INVESTIGATIONS OF STUCTURAL AND FUNCTIONAL CHANGES OF MEAT SYSTEMS AS TREATED WITH THE ENZYMIC PREPARATION PANCREATIN

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INTRODUCTION

The main tasks of the meat industry at the present time are the intensification of technological processes, rational use of raw materials, qua improvement of the end products. Modern biotechnological achievements, use of enzymic preparations for treatment of meat, especially w high content of connective tissue, will help to solve this problem.

In recent yaers use of enzymic preparations has increased all over the world, particularly in Great Britain, Germany, Denmark, the Netherla etc. They are used mainly to increase the tenderness of the meat and to break coarse, connective tissue ingredients, which decrease the qua of the finished product (Endaszewski T., Lesiow T., 1990). Various proteolytic enzymes of animal, vegetable or microbial origin, such papin, bromelin, pepsin, trypsin, pancreatin, protosubtilin, protofradin, etc are used for this purpose (Ratushny A.S., Renneberg R., 19 Khlebnikov V.I. et al, 1983). Nevertheless, the experience of using hydrolitic enzymes in our country has shown that not all the enzymes u for treatment of meat are effective. Some of them have a weak effect on fibrillar proteins of connective tissue, intensively hydrolyz proteins of muscular fibers; and the character of enzymic effect depends also upon the conditions of reaction, i.e. pH, temperature, availabi of activators and inhibitors, etc. The quality of the product being obtained can also be improved with additional outside effect - massaging electrical massaging (Kudryashov L.S., 1989). However, the available information is not sufficient and doesn't allow to predict the nature degree of the effect of enzymic preparations on finished products.

MATERIALS AND METHODS

In connection with the above-mentioned the objective of the present study was the investigation of the effect of pancreatin on meat syste with the aim of development of new generation of meat products. The object of investigations was beef of second grade, semitendino muscle and its muscular and connective tissue. Initial raw materials, the raw materials after mechanical processing and curing and the c products manufactured under different technological conditions were studied. The content of the enzymic preparation in model systems w 0.1%, 0.2% and 0.3%. The parameters studied were: pH, mass fraction of moisture, mass fraction of protein, fat, water-binding capacity degree of penetration, content of oxyprolin and free amino acids, proteolytic activity of the cathepsins of muscular tissue and weight losses structural changes of proteins of muscular and connective tissue, their microstructural characteristics, as well as organoleptical evaluations ready products. Pancreatin was obtained by extracting from pancreas of slaughter animals.

RESULTS AND DISCUSSION

During investigations it was found that optimum results with regards to the most parameters are obtained in case of 0.2% concentration pancreatin. The amount of free amino acids in model systems during curing increased 1.5 fold, mostly at the expense of arginine, glutam acid, leucine tyrosine, lysine and histidin. Simultaneously a decrease in the content of free aspartic acid was observed. In samples as treate with the enzymic preparation a shift of active acidity to the alkaline side was observed, probably, due to change of ionic content and ratio active groups in protein links.

Loosening of proteins structure and increase in the quantity of bound water also facilitates indentor penetration in model systems wi pancreatin.

Dynamics of weight losses changes during heating was studied by thermogravimetric method, and it was found that the increase in the ra and amount of weight losses was at the same temperatures, at which coagulation of proteins occured. Adding the enzyme shifts this process lower temperatures and decreases weight losses by 49% as compared to the control.

The investigations have shown that proteolytic activity of the cathepsins depended upon pH of buffer medium, the concentration of pancreat in model system, temperatures at which the model systems were maintained and on the temperature of technological treatment of the produc A certain residual activity of own cathepsins was maintained in the ready product.

The data of histological analysis have shown that curing of meat model systems with pancreatin added leads to changes in the structure both muscular and connective tissue. The degree of these changes is directly dependent upon the concentration of the used preparatio Muscular tissue undergoes greater changes. With pancreatin concentrations of 0.1% only cellular components of the system were affected while the fiber components of connective tissue were unchanged. With the increase of the content of pancreatin in the system destructiv processes in the fibers of connective tissue were also observed. After heat treatment, swelling and destructive changes in muscular tissue an in connective tissue fiber components increase, and in the system with 0,3% enzymes they were rather pronounced while in the system wit 0.1% - were too moderate. When studying the influence of enzymic preparation on thermodynamical properties of muscular and connectiv tissue, the increase in the enthalpy of transition with the increase of pancreatin concentration was observed, which probably was associate with the fact that enzymic dissipation of collagen structures covers both tough and reversibly melting structures of meat, increasing th number of irreversibly melting structures. A study of the spectrum of the fluorescence of the connective tissue during curing with differen pancreatin concentration has shown that up to 55^{0}C a usual temperature putting out of the fluorescence occured which changed sharply wit greater heating. Adding pancreatin reduces the temperature of transition and increases its cooperative action. With the increase of preparation concentration, the range of temperature transition increases. Thus, the comparison of microcalorimetric and fluorescence data for the initia

raw materials with the experimental samples shows, that adding pancreatin to the systems leads to significant changes in their parameters. With the addition of pancreatin both the cooperative character of transition of connective tissue, and the temperature of denaturation decreased. As far as the muscular tissue is concerned, the addition of enzymic preparation leads to the increase of the enthalpy of the transition and decrease of the temperature of denaturation (Fig. 1).

The sensory evaluation of finished pasteurized canned meat produced the lowest score for the product with 0.1% pancreatin (due to coarse connective tissue inclusions), medium- with 0.3% (due to excessive weakening of the muscular tissue) and the highest - for the product with 0.2% enzymic preparation added. The texture, tenderness, appearance and aroma of the pasteurized canned meats were the best with the use of pancreatin at 0.2%.

CONCLUSIONS

Based on the complex investigations one can come to the following conclusion: organoleptical characteristics of the end products, as well as all the studied structural and mechanical, chemical and histological characteristics suggest, that fermentation of beef by pancreatin contributes to improving its physico-chemical and consumer properties. The optimum amount of the added preparation is 0.2%.

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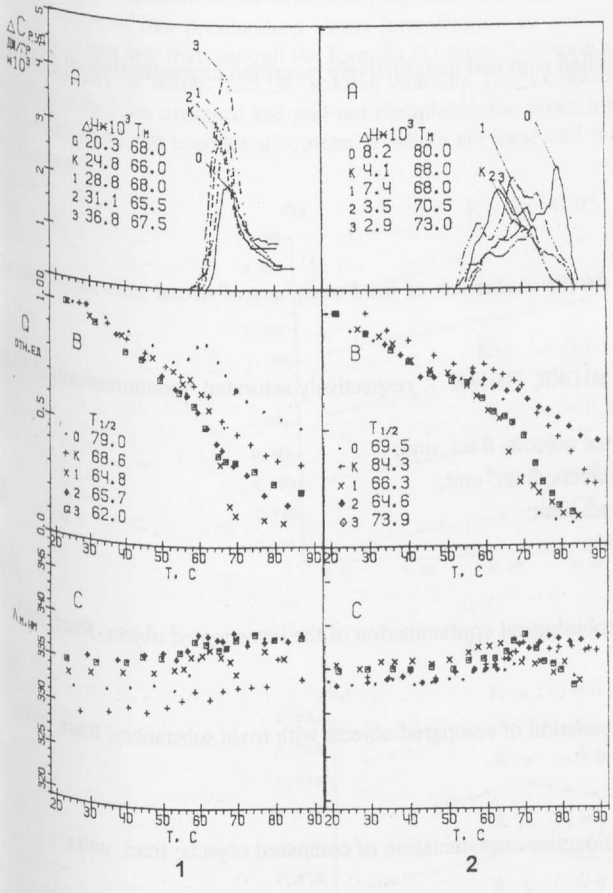

Fig.1. Influence of pancreatin concentration on temperature dependences of excessive heat absorption and parametrs of tryptophanyl fluorescence of connective (1) and muscular (2) tissue of meat after curing.

A. Temperature dependence of the excessive specific heat absorption - C_p.
Solid line - 0 - heat absorption of the initial sample, dotted line - K - experiment control - curing, dotted line 2 - 0.2% pancreatin, dotted line 3 - 0,3% pancreatin, H - specific value of denaturation enthalpy, mJ/mg. T_m - temperature of the maximum of transition, ^{0}C.

B. Temperature dependence of the relative value of quantum yield ( ) - areas under spectrum. 0 - initial sample, K - control, 1 - version 1, 2 - version 2, 3 - version 3. $T_{1/2}$ - temperature of the middle of the transition over the quantum yield, ^{0}C.

C. Temperature dependence of the spectrum maximum position. 0 - initial s ample, K - control, I - version 1, 2 - version 2, 3 - version 3. Excitation 280 nm.