

5 : 8

INFLUENCE OF THE THERMAL PROCESSING ON FISH SAUSAGES PROTEINS

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SUMMARY

The purpose of the present study was to investigate the changes in proteins which occurred during the thermal processing of the raw materials for freshwater fish sausages production. Three variants of non-structured and structured fish sausages have been investigated, produced on the basis of *H. molitrix* farce, with the addition of beef and bacon. The technological scheme for the production of cooked sausages, includes in itself the following: production and preparation of *H. molitrix* farce, as well as the preparation of the other meat components, formation of the filling mass; filling in sausage skins and thermal processing.

The changes in proteins during the thermal processing of fish sausages have been investigated - roasting and cooking. The changes in the indices, characterising the changes in protein composition have been studied: the quantity of watersoluble nitrogen, non-protein nitrogen, insoluble in KJ nitrogen, as well as the quantity of myofibrillar and sarcoplasmic proteins.

The respective conclusions in connection with the qualitative changes in proteins during fish sausages thermal processing have been drawn, from which it is evident that the different indices in the three variants change in a different degree.

INTRODUCTION

The interest in fish sausages production constantly increases but the investigation in this direction are still limited, and especially as regards freshwater fish meat utilization. Literature presents some studies concerning the question for fish sausages production, using oceanic fish species, namely cetacean meat, inferior fish meat, etc. (1,2). Some technological modes have been determined, the structural-mechanical properties and chemical composition of these sausages have been established.

In a previous publication of ours (3) we discussed that subject in details, as well as the reasons for using silver carp (*Hypophthalmichthys molitrix*). We have published the amino acid composition change data in the production of fish sausages. In the present article we are discussing the investigation results regarding the influence of technological impact on fish sausages proteins and more concretely - of thermal processing.

MATERIALS AND METHODS

In search of the purpose set three variants of fish sausages have been studied - two structured and one non-structured, produced on the basis silver carp farce, used in quantity of 60 %, with the addition of beef 25 % and bacon 15 %. In the production of sausages we used the technological scheme, created by us (3), including production and preparation of *H. molitrix* farce, as well as the preparation of other meat components (salting and aging),

production of the sausage mixture, filling in sausage skins, and thermal processing: roasting while the temperature into the sausage reaches 45°C and cooking to reaching inside temperature of 72°C. The parameters of the individual variants are shown on Table 1.

Table 1. A CHARACTERISTICS OF THE EXPERIMENTAL FISH SAUSAGES BATCHES

Parametres	v a r i a n t s		
	I	II	III
Sort of sausage structured	structured	structured	non-structured
Skin : type	artificial	natural	structured artificial
Duameter, mm	20 - 22	30 - 35	20 - 22
Roasting : Temperature, °C	80 - 85	95	80 - 85
Duration, min	50 - 60	70 - 80	50 - 60
Cooking : Temperature, °C	76 - 78	76 - 78	76 - 78
Duration, min	30 - 35	35 - 40	30 - 35

As it can be seen, the composition of the three variants of sausages is one and the same. A similar order was kept in the processing during mincing, too, but the cutting of bacon was done to reaching definite sizes (as regards the structured sausages), or a homogeneous mass (as regards the non-structured sausages).

After sausages cooking the latter were cooled down to ambient temperature and then they served for the production of middle-sized laboratory samples, which were then analysed. In order to follow protein changes during thermal processing, we studied the quantities of the separate protein fractions, determining their solubility. The method of Helander (4) for protein extraction and for further determination of the separate protein fractions was used. In such way we created a possibility for establishing sarcoplasmic and myofibrillar protein changes in quantity, as well as the quality of non-protein nitrogen. The data obtained were processed in mathematical statistics methods.

RESULTS AND DISCUSSION

From the results obtained, the data being presented on Table 2, it can be seen that during the technological process the protein state changes. In the technological scheme, accepted by us for the production of fish sausages there are two moments at which a similar change is possible: in mixing the separate components and additives (including water addition), and in thermal processing. It is only natural, that main changes in proteins solubility can be obtained in fish sausages thermal processing: as a results of the thermal denaturation of proteins their solubility de-

Table 2 CHANGES IN PROTEIN FRACTIONS SOLUBILITY IN FISH SAUSAGES (mgN₂/g dry substance)

Nitrogen	Raw material		after thermal processing											
	n	$\bar{x}_1 \pm tm$	I variant		II variant			III variant						
			n	$\bar{x}_2 \pm tm$	Δx	%	n	$\bar{x}_3 \pm tm$	Δx	%	n	$\bar{x}_4 \pm tm$	Δx	%
Total water-soluble nitrogen	6	9,05 ±0,13	6	7,85 ±0,21	-1,20	13,26	6	7,94 ±0,17	-1,11	12,27	6	7,93 ±0,17	-1,12	12,38
Non-protein nitrogen	6	3,84 ±0,22	6	3,03 ±0,12	-0,81	21,09	6	3,05 ±0,22	-0,79	20,57	6	2,23 ±0,16	-1,61	41,93
Insoluble nitrogen	6	22,76 ±0,45	6	24,08 ±0,22	+1,32	5,80	6	22,91 ±0,35	+0,15	0,66	6	25,89 ±0,13	+3,13	13,75
Sarcoplasmatic proteins	6	5,19 ±0,42	6	4,83 ±0,10	-0,36	6,94	6	4,89 ±0,14	-0,30	5,78	6	4,74 ±0,18	-0,45	8,67
Myofibrillic proteins	6	5,45 ±0,86	6	4,42 ±0,32	-1,03	18,90	6	4,10 ±0,22	-1,35	24,77	6	4,55 ±0,13	-0,90	16,51
pH	3	6,20	3	6,10			3	6,10			3	6,10		

creases. As regards animal proteins, that decrease commences at temperature rise above 40°C, that process flowing intensively - up to 50 - 60°C. More concretely speaking, when heating muscle juice from horse mackerel the beginning of protein solubility increase can be found in surpassing 30°C still, and the last protein fractions, thermostable, are precipitated just about at a temperature of 80°C. But more or less, the main denaturation changes in proteins end in reaching a temperature of up to 70°C (ref. to Sykowski). But in fact, the meat raw materials, where proteins are not to be found in pure state, that dependence can be expressed in the same way.

In determining the technological scheme for the production of fish sausages, we have been directed by the main condition that the heating time for products, containing a considerably small amount of conjunctive tissue, namely fish sausages, evidently should be equal to the time, that is necessary to carry out insoluble proteins denaturation, for which purpose the temperature inside the product should reach 70-72°C. That is why, we adopted a similar processing of the experimented fish sausages.

But the degree of the thermal denaturing influence on the proteins depends on a number of conditions. For example, animal proteins show a maximum stability towards denaturation in physiological meaning of pH. According to Hamm (6), proteins are most instable at pH values, near to their isoelectric point. Besides that, some other constituents in fish farce can have an influence, for example: the increased content of copper ions (Cu) is one of the reasons for proteins denaturation increase (7).

Our investigations have shown that the pH values are not changed in a high extent in practice, but as a result of the thermal processing, for example, pH of the ready product, are close to their native value. As regards the changes in protein status, it should be mentioned that they are expressed in decreasing the amount of the total water-soluble nitrogen, of non-protein nitrogen, and respectively of sarcoplasmatic and myofibrillic proteins. The quantity of insoluble nitrogen increases (max 13,75 % for one of the variants) (Table 2).

From the data obtained it is clear, that the degree of stable changes in the separate nitrogen fractions is different depending on the scheme enclosed for the production of the experimental batches of fish sausages. This is easy to explain because in practice, the heat exchange from the surface to the inside of sausages in a certain degree should have been dependent on the type of the packing, the sausage diameter, from the structure of the sausage mass, as well as from the time/temperature mode of the processing. It is evident that the higher temperature of roasting and the greater duration of cooking, applied to variant II lead to a greater protein solubility loss, and first of all, of myofibrillic ones (24,77 %).

It should be noticed that in the other two variants the loss in that protein group is also greater than that in sarcoplasmatic proteins. The pore structure of the sausage from variant II determines one more dynamic change of water state inside the product, in its consecutive roasting and cooking, and from that, that probably leads to differences in protein solubility change.

We have been recording also the differences in the separate nitrogen fractions changes, depending on the degree of mincing the fatty tissue and formation of a stable emulsion from the water and the fats. So, in variant III (non-structured sausage, of the type of the wiener wursts), there is an increase of insoluble nitrogen (13,75 %), which is many times greater than that increase in the remaining variants. Here, also, we have proved, that the influence of the factor thermal processing is statistically meaningful.

The sensory evaluation of the ready sausage shows that a product, possessing the characteristic indices of a meat cooked sausage has been produced: having a monolithic structure, a high elasticity, and without sign of extraction of fats and water.

When making an analysis of all indices we can make a general conclusion as regards the experience of applying the selected time/temperature modes, as well as the other parameters of the technological scheme for the production of cooked sausages, in the composition of which there is max 60 % meat of the freshwater fish *Hypophthalmichthys molitrix*.

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