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INFLUENCE OF ELECTRICAL STIMULATION ON STRUCTURAL - MECHANICAL PROPERTIES OF BEEF

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INTRODUCTION

In recent years the electrical stimulation (ES) of cattle meat and sheep meat has aroused wide interest among specialists in the meat industry as a method of improving meat quality and its tenderness in particular. Although the mechanism of ES is still not entirely known, researchers are unanimous that it precipitates the pH drop and the advent of rigor mortis. At the same time ES prevents and reduces the risk of cold shortening which, after an intensive chilling and freezing, results in tough meat. The purpose of the present work is to study the effect of ES on some basic structural and mechanical properties such as elacticity, structural strength and plastic strength that characterize the texture of the resulting meat to the greatest extent.

MATERIALS AND METHODS

Twenty-four bull-calves, "Black-motley" breed, 20 months old, 400 to 480 kg live mass, were used for the experiment. They were of one and the same batch and had almost similar preslaughter condition. Half of the calves were set aside as a control group and the other half, immediately after the bleeding, was stimulated by monopolar square pulses of 40 ms duration, 14.3 Hz frequency and 90 V (peak), derived from an electrical stimulator, type ES-4, specially designed at the Higher Institute of Food Industry in Plovdiv. The stimulation time was 2 min. Two monopolar stainless steel electrodes, each 150 mm long and 6 mm in diameter were applied in the muscles at the achilles tendon of both legs. A third electrode (made also of stainless steel in the shape of a clamp) with positive polarity was applied in the animal's nostrils. The control and stimulated carcasses were treated according to the methods generally practised in our meat-producing factories. After the stimulation the right halves were chilled at an ambient temperature from minus 10 °C to minus 15 °C and at air velocity (2 + 3) m/s up to a temperature of + 6 °C (in depth). After that they were kept at an ambient temperature of 0 °C to 2 °C.

The structural and mechanical properties of m. Longissimus dorsi were studied by assessing the elasticity, structural strength and plastic strength at the end of the 1st, 6th, 12th, 24th, 48th and 72nd hour from the moment of ES. For that purpose the method of penetration and an automatic penetrometer, type OB-205 MIM, Hungarian made, were used.

RESULTS AND DISCUSSION

The results reflecting the changes in the structural and mechanical properties are shown in Fig.1 to Fig.3. It is obvious that after the 24th hour there are statistically significant differences between the structural and mechanical properties of the examined muscles obtained from stimulated and non-stimulated carcasses. Besides that, on the third day the control samples demonstrate clearly expressed tough texture that is characteristic of the initial stage of the rigor mortis process, while at the same time experimental samples have a well-defined tendency toward better structural and mechanical properties. By the end of the period they achieve the properties which non-stimulated meat reaches after 10-12 days being stored at the same temperature conditions.

The results obtained in this study coincide with some of the date presented by other authors. For instance, Zacharov et al. [1] have established that the tenderness of stimulated samples of m. Longissimus dorsi (LD) has dropped a little immediately after ES, and after that improved steadily during the whole period (240 h) of ripening. Simultaneously, the tenderness of the control samples deteriorated during the initial 30 h after ES and it was hardly after that that it started to grow up. The samples stimulated have been reached the ultimate tenderness of the controls 150 h earlier. Bendall's date [2] give evidence that a stimulated sample of m. LD had more tender texture after the first day in comparison with that of the control sample on the 14th day (the shear force was 6.1 kg and 6.7 kg, respectively).

Davey et al. 4 have found that ES reduces the time of occurrance of rigor mortis from 24 h to 5 h.

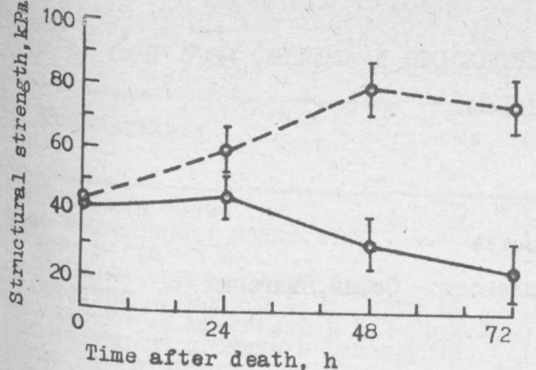

Fig.1

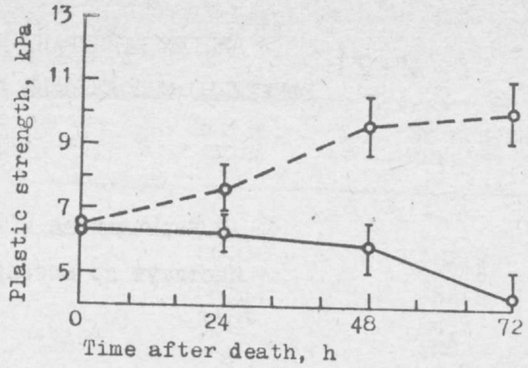

Fig.2

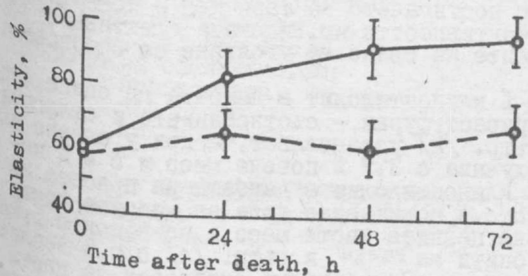

Fig.3

--- non-stimulated

Similar tendency for change of the tenderness of stimulated meat is supported by the studies of Bouton et al., George et al., Gilbert et al., Harsham et al. [3]; [5-8] and others.

CONCLUSION

The results obtained give reason to conclude that the regime of ES applied here improves the structural and mechanical properties of meat and can be successfully used for the purpose of better meat quality and energy saving.

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