EFFECTS OF AUTOLYSIS AND TECHNOLOGICAL PROCESSES ON THE CHANGES IN SALT SOLUBLE PROTEIN IN PORCINE

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Background

One of the most important criteria for consumer acceptability of meat is tenderness. The major factor affecting meat tenderness is ageing. Proteolytic degradation, which occurs early post-mortem as part of the ageing process, results in the production of protein fragments. They are therefore potentially useful in the prediction of meat and meats products quality characteristics. (Bailey, 1982; Casserly et al, 1998; Negishi et al, 1996).

Gelation of salt-soluble proteins (SSP) during thermal processing is mainly responsible for fat and water stabilization in processed meat products (Smyth at al, 1998; McCord at al, 1998).

The analysis of the data published during the past 10 years showed, that the bigger part of the protein qualitative and quantitive analysis performed was carried out using healthy and conditionally healthy raw materials. There is comparatively little data on influence of environment factors – temperature, pathogenic micro flora, inhibitors on qualitative changes of raw materials.

The animal disease is recorded according to the clinical symptoms. If the symptoms of the disease are not vivid and if the disease is in the incubation period the diagnosis is made by carrying out serological tests. Porcine reproductive respiratory syndrome (PRRS) is a viral disease of pigs. The causal agent of the disease, PRRS virus, is believed to be transmitted by aerosols or by contact. The pig herds of more than 60% of Lithuanian pig - breeding companies have circulating virus. People do not suffer from this disease, but the influence of the virus, circulating in the organisms of pigs, on the meat quality is not known.

It is known, that after occurrence of infection in the organism the changes in the protein system appear, the quantity of albumins decreases, and the quantity of globulins (salt soluble myofibrillar protein) increases. That is why it is important to identify biological value of pork meat, which gave positive serological reaction to PRRSV, to suggest technological regimes (identify the critical cooking temperature) for the meat processing.

Objective

The aim of the present study was conducted to determine the positive reaction to porcine reproductive respiratory syndrome virus (PRRSV) meat muscles' myofibrillar and sarcoplasmic salt soluble proteins (SSP) and evaluate the effects of autolysis and technological processes on changes in the salt soluble proteins of hot smoked loin.

Methods

For this purpose pork loin chops from 5 carcasses with positive reactions to PRRSV were used. The samples of the meat were subjected to maturation at 0 – 4°C for 1, 3 and 5 days. Upon injecting of brine the samples were subjected to mechanical tendering and hot smoking. SSP were extracted from *Longissimus dorsi* muscle following the procedure of Wang et al (1990). The proteins were identified by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS – PAGE) using acrylamide concentrations of 4 % for stacking and 12 % for resolving gels (Laemmli, 1970). The molecular weights of these proteins were estimated from relative mobilities compared to standard molecular weight markers (Biolabs, Inc, England) under identical electrophoretic conditions.

Results and discussion

Changes in the proteins of PRRSV positive pigs during autolysis are shown in Fig. 1, A and Fig. 1, B, on electrophoretograms lanes 1 to 16. The samples of the meat were subjected to maturation at 0 – 4°C for 1, 3 and 5 days. Fragments of the proteins were determined on the 1st day (5 – 8 lanes); on the 3rd day (9 – 12 lanes); and on the 5th day (13 – 16 lanes). It was observed that the protein with the higher molecular weight migrated close to standard rabbit myosin heavy chain (MW, 212 kDa), and was identified as porcine myosin heavy chain. The protein with the lower molecular weight (MW, 45 kDa) was identified as actin.

Results indicate that during the first day of autolysis the intensity of myosin and actin bands were not as high as on the third day of autolysis. In the post - mortem stage the increased concentration of Ca^{2+} ions was found to cause ATP – ase myosin activity. Troponin and tropomyosin blocked actions are inactivated. ATP division energy stimulates actin and myosin reciprocity.

The process of proteolysis starts in the muscles, when organic acids are being accumulated, and the capacity of proteolytic enzymes increases. Step by step the complex of actomyosin hydrolysis goes on and on the third day the quantities of myosin and actin increase up to 75 percentage in comparison to the first autolysis day.

Actin and myosin quantities decreased 70 percentage on the fifth autolysis day in comparison to the third autolysis day, i.e. the intensities of myosin and actin bands remind fixed bands of these proteins during the first autolysis day. It has relation with the proteolytic process, due to which other smaller molecular weight units (MW, 97 – 55; 40 – 25 kDa) are formed from actin and myosin proteins.

This salt soluble protein change character corresponds to the normal meat autolytic changes of proteins.

Samples of standard molecular weight allowed to identify more protein fractions e.g. as phosphorylase b (MW, 97,184 kDa) MBP - β -galactosidase (MW, 42,7 kDa), lactate dehydrogenase M (MW, 36,49 kDa), troponin (MW, 21 kDa) the biggest quantity of which is being found on the third autolysis day.

Albumin fractions (as compared with internal standard of bovine serum albumin MW, 66 kDa) are not defined in these fresh meat samples. We could presume, that porcine, with positive reaction to PRRSV increases globulines and decreases albumins.

Comparing SSP investigation data of fresh and thermal processed meat we see the significant quantity decrease of all protein fragments in hot smoked meat (Fig. 1, A; lanes 1 – 4). During electrophoretic separation protein bands were more intensive in hot smoked products, which molecular weight is 45 – 30 kDa.

The temperature of 72 °C was achieved inside the product during thermal processing. As a result of that fraction of proteins (MW, 210 –66,4 kDa) significantly decreased. Fig. 1, A electrophoretic profiles show, that low molecular weight proteins (MW, 14 – 25 kDa) are the least thermostable. The most stable fractions of proteins are those having molecular weight 45 – 30 kDa.

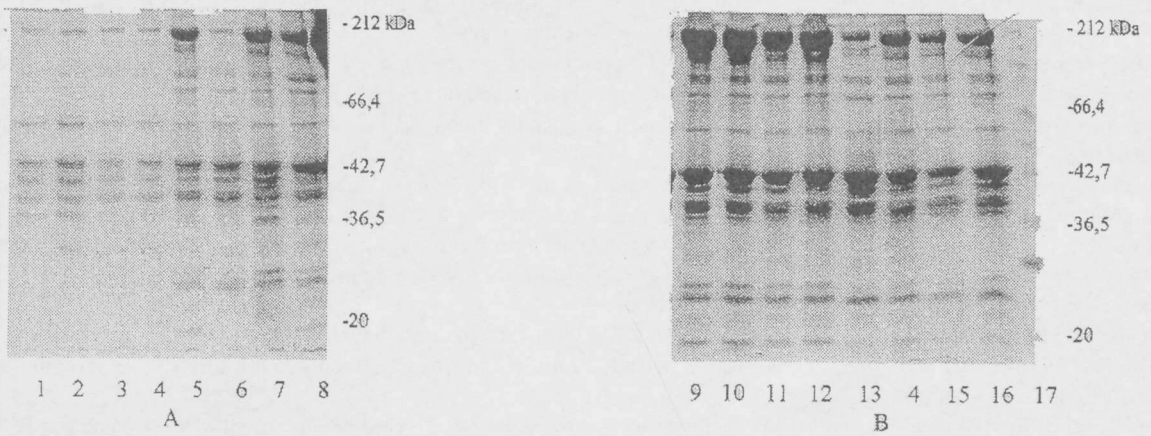

Fig.1

A– Electrophoretogram of heated (lanes 1 – 4) and unheated proteins (lanes 5 – 16); B - Electrophoretogram of unheated proteins (lanes 9 – 16); protein molecular weight standards (lane 17).

Conclusions

The most evident differences between the raw meat protein fraction (212 kDa, 45 kDa) concentrations were observed on the third day of ageing time.

Salt soluble protein change character in meat with positive reaction to PRRSV corresponds to the normal meat autolytic changes of proteins.

Albumin fractions (as compared with internal standard of bovine serum albumin MW, 66 kDa) are not defined in fresh meat samples. We could presume, that porcine reproductive respiratory syndrome alters albumin fractions changes.

Results suggest that due to the effect of thermal processing the quantities of the salt soluble proteins were significantly decreased. This protein change character in processed meat with positive reaction to PRRSV corresponds to the normal meat changes of proteins during thermal processes.

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