UDC 637.5.03

Investigation in fat-acid content of meat pastes and their oxidative stability

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The purpose. To study fat-acid content of meat pastes, enriched with corn, linen flour, their mixture, and also coupages of oils (corn, linen, sunflower). **Methods.** Study of fat-acid content of vegetable oils, their coupages and model meat pastes were carried out using method of gas chromatography on a device «Kupol». Oxidation level of fat was determined using method based on oxidation of monohydroiodide acid by peroxides which contain in fat, with the subsequent titration of the secreted iodine by thiosulphate of sodium. Quality of meat and meat food during storage was evaluated on accumulation of by-products of oxidative spoilage of fat which react with 2-thiobarbituric acid. Object of probes were samples of meat pastes produced in industrial conditions which formulas included semifat pork, premium beef, chicken liver, corn flour, linen flour, or their mixtures, coupages of vegetable oils (sunflower, linen, corn). **Results.** They studied fat-acid content of meat pastes, enriched by corn, linen flour, their mixture, and also coupages of oils. It was established that use of the specified vegetable components increased the content of polynonsaturated fatty acids in finished products in 1.6 – 1.7 times as compared to check samples. That significally influenced ratio w-6 and w-3 fatty acids within the limits of (9.8 – 11.0):1,0. They also fixed that in structure of protein there were all essential amino acids, their general amount in the probed samples was on 1.3 – 3.1% above, than in control. Biological value of meat pastes was determined. It was established that meat pastes with vegetable components possess a higher biological value in comparison with check samples on 7.3 – 9.3%. **Conclusions.** The opportunity is established of adjustment fat-acid content of meat pastes for feed of children of preschool and school age by introduction in formulas of different kinds of flour and vegetable oils.

Key words: *polynonsaturated fatty acids, flour, coupages of vegetable oils, pastes.*
DOI:https://doi.org/10.31073/agrovisnyk201908-11

The problem of nutritionally full and healthy food has been still on the global agenda. Nutritionally full nutrition creates conditions for optimal physical and mental development, allows maintaining high performance as well as increasing the body's ability to resist the action of environmentally unfavorable factors [1].

The problem of healthy nutrition is on the agenda for all countries of the world. Improving the nutritional structure of the population provides for an increase in food production due to the improvement of existing and the creation of new food technologies for functional purposes [2, 3]. Such products should have a balanced chemical composition, low energy value, low content of sugar and saturated fatty acids and high content of healthy ingredients for functional, health-improving and prophylactic purposes. But, of course, such products must be absolutely safe for humans [4].

One of the trends in the development of healthy foods is to reduce the calorific value (fat content) of the finished product due to the introduction of vegetables, grain and leguminous crops, fiber, citrus and the like.

German scientists believe that the optimal in terms of health benefits is the partial replacement of fat by a combination of soluble (inulin) and insoluble (wheat bran) ballast substances. For example, in by-product sausage up to 20% of fat was replaced by water-soluble inulin and wheat fibers were added in a small amount (about 1%) due to their negative effect on the sensorial parameters of the product [5].

Preschool and school children diets were the subject of research their results containing the scientific works of Karpenko P. O., Kulchytska V. P., Prytulska N. V., Fedorenko V. I., Belmer S., Anderson M., Kull

I., Khanna K., which confirm the growing actuality of the problem of preschool and school children nutrition.

Considerable attention to the nutrition of children of preschool age is given in Ireland – experts consider especially important, in this sense, the proper content in foods that small consumers consume, calcium, vitamin D and iron [6].

Forming proper diets of children of preschool age, Polish nutritionists use scientifically based standards [7]. In particular, they normalize the content of such nutrients as vitamins A, B6, B12, D, E, C, as well as thiamine, riboflavin, niacin, folic acid, sodium, potassium, calcium, phosphorus, magnesium, iron, zinc, copper, iodine, manganese and others [8].

Today the state of health of a human is largely determined by the quality of nutrition in childhood, when rapid growth occurs and the exchange reactions proceed most intensively. Rational and balanced nutrition is among the most important components ensuring the development of a child, forming mental and physical health [9]. A healthy diet of children is based on the use of various foods, both vegetable and animal, that provide a synergistic effect on the nutritional and nutritional value of the said foods.

The creation of functional meat products is an important and rather difficult social and scientific task, since the development of such products requires significant changes of traditional approaches to the technological process. It is important to enrich a formulation with functional ingredients that do not reduce consumer and technological properties of the product. Modern methodology for the creation and production of functional products covers comprehensive research and development of processes for the production of raw materials and components, modeling formulations and technological processes of production, as well as addressing the issue of preserving the basic properties of products until their consumption.

A promising area of research is the improvement of technology and the development of paste formulation with the addition of blends of vegetable oils of enhanced biological value in order to improve the balance of amino acid and fatty acid contents, quality indicators of finished products and increase their digestibility, as well as expanding the range of products for feeding children of preschool and school age [10].

Raw meat is a source of complete protein, that is, it has the natural properties inherent in functional foods. Meat is characterized by a balanced amino acid composition, it contains all essential amino acids, including tryptophan, lysine and methionine, has a high content of mineral elements (iron, phosphorus, zinc, copper, chromium, selenium, fluorine, potassium, sulfur), including essential, is important a source of vitamins of group B. These components together determine an outstanding nutritional and biological value of meat.

Problems arise in the process of creating functional products this stipulating the search for new scientific approaches to solve them.

One of the trends in the development of healthy foods is to reduce the calorific value (fat content) of the finished product due to the introduction of vegetables, grain and leguminous crops, fiber, citrus and the like.

Analysis of foreign literature has shown that in recent years, scientific developments in the field of creating functional meat-based products are conducted in the following areas:

- organic meat raw materials, which do not cause allergies;
- reducing the calorie content of meat products by replacing part of the fat in formulations;
- modification of the fatty acid composition of raw meat and meat products by replacing part of the animal fat with vegetable one together with and lipids of marine fish and invertebrates;
- enrichment of raw meat and meat products with fat-soluble vitamins and minerals;
- development of functional foods with antioxidant action.

The purpose. To investigate the fatty acid composition of pastes after adding vegetable components to their formulation, namely, corn flour, flaxseed flour, blends of vegetable oils (corn, sunflower) and oxidation of the finished product and assess the stability of the properties of meat pates during storage.

Methods. The study of the fatty acid composition of vegetable oils, their blends and model meat pastes was carried out by the method of gas chromatography using the “Kupol” device. The degree of fat oxidation was determined by the method based on the oxidation of hydroiodic acid by peroxides, which are contained in the fat, followed by titration of the released iodine with sodium thiosulfate. The quality of meat and meat products during storage was assessed by the accumulation of secondary products of oxidative fat deterioration, which react with 2-thiobarbituric acid.

Results. The principal raw meat for the production of pastes is pork, beef and chicken liver. The latter is important as a source of iron-containing proteins, folic acid, affecting the development of the blood and immune systems in children of preschool and school age. More than half of the lipids of chicken liver are phosphatides, the rest are the neutral fats [11].

We used corn and flax flour, as well as their mixtures in a 1: 1 ratio as a natural source of dietary fiber. In order to improve the balance of fat-acid composition, quality indicators of ready-made meat pates and increase their digestibility, blended vegetable oils were added to the recipes: blend 1 containing sunflower and flax in the ratio of 90:10) and blend 2 (corn and flax in the ratio of 85:15) – according to [12].

Vegetable oils are a source of essential substances that are necessary for the normal functioning of the human body, especially children of preschool and school age, they are characterized by a high content of fat-soluble vitamins, stearin and other biologically active components, as well as essential fatty acids.

Fat acids composition of meat pastes, enriched with corn, flax flour, their mixture, as well as blends of corn, flax and sunflower oils, are presented in table 1.

1. Share, %, of unsaturated (UFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids in formulations of meat pates

Fatty acids	Control	Formulation 1	Formulation 2	Formulation 3
UFA	43.60	36.15	34.31	35.86
MUFA	36.33	34.14	35.28	32.18
PUFA	17.96	28.42	29.11	30.29
UFA + MUFA + PUFA	97.89	98.71	98.70	98.33
PUFA/ UFA	0.41	0.79	0.85	0.84
-6/ -3	16:1	9,8:1,0	10,1:1,0	11:1

As can be seen from the above results, the content of PUFA in the prototypes of meat pastes increased (1.6-1.7) times compared with the control samples, significantly influenced the ratio of omega-6 and omega-3 fatty acids.

Analysis of the balance of enriched meat pastes fatty acid composition after sterilization showed that all formulations had an acceptable, from the point of view of healthy nutrition, ratio of omega-6 and omega-3 fatty acids in the range of 9.8-11.0: 1.0.

To assess the stability of the properties of meat pate during the storage period, indicators characterizing the lipid oxidation were determined (Table 2).

2. Indicators of the lipid oxidation in meat pastes

Sample	Storage duration, months	Peroxide number (PN), mg/%	Thiobarbituric number (TBN), mg/%
Control	before sterilization	0.23	0.07
	0	0.27	0.08
	6	0.31	0.09
	9	0.32	0.10
Formulation 1	before sterilization	0.22	0.05

	0	0.24	0.07
	6	0.25	0.07
	9	0.25	0.08
Formulation 2	before sterilization	0.23	0.06
	0	0.25	0.07
	6	0.25	0.08
	9	0.26	0.08
Formulation 3	before sterilization	0.21	0.06
	0	0.23	0.08
	6	0.24	0.08
	9	0.25	0.09

The results of studies of lipid oxidation indices of meat pastes showed that the oxidative processes did not differ in intensity during their storage, this being confirmed by the determined values PN and TBN.

Conclusions

The above leads to the conclusion that the use of corn flour, flax flour, their mixture, as well as blends of corn, flax and sunflower oils for the production of meat pastes increased the content of PUFA in the finished products (1.6-1.7) times compared to control samples, consequently the ratio of -6 and -3 fatty acids was favorable in the range (9.8-11.0) : 1.0. Thus, the possibility of adjusting the fatty acid composition of meat pastes for feeding preschool and school children by adding to the formulations of various types of flour and vegetable oils has been established.

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