Ultrastructural changes in pork from Camborough hybrids transported at short distances

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Pig transportation from breeding farms to the meat packing plant is accompanied by fatigue, fear, excitation, physiological stress, which are related to the physiological peculiarities of the pig characterized by a high sensitivity which is enhanced with the improvement and specialization of meat breeds.
Nerve and muscle strain and starvation during the animals' transportation and pre-slaughter rest influence meat pH values and beef and pork glycogen (Howard, 1966; Wismer-Pederson, 1959; Debrot, 1971).
Transportation accompanied by muscle strain and excitation in the boxes immediately before stunning the animals is followed by a low pH value 45 min. post mortem (Clark, 1973; Wismer-Pederson, 1959).
Baychev (1980) found a high sensitivity in Camborough pigs, and an incidence of pale soft exudative meat of 26%. According to Gakev's (1979) data, the share of pale soft exudative meat in the British hybrid, Camborough, constitutes 19,3% on the average.
The object of the present investigations is to study ultrastructural changes in the meat of Camborough pigs transported at short distances.

Material and Methods

The studies were carried out using 30 Camborough pigs equal in age and live weight. The animals were transported by trucks on summer mornings over distances of 5 or 6 km. Half of them (the experimental group) were sacrificed immediately after their arrival at the meat packing plant, and the rest (the control group), after 24 hours of pre-slaughter rest. Samples for electron microscopy studies were taken from M. longissimus dorsi 45 min. to 1 hour post mortem. After fixation in 5% glutaraldehyde for 2 hours and in 2% osmium tetroxide for 2 hours, dehydration in an ascending order of alcohols and passage through propylene oxide, the samples were embedded in Durcopan. Ultrathin sections prepared using an LKB III ultramicrotome, contrasted with uranyl acetate and lead nitrate, were observed using a Tesla BS-613 electron microscope at 80 kV.

Results and Discussion

The results of the electron microscopy analyses of muscles of a pH of 5,4-5,5 from animals, slaughtered immediately on arrival at the meat packing plant, are illustrated in Figures 1 and 2. A fragmentation of the Z-lines, a lack of glycogen granules in the sarcoplasm, and a de-

Figure 1. Magnif. X 27,000

Figure 2. Magnif. X 27,000

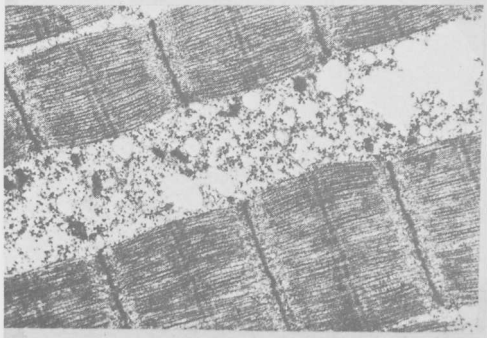

Figure 3. Magnif. X 14,000

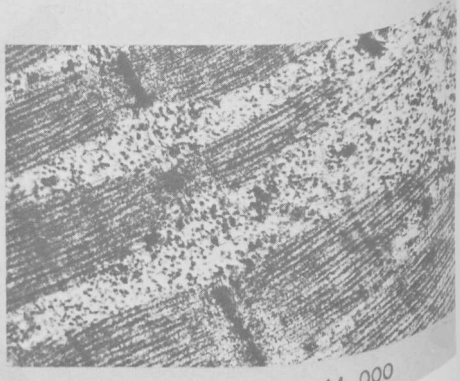

Figure 4. Magnif. X 14,000

struction of the mitochondrial cristae and boundary membranes can be seen in them. Splittings and local destructive changes in the myofibrils are observed. The described electron microscopy changes are in good correlation with the ultrastructural changes found by Bergman and Wesemeier (1973) in pale soft exudative pork.

The electron microscopy pattern of muscles of a pH of 6,5 from animals slaughtered immediately after their arrival at the meat packing plant (Figs. 3 and 4) demonstrates the following features. Myofibrils are straight and parallel to each other. I-disks and A-disks are without any particular changes. Z-lines, H-zones and M-lines are well outlined. Glycogen granules are found in the sarcoplasm and at places between the protofibrils.

In muscles of a pH of 6,3-6,4 from animals slaughtered after a 24-hour pre-slaughter rest (Figs. 5,6,7, and 8), it is found by electron microscopy, that I-disks, Z-lines, A-disks, H-zones and M-lines are without changes. Glycogen granules are found in the sarcoplasmatic bands between myofibrils and between the protofibrils.

From the results obtained it becomes obvious that the ultrastructural changes in muscles of a pH of 6,5 from animals slaughtered on arrival at meat packing plants, and in muscles from animals slaughtered after a 24-hour stay, demonstrate similar electron microscopy patterns. That ultrastructure of the muscles contributes to the normal course of the post mortem processes and the ageing of meat and to its higher water absorption capacity.

We assume the destructive changes in the ultrastructure of muscles of a pH of 5,4-5,5 derived from animals sacrificed right after their arrival at the meat packing plant, to be due to the mechanism proposed by Bergman and Wesemeier (1972) for the pathogenesis of pale soft exudative pork (cited after Skalinsky and Belousov, 1978). The contributing endogenous factors, muscle development, the contributing exogenous factors and the unlocking factors in their complexity are in the basis of the changes described. Nevertheless, we feel that a focusing of our attention on the unlocking factors (increase of overtaxing the organism, the action of stress factors) and their minimizing in the loading and unloading operations and the road transportation of Camborough pigs at short distances, would have a positive effect on meat production. But that should by no means undervalue the role of the remaining factors mentioned above.

Conclusions

The results obtained from these investigations on the ultrastructural changes in muscles from Camborough pigs transported over short distances, allow the drawing of the following conclusions:

(1) Camborough pigs show a different sensitivity resulting in a preservation of the normal ultrastructure or in clearly expressed destructive changes of the myofibrils, the mitochondrial cristae and the boundary membranes, and in an exhaustion of glycogen.

(2) Regardless of the complex character of the factors contributing to provoke the sensitivity of Camborough pigs, a definite attention should be paid to the so-called unlocking factors (the increase of overtaxing the organism and the action of stress factors) and their minimizing in the loading and unloading operations and in the truck transportation

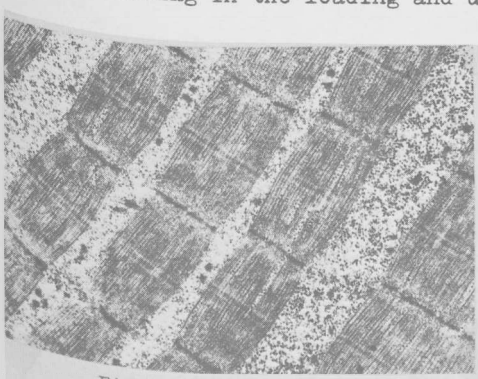

Figure 5. Magnif. X 14,000

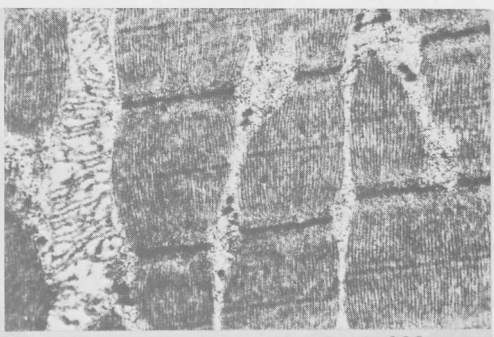

Figure 6. Magnif. X 14,000

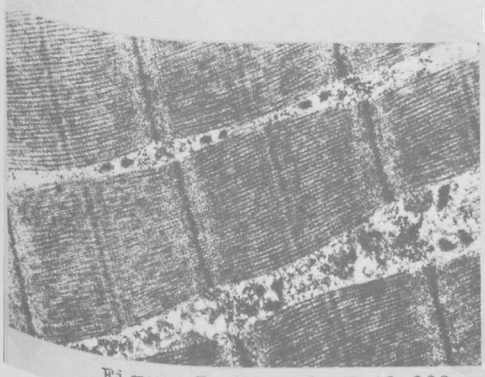

Figure 7. Magnif. X 19,000

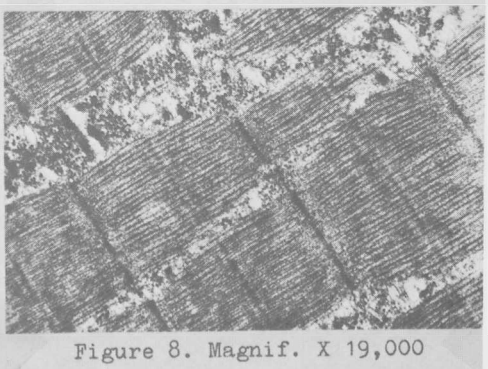

Figure 8. Magnif. X 19,000

of the animals.

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