APPLICATION OF A SUNFLOWER PROTEIN CONCENTRATE IN COOKED NON-DURABLE SAUSAGES. I. CONCENTRATE EFFECT ON THE FUNCTIONAL PROPERTIES OF THE STUFFING MASS AND FINISHED PRODUCT YIELDS.

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SUMMARY: The objective of the present work was to investigate the effect of a sunflower protein concentrate on the technological properties of the stuffing mass for cooked non-durable sausages, and on the product yield. The studies were carried out with texturized pork sausage and Prague frankfurters whose compositions included 1, 2 or 3% of the sunflower protein concentrate. The water-holding capacity of the stuffing mass was determined by Grau and Hamm's method, and the meat emulsion stability was measured by sedimentation analysis under unstatic conditions. The results obtained showed that the concentrate additions increased the water-holding capacity of the stuffing mass and the meat emulsion stability. It was established that the increased amount of the added concentrate increased the product yields: from 98.40% to 103.10% for "Kamchia" pork sausage, and from 99.60% to 129.18% for Prague frankfurters. The organoleptical evaluation indicated that the sunflower concentrate improved the products' organoleptical properties.

INTRODUCTION: The rational utilization of all protein sources is indispensable both because of the need to satisfy the protein necessities, and in relation to the contemporary regulations for rational and adequate nutrition. The basic principles of the theory of adequate nutrition called forth some new trends in technology developments for production of traditional meat products, and substantiated the expedience of new formulations with elevated content of nutritive fibres (Rogov et al., 1987). In this respect, an important reserve is the utilization of vegetable protein concentrates as additives in cooked non-durable sausages. There is altogether scarce information about the application of sunflower protein concentrates as additives in meat products.

Our aim in the present study was to understand the effect of a sunflower protein concentrate on the functional properties of the stuffing mass for cooked non-durable sausages and on the yield of the finished product.

MATERIALS AND METHODS: The tests were carried out with texturized pork sausage "Kamchia" (50% non-fat and 50% semi-fat pork) and Prague frankfurters (40% veal and 60% pork) with 1, 2 or 3% of sunflower protein concentrate added to the meat. The sunflower protein concentrate was hydrated in advance in water in 1:5 ratio. The sausages were were processed according to the established technology for their variety. Control samples were prepared from the same sausage varieties without addition of the sunflower concentrate. All samples were stored

at 2-3°C for two days. The sunflower concentrate was prepared by grinding deoiled sunflower kernels to a grain size below 190 .

The functional properties of the stuffing mass were characterized by means of its water-holding capacity that was determined by Grau and Hamm's method (Grau, 1964), and by the meat emulsion stability. The latter was determined by the following centrifugation method: samples of 20 ± 0.0001 g were taken from the mean sample for each sausage variety stuffing and were placed in centrifugal tubes. The sample was then centrifugated at 314 rad/sec for 20 minutes, and the separated liquid phase was poured into a measuring flask. The sample from the first test was held in 90°C water bath until the temperature in its core reached 72°C. The sample was then centrifugated again at 314 rad/sec for 5 minutes. The separated liquid phase was added to the previous one and their total volume was measured. The measured volume of the centrifugally separated liquid phase was considered as an indicator for the emulsion stability. The results thus obtained were processed by the methods of the variation-statistical analysis (Dedenko et al., 1977) and (Gerasimovich et al., 1978).

RESULTS AND DISCUSSION: The results from the studies on the water-holding capacity, meat emulsion stability and product yields are given in Table 1.

Table 1. Effect of the sunflower concentrate on the functional properties of the stuffing mass and yields of cooked non-durable sausages.

Sausage Variety	Water-holding Capacity, % free water	Emulsion Stability, Liquid phase, cm^3	Yield, %
"Kamchia"			
Controls	7.10±0.31	1.20±0.04	98.40±4.51
Test samples-1% PC	5.73±0.23	1.00±0.04	101.30±4.97
Test samples-2% PC	4.62±0.20	0.52±0.03	102.00±5.20
Test samples-3% PC	4.22±0.21	0.36±0.02	103.10±5.20
Prague Frankftrs			
Controls	9.28±0.37	3.29±0.15	99.60±3.32
Test Samples-1% PC	8.50±0.34	2.36±0.08	102.73±4.89
Test Samples-2% PC	6.25±0.30	1.64±0.04	117.41±5.27
Test Samples-3% PC	5.95±0.30	1.05±0.04	129.18±5.68

PC = protein concentrate

It is obvious that the amount of the water liberated during the centrifugation of the stuffing mass decreases when the amounts of the added concentate is higher. The minimum values are noticed at 3% concentrate addition: 0.36±0.02% for "Kamchia" and 1.05±0.04% for Prague frankfurters. This result indicates that the sunflower protein concentrate has a good water-holding ability and thus improves the hydrophilic properties of the stuffing mass. This fact was also supported by the results obtained from the pressing method studies on the water holding capacity, and confirm the conclusion that the sunflower concentrate increases the water-holding capacity of meat of both sausage varieties owing to its good swelling ability. For "Kamchia", the water liberated at pressing wass less when the amount of the added protein concentrate was increased. The

concentrate increases the water-holding capacity of meat of both sausage varieties owing to its good swelling ability. For "Kamchia" the water liberated at pressing was less when the amount of the added protein concentrate was increased. The highest water-holding capacity was observed with the 3% addition. In that case the amount of the separated free water is 4.22±0.21% for "Kamchia", and 5.95±0.30% for Prague frankfurters. It is well known that the better hydrophilic properties of the stuffing mass result in higher product yields. That was the case in our study too, and with higher sunflower concentrate amounts there were higher yields.

The results from the organoleptic analysis are presented in Table 2 for "Kamchia" and in Table 3 for Prague frankfurters. The organoleptic evaluation pointed out that the addition of a sunflower concentrate with a grain size below 190 improved the organoleptical properties of the finished product at 1% sunflower protein level. The further addition increase deteriorated the flavour, taste, colour and outer appearance as well as the total evaluation.

Table 2. Organoleptical evaluation of "Kamchia" sausage variety prepared with sunflower protein concentrate additions.

Characteristic	Control	1% PC	2% PC	3% PC
Texture	6.23±0.39	8.93±0.33	7.02±0.28	6.39±0.29
Juiciness	7.40±0.34	7.98±0.31	6.31±0.30	5.47±0.30
Flavour	5.92±0.26	6.31±0.29	5.39±0.26	5.10±0.27
Taste	6.81±0.31	7.09±0.35	6.45±0.37	5.93±0.23
Outer appearance	8.71±0.38	7.56±0.31	5.36±0.26	4.81±0.28
Colour	8.36±0.34	8.23±0.36	5.61±0.30	5.10±0.29
Overall evaluation	7.66±0.33	8.10±0.34	6.23±0.29	5.89±0.22

Table 3. Organoleptical evaluation of Prague frankfurters prepared with sunflower protein concentrate.

Characteristic	Control	1% PC	2% PC	3% PC
Texture	7.21±0.31	8.53±0.33	7.36±0.28	6.39±0.30
Juiciness	6.89±0.32	7.86±0.29	6.81±0.30	6.05±0.29
Flavour	5.34±0,25	6.12±0.27	5.71±0.27	4.38±0.22
Taste	7.18±0.23	8.24±0.25	6.83±0.30	5.68±0.26
Outer appearance	7.91±0.33	7.87±0.34	6.18±0.31	5.21±0.23
Colour	8.69±0.35	8.23±0.31	6.43±0.29	5.56±0.26
Overall evaluation	7.14±0.30	8.00±0.33	6.57±0.29	5.08±0.27

CONCLUSIONS: 1. The addition of previously hydrated sunflower protein concentrate in meat in amounts up to 3% improves the water-holding capacity of the stuffing mass and the stability of the meat emulsion in the production of "Kamchia" pork sausage and Prague frankfurters.

2. The addition of previously hydrated sunflower protein concentrate in the amounts experimented by us increases the finished product yields.

3. The addition of 1% of sunflower protein concentrate results in certain improvement of the organoleptical properties of the finished product. With higher amounts (2 and 3%), however, the addition has a negative effect on these chacteristics.

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APPLICATION OF A SUNFLOWER PROTEIN CONCENTRATE FOR THE PRODUCTION OF COOKED NON-DURABLE SAUSAGES. II. EFFECT OF THE CONCENTRATE ON THE STRUCTURAL AND MECHANICAL PROPERTIES, AND THE CHEMICAL COMPOSITION OF THE END PRODUCT

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SUMMARY: The addition of vegetable and animal proteins in meat products has now become a regular practice. These preparations have definite nutritive, biological and technological advantages. The aim of the present work was to determine the effect of a sunflower protein concentrate on the chemical composition and structural and mechanical properties of cooked non-durable sausages. The amount of the added concentrate was 1, 2 and 3% of the meat stuffing mass. The total protein level was determined by Kjeldahl's method, and Soxlett's method was used to determine the total fat level; the structural and mechanical properties were estimated by the method of penetration. It was ascertained that the addition of 1% sunflower concentrate improved insignificantly the elasticity of Prague frankfurters when compared to the control samples (from 80.55% to 82.70%). The results obtained for the chemical composition indicated that the addition of the sunflower concentrate was expedient.

INTRODUCTION: It was the theory of adequate nutrition that pointed out and gave scientific explanation of the vitally important role of the so called "ballast" substances, mainly nutritive fibres, in the metabolic processes.

Nutritive fibres ensure the formation of gelatinous structures that control the process of stomach evacuation while their physico-chemical properties maintain the normal metabolism of steroid hormones, cholesterol, etc. These fibres possess cation exchangeability that assist the binding and evacuation of metals and cancerigenic substances (Rogov et al., 1987) and (Dudkin et al., 1988). In this respect vegetable protein preparations which contain certain amount of ballast substances have definite nutritive, biological and technological advantages. Thus for instance, the use of vegetable protein concentrates for the production of sausages makes possible to optimize the amino acid composition of the finished product hence the protein efficiency coefficient. There is little information available in literature on the effect of sunflower protein concentrates introduced as protein additives in meat products. The aim of the present work is to study the effect of a sunflower protein concentrate on the structural and mechanical properties, and the chemical composition of cooked non-durable sausages.

MATERIALS AND METHODS: The studies were carried out using the structured "Kamchia" sausage (50% non-fat and 50% semi-fat pork), and the structureless Prague frankfurters (40% veal, 60% pork); 1, 2 or 3% of the sunflower protein concentrate were added to the sausages according to the quantity of the meat raw

materials. The sunflower protein concentrate was hydrated in water beforehand, and was then added in a ratio 1:5. The sausages were processed according to the established technology for cooked non-durable sausages. Control samples of both sausage types were prepared in the same way without sunflower concentrate additions. The test samples were stored at 2-3°C for 2 days. The sunflower concentrate was prepared by milling of deoiled sunflower kernels. The concentrate particles had a size below 190 μ. Water content was measured after the samples were dried at 105°C to a constant weight. The total nitrogen of the finished product was measured by Kjeldahl's method, and the total fats were determined by orgamic solvent (diethyl ether) extraction in Soxlett's apparatus. The structural and mechanical properties of the finished product were characterized after studying its structural strength, plastic strength, and elasticity by the penetration method (Voskresenski, 1958). Samples were taken immediately after cooling, and after 24 and 48 hours of storage. The obtained results were processed according to the variation statistical analysis (Gerasimovich et al., 1978) and (Dedenko et al., 1977).

RESULTS AND DISCUSSION: The results on the effect of the concentrate on the structural strength of the finished product are given on Figures 1 and 2.

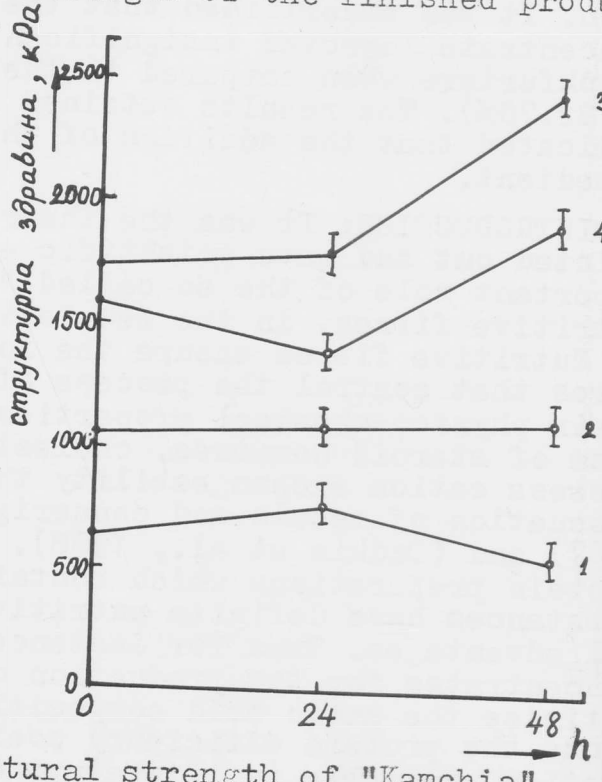

Fig.1. Changes in the structural strength of "Kamchia" sausage: 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

The Figures show that additions up to 3% protein concentrate improve the structural strength of the finished product. The structural strength values for the test samples are higher than those of the control. It was followed that the structural strength of the test samples increased successively with 1% and 2% additions while the 3% addition resulted in lower structural strength compared to the 2% samples. The results on the

effect of the 48 h cold storage indicated that in all "Kamchiä" sausage samples the structural strength did not change significantly during the first 24 hours of storage. Further storage (48 h) resulted in increased structural strength in samples 3 and 4. In Prague frankfurters the increase of this characteristic was established during the first 24 hours of storage. Further storage did not lead to significant changes in their structural strength.

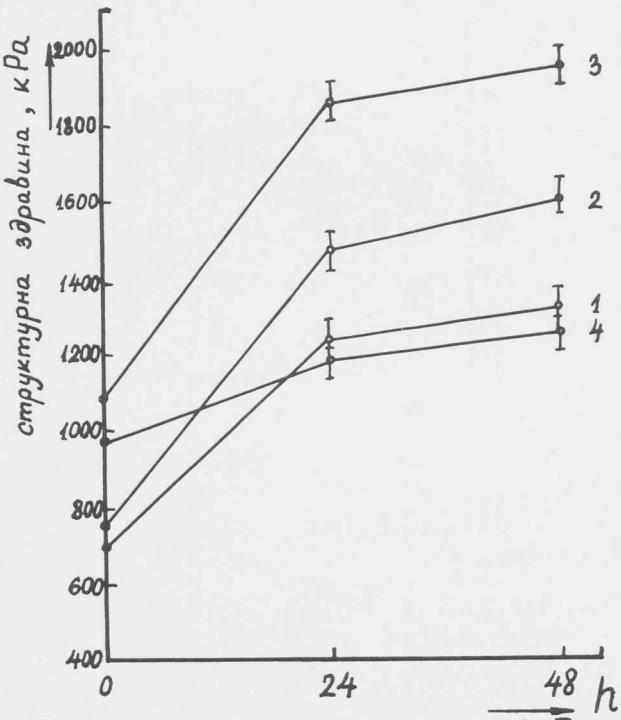

Fig.2. Changes in the structural strength of Prague frankfurters: 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

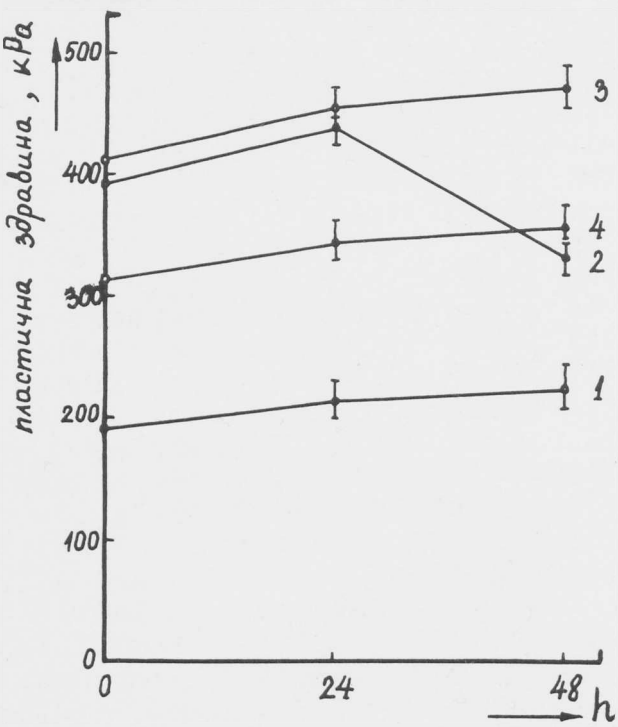

Fig.3. Changes in the plastic strength of "Kamchia" sausage 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

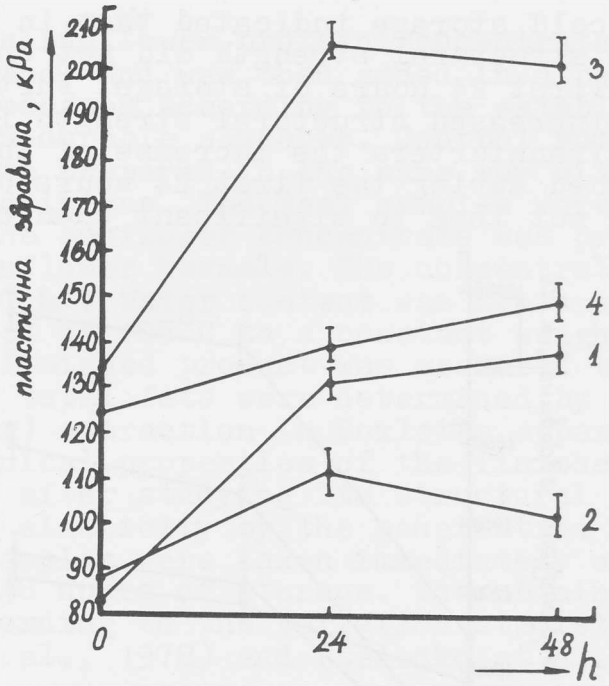

Fig.4. Changes in the plastic strength of Prague frankfurters: 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

The changes in the plastic strength of the studied samples in relation to the added amount of concentrate (Figures 3 and 4) gave almost the same tendency as for the structural strength. Here it was also seen a successive increase of the values for 1% and 2% additions, and there was a corresponding decrease in sample 4 as compared to sample 3. The storage of "Kamchia" sausage samples resulted in only a slight increase of the plastic strength that was obvious on the 48th hour in samples 1, 3 and 4. In sample 2 the increase was observed on the 24th hour of storage and after that there was a decrease from 452.18 kPa to 335.21 kPa. The results for the Prague frankfurters for this characteristic showed a similar tendency except that the plastic strength values decreased after 24 h storage both in samples 2 and 3.

The changes in elasticity of the studied samples are given on Figures 5 and 6.

Fig. 5 shows that with the increase of the concentrate amount there is a corresponding increase in the finished product elasticity (from 51.26% in the control to 70.00% in the sample with 3% addition). With Prague frankfurters there is a statistically significant difference in the elasticity only in the control when compared to samples 3 and 4 that received 2% and 3% concentrate additions, respectively. It was established that when added in the above levels the finished product elasticity increased insignificantly. Following 24 h storage the elasticity of samples 1 and 2 increased, and then there was a slight decrease only in sample 1. Samples 3 and 4 tended to slightly decrease their elasticity during the 48 h storage. We assumed that the sunflower concentrate took direct part in the process of formation of the so called meat emulsions used for stuffing the sausages studied by us and

thus exerted specific influence on their structural and mechanical properties.

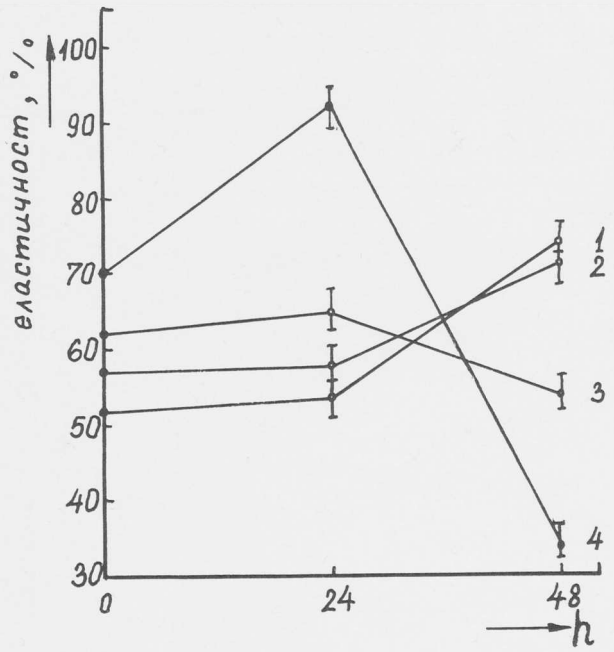

Fig.5. Changes in the elasticity of "Kamchia" sausage: 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

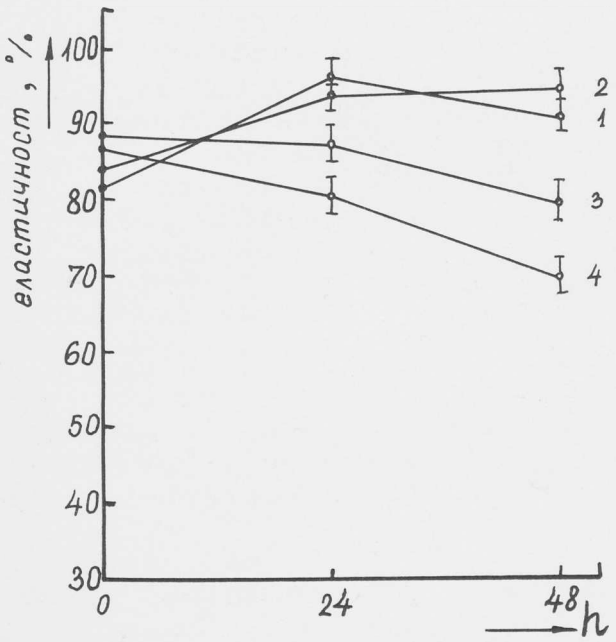

Fig.6. Changes in the elasticity of Prague frankfurters: 1 - control; 2 - 1% protein concentrate; 3 - 2% protein concentrate; 4 - 3% protein concentrate.

The results for the water, protein and fat levels in the studied sausages are given in Table 1. It was established that the protein level increased depending on the added sunflower concentrate percentage. As for fats, their level decreased

with the protein concentrate increase.

Table 1. Water, protein and fat levels in "Kamchia" sausage and Prague frankfurters (% of total mass).

Variety	Proteins	Fats	Water Content
"Kamchia" Sausage			
Controls	17.00 ± 0.63	25.76 ± 1.08	58.60 ± 2.53
1% PC samples	17.28 ± 0.61	24.29 ± 1.24	62.57 ± 2.96
2% PC samples	17.82 ± 0.69	23.31 ± 0.98	65.45 ± 3.10
3% PC samples	18.09 ± 0.75	21.29 ± 0.95	59.02 ± 3.08
Prague Frankfurters			
Controls	16.10 ± 0.60	21.71 ± 0.99	64.61 ± 3.12
1% PC samples	16.82 ± 0.68	21.54 ± 0.97	66.04 ± 3.10
2% PC samples	18.11 ± 0.73	20.11 ± 0.97	65.46 ± 3.15
3% PC samples	19.59 ± 0.81	18.73 ± 0.83	67.15 ± 3.24

PC = protein concentrate

It was of particular importance to follow the effect of the protein concentrate on the basic chemical characteristics (protein and fat levels) of the finished product which characterize to a great extent its nutritive value. The results in Table 1 confirm the predicted tendency of protein level increase and corresponding decrease in fat levels with concentrate increase. Thus the protein level increased from 17.00% in "Kamchia" controls to 18.09% in the 3% protein concentrate samples, and in Prague frankfurters the increase was from 16.10% to 19.59%. The higher protein levels resulted in corresponding decrease in the fat levels from 25.76% in control samples to 21.29% in 3% protein concentrate "Kamchia" samples, and from 21.71% to 18.73% in Prague frankfurters.

CONCLUSION: The introduction of 1% sunflower concentrate in meat raw materials to produce the studied sausage varieties does not change significantly the structural and mechanical properties of the finished product. With higher concentrate levels (2 or 3%) the values characterizing these properties also increase.

The 48 h storage of the sausages does not manifest any effect on the structural and mechanical properties of the finished product.

The introduction of the sunflower concentrate is expedient in view to improving the nutritive and biological value of the finished product, and its more adequate response to the requirements of the modern science of nutrition.

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