CHANGES IN MICROSTRUCTURE OF LOW-GRADE MEAT RAW MATERIALS UNDER THE INFLUENCE OF COLLAGENOLYTIC ENZYMIC PREPARATION, BEING ACTIVE AT LOW POSITIVE TEMPERATURES

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Introduction

The improvement of meat consistency and specific properties acquired during various technological processes largely depend upon the activity of its own enzymes. Taking into account that the concentration of enzymes in muscles is insignificant, much attention during last decades was given to the incorporation into meat of enzymic preparations with different effects on structure of muscular tissue (1,2) of the meat. Enzymic preparations splitting collagen are of special importance, because they are found in large amounts in the meat raw materials and considerably reduce functional-technological and consumer properties of the obtained meat products.

At the present time for meat tenderization, proteolytic enzymes of plant, animal and microbial origin are used. In this case optimum activities of the majority of used enzymic preparations lay within the range of 37-60□C (1). Taking into account that the main technological processes (aging, curing) take place at low positive temperatures (2-4□ C), the effect of the used enzymic preparations under these conditions will be minimum.

There arose a necessity of development of the enzymic preparation having collagenolytic activity with optimum activity at low positive temperatures. After studying 123 museum cultures and 204 strains isolated from meat and meat products a strain was selected which allowed to obtain a proteolytic collagenase with pronounced effect on substrate at temperature 4-10□C (3).

The objective of the work

Study of changes in microstructure taking place in low grade meat raw materials with large amount of collagen under the influence of collageolytic enzymic preparation in curing during 72 hours and temperature 4□ C.

Methods of investigations

The refrigerated meat (as a coarsely cut meat or subjected to multi-needle injecting) was cured with the addition to a curing brine (15-20% from the weight of the raw materials) of 25 conventional units of collagenolytic enzymic preparation per I kg of meat. The same raw materials without collagenolytic preparation were used as a control. The changes in microstructure of meat raw materials were investigated with the help of scanning electron microscopy. Concurrently water-binding capacity of meat and cooking property of collagen was studied according to generally accepted methods.

Results of the investigations

In the refrigerated meat the muscle fibers are straight or slightly coiled with well pronounced cross striation. The nuclei of fibers have oval or rod-like form with grainy-lumpy structure of chromatin. Separate muscle fibers had a disturbed cross integrity that could be seen from the presence of microcracks or small slot-like spaces, that is the consequence of development of destructive autolytic processes in the meat.

Connective tissue interlayers looked like coiled strands with tightly packed collagen fibrils (Fig. 1).

At 48 hours after treatment of the coarsely cut meat or muscle tissue with the brine with collagenolytic enzymic preparation the muscle fibers became swollen, the cross and longitudinal striation became slightly expressed, there was a shrinkage of nuclei, destruction and disruption of integrity of the sarcolemma. A decomposition of separate parts of muscle fibers into homogenous fine-grained mass took place.

The most deep changes were marked in a collagen substance of the meat. They were characterized with sharp swelling and loosening of collagen fibers due to destruction of proteoglycans associated with collagen fibrils. Tight connective tissue strands have been transformed into interrelated net loose structure, somewhere fragmentation of collagen fibrils was revealed (Fig.2). The integrity of structures of the walls of fat cells was somewhere disrupted.

As the time of meat holding rose to 72 hours, the changes in the structure of the muscle and especially connective tissue increased, they became widely spread, swelling and fragmentation of collagen structures increased which resulted in their more pronounced cross striation (Fig. 3). Destruction of connective tissue base of the fat cells of the muscular tissue was increased (Fig.4).

In control samples of the comminuted meat the structure of fibers in muscle bundles was characterized with well-defined wide cross striation, the nuclei of the fibers have a stretched shape. Destructive changes of fibers were revealed as separate microcracks. Connective tissue was characterized with well defined structure of the arranged in good order parallel to each other collagen fibers forming dense thick bundles.

A correlation between microstructural and physico-chemical characteristics of the meat treated with enzymic preparation was established.

Moisture-binding capacity of the meat raw materials, subjected to fermentation, increased by 18-20% after 72 yours, while in the control samples it was increased only by 10%. Cooking capacity of collagen increased up to 60% and 25%, respectively.

Discussion of obtained results and conclusions

After analysis of the obtained results it became evident that the increase in moisture-binding capacity of low-grade meat and the cooking property of its collagen were the result of deep destructive changes in its structure, primarily in the connective tissue collagen interlayers. This suggests about high activity of the developed collagenolytic preparation at 4□C, that allows to improve quality of low-grade meat raw materials, combining its fermentation with curing without the increase of the time of the whole technological process.

References

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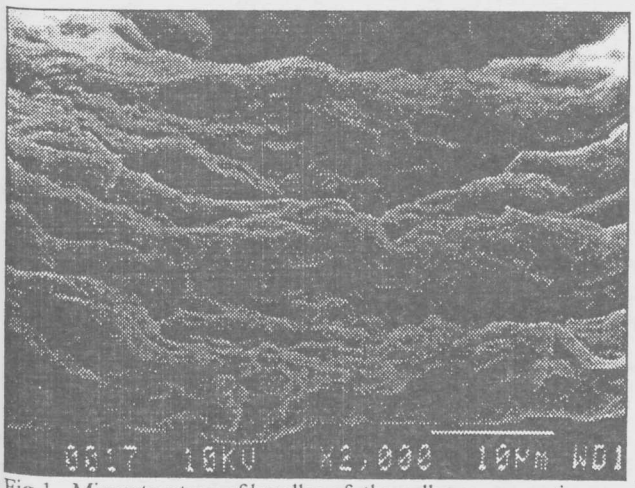

Fig.1. Microstructure of bundles of the collagen connective tissue of refrigerated meat.

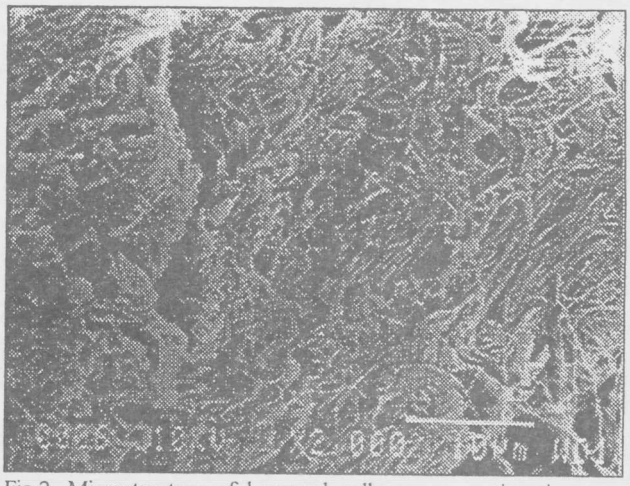

Fig.2. Microstructure of loosened collagen connective tissue after 48 hours of keeping in brine with collagenolytic preparation

Fig. 3. Microstructure of loosened swollen and fragmented connective tissue after keeping during 72 hours in brine with collagenolytic preparation

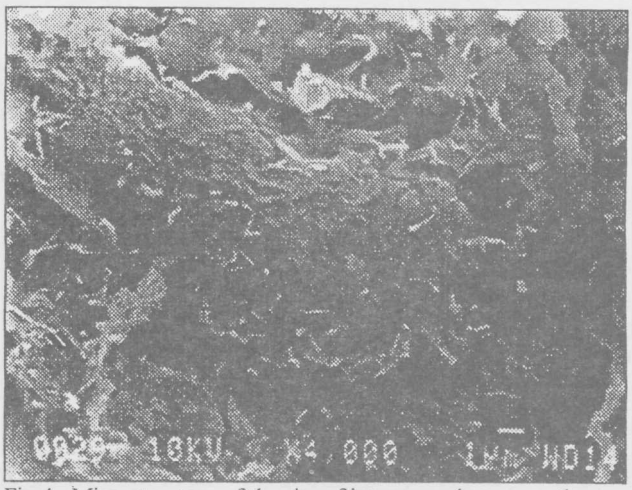

Fig.4. Microstructure of the site of intermuscular connective tissue with destroyed fat cells