ELECTROSTIMULATION OF MEAT OF DIFFERENT PATTERNS OF AUTOLYSIS

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Literature on electrostimulation effects on the proteolytic activity in muscles is limited and contradictory. The authors studies the influence of ES on the catheptic activity (as exemplified with cathepsin D) in beef muscles of different autolysis patterns. Normal (NOR), DFD and PSE l. dorsi muscles dissected from carcasses within 3.6 x 10^3s post slaughter were tested. The left muscles were electrostimulated, the right ones served as controls. Samples were packed and stored at 277 K for 72 h. The free activity was recorded before ES and after 0, 24, 48, 72 h. The results indicate that ES of the NOR meat causes initially and increased (3-fold) activity, it remaining twice as high and 1.5 times as high as compared to controls after 24 and 48 h storage, respectively. At 72 h the enzymic activity decreases, while it reaches the peak value in the control samples. Similar relationships are derived for DFD and PSE meat, though the proteolysis extent in such meat is much lower. With account for the fact that DFD meat constitutes a high percentage in the total beef production volume, one should selectively decide on meat electrostimulation.

The catheptic activity (as exemplified with cathepsin D) in the extracts of normal (NOR), DFD and PSE beef muscles after electrical stimulation (ES) and in the course of autolysis (2, 24, 48, 72 h) was evaluated quantitatively. The results indicate that ES of the NOR meat causes initially a 3-fold increase of the activity; it remains twice as high and 1.5 times as high as compared to controls after 24 and 48 h, respectively. At 72 h the enzymic activity decreases while it reaches the peak value in controls by the same period. Similar relationships are derived for DFD and PSE meat, though the extent of proteolysis in this meat is much lower. DFD meat constitutes a high percentage in the total beef production, therefore one should selectively decide on meat stimulation.

INTRODUCTION

Certain effects upon the muscle tissue of animals during or after slaughter can retard or accelerate enzymes released from lososomes and thus influence the intensity of autolytic processes. The results of determinations of the total, free and lisosome-bound activity of cathepsin C and ß-glucuronidase (Melo et al. 1974; Dutson et al. 1980) showed that ES contributed to a faster release of enzymes from their limiting structures to cytoplasm. A comparison of the histochemical determination of acid phosphates activity and the assay of the free activity of cathepsin D in beef muscles with the normal autolysis (NOR) after ES (Gorshkova et al. 1986) evidence activation of lisosomal proteases. At the same time Wu et al. (1985) found no effect of ES on the lysosomal enzymic activity. Dutson et al. (1982) and Fjelkner-Modig and Ruderus (1983) recorded no significant advantages of ES-treated DFD meat (muscle colour, ultimate pH, strength and sensory qualities) as compared to non-ES meat. There was no data on the influence of meat ES in case of different patterns of autolysis (NOR, DFD, PSE) upon the activity of tissue proteases. The reported here experiments were performed to elucidate the expediency of electrical stimulation of DFD meat.

EXPERIMENTAL METHODS

As test objects served NOR, DFD and PSE l. dorsi muscles dissected from beef sides within 2.7 x 10^3s. The right muscles were control The left (test) muscles were stimulated (220 V, 1 Hz, pulse duration 0.4 s, pulse period-to-pulse duration ratio 0.6 s the total ES time 3 x 10^2s). Samples were packed and stored at 277 K for 73 h. The free activity of cathepsin D was determined in control and test samples in the course of autolysis at 2, 24, 48 and 7[illegible]. The lisosomal fraction was isolated from muscle according to Stagni and De Bernard (1968). The free activity of cathepsin D was found according to Caldwell and Grosjean (1971) with some modifications. Protein concentration in the headspace liquid was measured according to a modified method by Whitaker and Granum (1980).

RESULTS

The Figure illustrates that the activity of cathepsins in stimulated NOR meat increased by 3-fold as compared to non-stimulated samples. During autolysis the activity of tissue proteases continues to grow and becomes twice and 1.5 times as high 24 and 48 h later (respectively) as compared to control samples. A similar relation was observed in case of ES and DFD and PSE meat, though changes in the enzymic activity here are less pronounced. Thus, after stimulation of PSE meat the catheptic activity grew by 1.5 times and of DFD meat by about 1.3 times. 24 h post slaughter the catheptic activity in stimulated PSE meat remains 1.3 times higher as compared to controls, whereas in case of DFD meat it is practically similar both in test and control samples.

From the Figure it is also clear that 24 h post slaughter the catheptic activity in stimulated PSE and DFD meat starts to decrease. For control PSE and DFD samples activity reduction becomes noticeable 48 h post slaughter.

DISCUSSION

The problem of ES influence upon changes in meat has long been discussed. There are however very few publications (Dutson et al. 1982; Fjelkner-Modig and Ruderus. 1983) which deal with the problem from the viewpoint of variations in pHs of the meat supplied. It is known that DFD meat constitute a high percentage in beef production (Tatulov, 1984; Warriss, 1984). Our results demonstrated that ES has an effect on the catheptic activity of meat with different patterns of autolysis. After stimulation of NOR meat its level is however much higher than in PSE and DFD meat. Such a difference in the results is due, first of all, to different initial levels of the enzymic proteolytic activity in hot NOR, DFD and PSE beef muscles prior to ES. Gorshkova et al. (1987) showed that a high level of tissue proteases in DFD and PSE meat results from the destabilisation of lisosomal membranes and from a higher release of enzymes from lisosomes. Therefore, electrical treatment of such muscle tissue had no significant effect on the muscle tissue as was observed in NOR beef. Of great importance is, obviously, the course of glycolytic processes, which is known to differ considerably in NOR, DFD and PSE meat. Thus, Pezacki (1980) thinks disturbances in the processes of glycogenoly-

sis in animals as a result of stress causes changes in metabolic dynamic equilibrium, it, in its turn, influencing the activity of tissue enzymes during meat autolysis. This may be the reason of the fast reduction in the activity of enzymes both in stimulated and non-stimulated DFD and PSE meat.

CONCLUSIONS

The data obtained allow to believe that different effects of ES upon NOR, DFD and PSE meat requires a selective approach to deciding on the necessity and expediency of raw meat electrical stimulation.

REFERENCES

Caldwell, K.A. and Grosjean, O.L. (1971). J.Agric.Food Chem. **kl19**:108.

Dutson, T.R., Smith, G.C. and Carpenter, Z.L. (1980). J.Food Sci. **45**:1097.

Dutson, T.R., Savell, J.W. and Smith, G.C. (1982). Meat Sci. **6**:159.

Fjelkner-Modig S. and Ruderus H. (1983). Meat Sci. **8**:185.

Gorshkova L.V., Buslayeva T.P., Bolshakov A.S., Kudryashov L.S. and Belousov A.A. (1986). Proceedings 32rd European Meeting of Meat Research Workers, p.22.

Gorshkova L.V., Kudryashov L.S., Bolshakova A.S., Buslayeva T.P. and Belousov A.A. (1987). Proceedings 33rd International Congress of Meat Science and Technology. p.38.

Melo T.S., Blumer T.N., Swaisgood H.E. and Monroe R.J. (1974). J. Food Sci. **39**:511.

Pezacki W. (1980). Fleischwirtschaft **60**:1284.

Stagni N. and De Barnard B. (1968). Biochim. Biophys. Acta **170**:129.

Tatulov Yu.V., Kuritsyn N.I., Nemtchinova I.P. and Mittelstein T.M. (1984). Review, p.14.

Warriss P.D. (1984). J. Sci. Food and Agric. **35**:863.

Whitaker J.R. and Granum P.E. (1980). Analytical Biochemistry **109**:156.

Wu F.Y., Dutson T.R., Valin C., Cross H.R. and Smith S.B. (1985). J. Food Sci. **50**:1025.

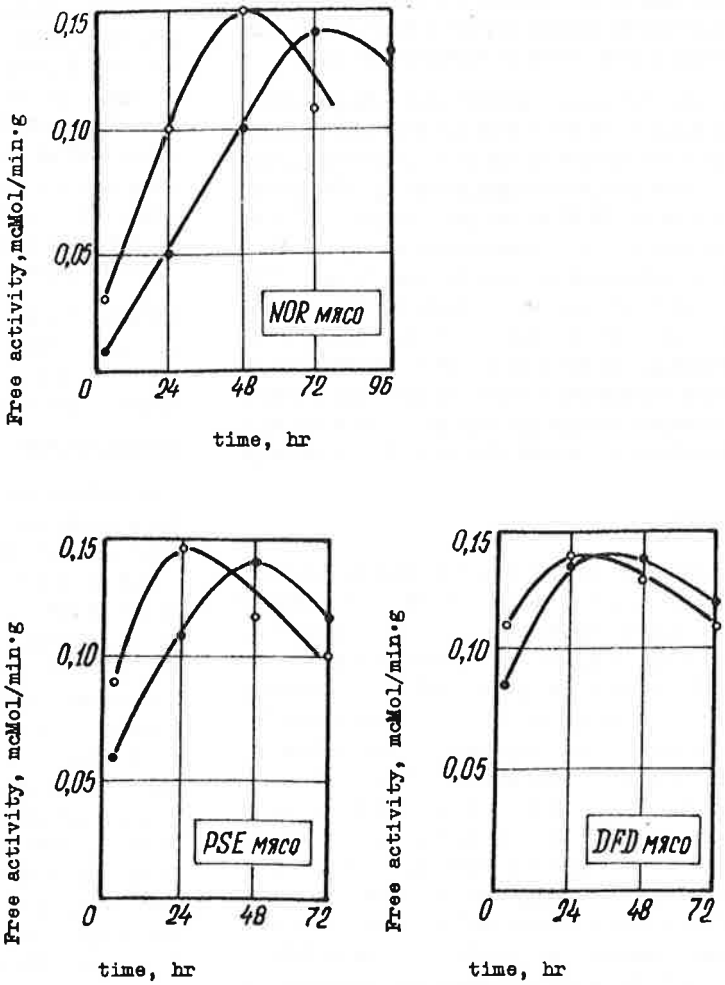

Fig. Changes in the free activity of Cathepsin D in stimulated (o) and non-stimualted (•) NOR, DFD and PSE beef in the course of autolysis