Change in paunch tissue microstructure during the protein product manufacture.

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INTRODUCTION

Collagen is the perspective biopolymer for manufacture of collagen-based protein productts which are used in the meat technology. It is explained by the unique structure and properties of collagen. The main obstale in the use of collagen as proein product is its unsoiubility and its raw maerial rigidity, that connected with the intermolecular bonds of various origin.

The development of collagen chemistry makes possible the selective disruption of cross bonds, which leads to loosening the three dimensional structure of molecule [1].

The method of treatment of collagencontained raw material, namely, catte paunch, was developed and pattented in MSUAB. The use of paunch in sausage and canned foods industry occount for only 50 percent from the total output of manufacture of this valualle raw material. That decrease the efficiency of manufacture of high quality protein foods [2].

The method developed provides for the consecutive action on the paunch of the alkali-salt solutions of salt and acid, which are authorized in the food indusry. The alkali -salt modification allows for the loosening the paunch structure and leads to the increase the water in it (water dipoles connect with the free peptide bonds). As a result, the fibrous structures of the paunch protein product (PPP) are hidrated by water, the disttance between structures is increased, and product consistency is improved. That reflects in the improvement of functional and technological properties of PPP, and in the approximation of their values to the analogous for beef.

In connection with the complex morphology of paunch we studied the chandes of itts tissue structures during the treatment.

MATERIALS AND METHODS

In deciding on the subject of histological studies we are governed by the fact, that the highest amount of connective tissues is present in the mucous membrane. Since the changes of collegen fibres in this membrane are studied.

The histological studies were carried ou on the scanning electrone microscope ISM-35CF (Jeol) at magnification of 600.

The preparation of the samples was carried out according to the procedure defined as the modifications of methods described in [3,4]. The procedure involves: the sampling, the fixation of samples with 20% neutral solution of formaldehide, the preparation of samples to dehydratation and dehydratation with alcohol of increasing concentraion (50-100%), and mixture of alcohol and acetone and 100% acetone. At the final stage the subject was supplied by conductivity, for this aim the sample was sticked by Adcontained glue on the metal table, then vacunmed and then the aurum was sprayed on the surface of the sample.

RESULTS AND DISCUSSION

The three sets of experiments were carried out that allows for studying the changes of paunch during its technological treatment. The microstructures of native paunch (Fig 1), paunch protein product (Fig 2) and paunch protein product after heat treatment (Fig 3) were presented on the photographies.

At the figyre 1 one can see that the internal surface of the paunch wall is formed by the flat fibres. In these fibres and mucous and undermucous layers the large amount of fibrous elements was revealed. hese fibrous elements were presented by the collagen fibres of different thick, that one can see at figure 1. These fibres were assembed in tight bundles crossing in the various directions and forming the complex three dimensional het. The separate collagen fibrilles are in the fibres and bundles. The cell elements are rare in occurence between the bundles. The alkali-salt treatment leads to the significant increase of PPP thick. This thickness appears at a sacrifice in swelling the collagen fibres of membrane and under membrane base. The total structure form of layer after treament is losser. (Fig.2) The bundies of collagen fibres become thinner as a result of cleavage of thick bundles of native paunch into several thin ones. Simultaneously the hydrolytic action provides for swelling collagen fibrilles. That appears as some homogenization of fibrillar structure and collagen bundles formed from them.

The PPP microstructure after the heat treatment (70 ±2° C, 60 min) also changes, namely, the thick of wall is increased. The fibres on the mucous layer are swell, and fibrous base under mucous becomes more homogenous and is formed of uniform net of collagen fibres. The distances between the elements of collagen fibrilles are decreased, and bundies of fibres become thinner at a sacrifice in longitudinal cleavage. The separate fibrilles lose their contours. Simultaneously with the longitudinal cleavage of the thick bundles of collagen fibres their fragmentation takes place and, accordingly, their shortening. As a result of their proceses the state of fibrous layer becomes net-granular. The separate small pores are revealed in the under mucous layer.

The occurence of pores in the PPP structure after heat treatment can be explained as follows. Under the heat treatment the structure of PPP as net frame from collagen and muscle fibres is formed. The free water and water connected with the products of thermochemical hydrolysis of collagen fibrilles are present inside the frame. The ratio between these forms of water is the sudject of the further investigations. After the heating and air cooling the gelling of liguid structures inside the frame occur. At the preparation of samples their dehydratation was carried

out. As a result of samples their dehydratation the free and bond water were removed from these gel-like structure that leads to the forming hollowness and swell fibrous frame (Fig.3).

The microphotographies presented allows for reconstituting the changes of collagen fibres under alkali-salt and further heat treatments.

At the treatment by stages of the paunch and PPP the progressive inorease in the destructive changes of fibrous elements of paunch connective tissues is observed.

These changes in the highest extent are consist of the net of bundies of collagen fibres at the first stage. In the PPP the definite fibrous collagen structure is lost. At first, the separate fibrilles are swell, and large bundle are break down and fragmented. After the heat treatment of PPP the collagen-contained layer has the number of pores and fragmentation of fibroys elements to the formation of granular structure.

CONCLUSTON

On the base of the results obtained we concluded that alkali-salt treatment allowing for swelling the structure of the raw material leads to the formation of gel-like structures in the product. The functional, technological and biological properties of meat foods in which the PPP is included are imroved. This conclusion was suggested by the studies of mobel cooked sausages contained 15 percent of PPP instead of meat. The mobel saysage has imroved consistenoy, larger output in comparison with the standart and imroved digestability at the correspondence of the amount of irreplaceble aminoacids in sausage to the requirements of WHO (1985).

REFERENCES

1. Mikhailov A.N. Chemistry and physics of the collagen of skin cover. - Moscow, Light Industry, 1980, 232.
2. Titov E.I., Apraksina S.K., ets. "The method of manufacture of protein preparations of subproducts of 2nd grage". Patent N 95120978/13 (036698); 13.12.95.
3. Volkova O.V., Yeletski Y.K., Fundamentals of histology and histological technique. Moscow, Medicine, 1982.
4. Method of scanning electron microscopy in the pathological morphology of animals: methodological reccomendations, Novosibirsk, Siberian Branch of Russian Academy of Agricultural Sciences, 1986.

Figure 1.

Microstructure of the native paunch

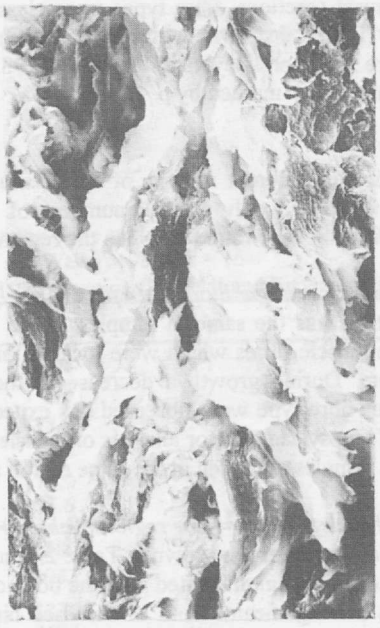

Figure 2.

Microstructure of the paunch (PPP)

Figure 3.

Microstructure of the protein product (PPP) after heat treatment