Meat product technology with optimized aminoacid and fatty acid composition

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Meat processing industry faces a number of problems related to the technology of meat products with optimized composition. As elements of the nutrition method, these products have the important fonction to contribute for the restriction, discontinuation or elimination of pathological phenomena in certain organs or systems manifested as a morbid status of the human organism. In this respect, the contemporary science of nutrition and the science of dietary (medicinal) nutrition in particular (3, 4, 6, 7) lay still greater demands from foodstuffs.
In nutritional respect, meat product proteins are marked by a high ability of compensating the continuous loss of proteins in the organism. They possess a high biological value in comprising of an optimum of essential aminoacids and other nitrogen-containing components necessary to maintain the nitrogen balance in the human body. The fats included in the structure of the various in origin fatty tissues, used as raw materials in meat food production, similar in caloricity as they are, are not equally assimilated considering their composition and properties. Extractives in meat raw materials as well as substances that are formed and accumulated during technological processes not only determine the taste and flavour of the ultimate meat products but, since they are some of the best stimulators of the gastro-enteric secretion, highly influence the better assimilation both of meat and other food products. Besides that, meat products are a good source of B-group vitamins and of fat soluble vitamins.
The influence of the different technological operations and processes on the nutritional-biological value of the ultimate meat products differs and depends on their character. In total, the final effect of this influence is reflected on the quality of the ready product.
The worldwide defficiency of animal proteins determines the tendency to include vegetable and milk proteins in meat products in certain proportions and combinations. The use of supplements and substitutes of vegetable and milk origin has not an economical effect only. On one hand, it gives an opportunity of increasing the protein level of the product at the expense of its lipid content while preserving the balance of the aminoacid composition, and on the other, of optimizing the fatty acid composition, and, respectively, enriching the product with biologically active substances (vitamins, microelements, etc.).
The object of the present study was to create a food product with a balanced aminoacid composition (1, 2, 5) with relatively low total energy content at the expense of lipids, and with an improved fatty acid spectrum. To reach this object, the following basic raw materials were included: first grade lean veal, chicken, Hypophtalmichtys molitrix meat, wheat gluten, sour cream protein and pig's whole blood. These raw materials were tested for their aminoacid and fatty acid composition, as well as for the total protein and lipid content and the fats' peroxide number. On the basis of the analytical data obtained two mathematical models were worked out: the first one treating the aminoacid spectrum of the final product, and the second referring to its fatty acid composition. The following requirements were taken into consideration:
- proteins: essential aminoacid content maximumly close to the ideal protein content, and a chemical score of 100, according to the requirements of FAO (1973), at a maximum possible increase of the essential/total aminoacids correlation.
- fatts: the total lipid content should not exceed 15 % in the raw product with balanced fatty acid spectrum. On forming the optimum fatty acid composition an attention is to be paid to the quantitative correspondence among fatty acid groups, and not between separate fatty acids as it is with aminoacids. Thus the polyenic acid content, for instance, should be approximately 20 % of all fatty acids: of this 16 % is biologically active cislinolic acid, 1.6 % linolenic acid

and 2.4 % arachidonic acid. The content of monoenic acids should be about 50 %, of saturated fatty acids 30 %, and it is desirable that the ratio of the short- and medium-chained saturated fatty acid fractions and the long-chained saturated fatty acid fraction is 1:3 to 1:4 (for meat products9.

- There existed also limiting requirements from technological point of view which were expressed in the models in a special type of inequalities. The mathematical models and the optimized recipe consistent with the abovementioned requirements were processed on a 1204 type of computer (Soviet made). The programme used was for "Modified simplex-method for linear programming" worked out in FORTRAN. For objective functions of the first model we have consequitively chosen limiting conditions to optimize the contents of three essential aminoacids: isoleucine, lysine and threonine, and for objective function of the second a maximized content of the biologically active cislinolic acid was chosen.

The final optimized recipe obtained from the computer's solution of the mathematical problem is the following:

x_1	(lean veal)	- 64.11%
x_2	(chicken)	- 7.85 %
x_3	(Hypophtalmichtys molitrix meat)	- 19.08 %
x_4	(wheat gluten)	- 5.96 %
x_5	(milk protein)	- 3.00 %
x_6	(pig's whole blod)	- 0 %

This programme ensures the following aminoacid and fatty acid composition:

ESSENTIAL AMINOACIDS

	Total protein	Chemical score
isoleucine	43.25	108
leucine	75.71	108
lysine	93.05	115
methionine + cystine	33.70	96
phenylalanine + tyrosine	75.50	126
tryptophan	9.89	99
thre	39.91	100
valine	46.65	93

GROUPS OF FATTY ACIDS IN %

linolic acid	15.67	(16)
linolenic acid	1.86	(1.60)
arachidonic acid and other polyenic acids	1.74	(2.40)
monoenic acids	47.49	(50)
short + medium-chained saturated fatty acids	0.15	(1)
long-chained saturated fatty acids	33.14	(29)

With regard to the fact that in the optimized recipe thus obtained a considerable percentage (approx. 9 %) of the raw materials are of non-meat origin (5.96 % gluten and 3 % milk protein) the new dietary meat product of mixed origin was specified to be produced in accordance with the technological design for structureless smoked and cooked sausages.

The basic raw and secondary materials used for the production of the dietary structureless sausage should comply with the following requirements: Lean veal, first grade, from healthy animals, observing the technological requirements of meat production and boning. It can be warm, chilled, frozen or defrosted, but by all means in a condition prior to or post rigor mortis; chicken meat from healthy well-rested poultry (broilers), observing the technological rules for chicken meat production; fresh, chilled or defrosted fish - Hypophtalmichtys molotrix - also in a condition prior or post rigor mortis; wheat gluten, sour cream protein, salting condiments which do not irritate the gastro-enteric tract.

The results from the organoleptic test pointed to some comparatively good qualities of the new product.

The chemical analysis of the product gave the following results compared to those of already existing sausages: (Table 1)

The examination of the aminoacid and fatty acid compositions revealed that they are comparatively similar to the values obtained by solving the mathematical model. Differances are within the range of the theoretically tolerated error.

Table 1

I N D I C A T I O N	Dietary sausage	"Hissar" diet.saus.	"Hamburg" sausage	"Strandja" frankfurters
Water content, in % of the total mass	70.00	73.00	57.80	55.50
Total protein content, in % of the total mass	22.97	19.27	14.49	14.95
Fats, in % of the total mass	2.84	4.21	25.02	26.60
Salt,in % of the total mass	2.00	1.55	2.20	2.20
Proteins/fats proportion	8.09	4.58	0.58	0.56

The results obtained by us give reason to conclude that the new assortment sausage satisfies the dietary and profilactic nutrition requirements and can find application in nutrition of certain group diseases: diets diets NoNo 5, 8, 9, 11 and 15, and sometimes 3 and 4.
The new assortment can find application in rational nutrition, too.

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The final optimized recipe obtained from the computer's solution of the mathematical [illegible]

x_1 (lean veal) – 64.1 %

x_2 [illegible]

x_3 (Hypophthalmichthys [illegible])

x_5 (milk protein) – 3.00 %

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