.

Determination of moisture content and dry solids weight ratio was performed by drying the test sample in a thermostat to a constant weight at 103 ± 2°C [9].

Determination of a weight fraction of a protein was performed by mineralization of the tested product and determination of the amount of released nitrogen was done by the Kjeldahl method [11].

Determination of a weight fraction of the fat was carried out gravimetrically in a Soxhlet apparatus [9].

Determination of a weight fraction of ash was performed in a muffle furnace at the temperature of 500–550 °C with pre-drying [9].

Determination of a weight fraction of cellulose was performed by a direct gravimetric determination in Ermakova's modification [10].

Determination of a weight fraction of starch performed by the method based on oxidation of aldehyde groups of monosaccharides, which formed during hydrolysis of starch in an acid medium, by bivalent copper of Fehling's solution with formation of a precipitate of cuprous oxide [11].

Determination of a yield of finished products is determined by the ratio of actual final product obtained (A_1, kg) to the amount of raw material (A, kg) spent on its production. The yield as calculated by formula 2, evaluated in %:

$$B = (A_1 \cdot 100)/A, \quad (2)$$

where A_1 is the weight of the finished product, g;

A is weight the raw materials, g;

100 is a multiplier to calculate into %.

A composition of fatty acids was determined by a method of gas-liquid chromatography with usage of flame ionization detector "Chrome-5" (Czech Republic) [9].

RESULTS AND DISCUSSION

As a result of the FEP studies of the wheat germ flakes the following data were found: moisture retention 2.28 ± 0.03 g H_2O/g; fat retention 2.75 ± 0.06 g fat/g; gelling 41 %. The obtained results show that it is feasible to use wheat germ flakes as an ingredient of meat products based on the native muscular tissue, with a specific content of fat and aqueous parts, especially in the sausage minced materials, which are aqueous-protein-fat emulsions. The obtained results of the above organoleptic properties assessment (Fig. 1) show that adding wheat germ flakes and walnut oil does not significantly impact organoleptic property indicators of the model materials. No separation of the fat fraction was observed, appearance of pleasant nut aftertaste was noted in option N^o 5, whereas the control sample was not juicy. This drawback was eliminated by introducing vegetable supplements into the system. Thus, wheat germ flakes and walnut oil are promising ingredients of meat products for the nutrition of older age groups.

The above organoleptic studies enabled to establish reasonable range of ingredient content in the recipe of new meat products: quail meat 60–62 %, wheat germ flakes 9–12 %, back fat 20–22 %, walnut oil 7–9 %, which further gave an opportunity to develop the recipe of geriatric boiled sausage products (sausages). According to the developed recipe a sample product batch was made and its chemical formula, nutrition value and the biological effectiveness of the fat fraction were studied (Tables 3–5).

The fat fraction of the product considerably influences not only the energy, but also the biological value of meat products. It depends on the content of unsaturated fatty acids, which are not synthesized in the human body, including polyunsaturated fatty acids (PUFA) – linoleic, linolenic and arachic. Researchers established proportional interrelation between the ratio of saturated and unsaturated fatty acids and consumers' health. Saturated fats are recognized as risk factors, provoking the development of cardiovascular diseases and their related death rate, while PUFAs are considered as those encouraging prevention of these diseases [12]. Therefore, to develop healthy and functional food products it is required to identify the optimal ratio of these groups of fatty acids and, thus, ω-3/ω-6 ratio may serve an indicator of the product value.

Based on the data available in literary sources [13], it may be stated that partial replacement of animal fat with vegetable oil, which is contemplated in the recipe, enables to improve the quality of fat ingredients.

The research into the fatty acid lipid formula confirmed feasibility of combining animal and vegetable fats made in the test recipe. This enabled to approximate the vegetable/animal fat ratio to the recommended rate (30:70), change the ratio of saturated, monounsaturated and polyunsaturated fatty acids in the product.

The quality formula of test sample fats, which included vegetable oil, is given in Table 4.

Calculations enabled to establish that the fat fraction of the test product complies with the regulatory requirements [14]. The results are given in Table 5.

However, it is to be noted that when processing the product we encountered issues as well. In particular, the quail weight is low (on average 90–130 g) and, consequently, manual dissection process is highly labour intensive. Moreover, considerable percent of meat remains on the bones (up to 12–15 %), which requires additional mechanical bone dissection to reach the optimal use rate of the animal raw material. Mechanical dissection output is the meat mass, which is notably different from

the muscular tissue in terms of its properties and chemical formula and this requires further research to find out whether quail meat mass may be used in the geriatric dietary products and whether it may be used in the development of recipes.

CONCLUSIONS

Based on the conducted test studies it may be concluded that quail meat is a promising raw material for the production of geriatric dietary products. To manufacture the products rich in minerals, vitamins, substances stimulating intestinal motility and antioxidants, inhibiting oxidation of lipid membranes it is reasonable to complete the product ingredients with wheat germ flakes up to 12 % of the total weight of the recipe and replace up to 30 % animal fat with walnut oil. The finished product features good organoleptic properties, has traditional structure and texture. Owing to the combination of animal and vegetable fats the product fat fraction is characterized by the well-balanced fatty-acid formula, and 33.66 % PUFA of the total fatty acid content enables to state potential antisclerotic, thrombolytic and cholesterol lowering effect of the developed product.

REFERENCES

[1] *The Population of Ukraine*. The imperative of demographic aging, "ADEF-Ukraine", Kyiv, 2014. (in Ukrainian).

[2] Kochetkova, A. A.: Functional foods. *Food Industry*, **3**, 4–5 (2009) (in Russian).

[3] Zubar, N. M.: *Fundamentals of Physiology and Food Hygiene: Manual.* Center of educational literature, Kyiv, 2010 (in Ukrainian).

[4] Makarov, A. V, Antipova, L. V.: The food and biological value of quail meat. *Meat Industry*, **1**, 55–57 (2007) (in Russian).

[5] Dragomiretskiĭ, J. A.: *Treatment of nuts.* Nevskiĭ Prospekt, St. Petersburg, 2000 (in Russian).

[6] Maksimchuk, B., Kolomenskiy, S.: Production of wheat germ. Nutritional value and use. *Bakery*, **2**, 46–48 (1995) (in Russian).

[7] Titov, E. I., Aleksakhina, V. A., Stefanov, A., V, Piltsova, L. A. et al.: Role of wheat germ in technology of meat products of therapeutic and prophylactic purposes. *Express Information*. **5**, 78–79 (1994) (in Russian).

[8] Gurova, N. V., Popelo, I. A., Suchkov, V. V., Kovalev, A. I. et al.: Methods for determining the functional properties of soy protein products. *Meat industry*, **9**, 30–32 (2001) (in Russian).

[9] Antipova, L. V., Glotova, I. A., Rogov, I. A.: *Methods of meat and meat products*, Kolos, Moscow, 2001 (in Russian).

[10] Markh, A. T., Zykina, T. F., Golubev, V. N.: *Technical-Chemical Control of Canning Production*, Agropromizdat, Moscow, 1989 (in Russian).

[11] Zhuravskaya, N. K., Alekhina, L. T., Otryashenkova, L. M.: *Research and Quality Control of Meat and Meat Products*, Agropromizdat, Moscow, 1985 (in Russian).

[12] Klimov, A. N., Nikulcheva, N. G.: *Exchange of Lipids and Lipoproteins and its Disorders*, SPb., St. Petersburg, 1999 (in Russian).

[13] Tutelian, V. A., Sukhanov, B. R.: *Optimal Nutrition is Key to Health.* Magazine Publishing House "Health", Moscow, 2004 (in Russian).

[14] Guidelines 2.3.1.2432-08 MR. *The norms of physiological requirements in energy and nutrients for different groups of the Russian population.* Federal Centre of Sanitary Inspection Ministry of Health of Russia, Moscow, 2008 (in Russian).