E45

COMPARATIVE MICROSTRUCTURAL ANALYSIS OF CATTLE MUSCLES WITH QUALITY DEFECTS

S.I. KHVYLYA, T.G. KUZNETSOVA, V.V. AVILOV

All-Russia Meat Research Institute, 26 Tallalikhin str., 109316, Moscow, Russia

Key words: DFD and PSE meat defects, autolysis, morphometry, connective tissue frame, muscle fibre diameter

The purpose of the study was to analyze microstructural characteristics of 12 different muscles separated from cattle animals after 48 hours of storage and cooling, using methods of quality and quantity histology. It is known that defects may develop in different ways in various muscles, and autolytic process proceed with different rates. Using morphometric analysis the comparison of the following muscle indices was made: muscle fibre diameters and the spacing of the muscular tissue estimated as the ratio of the muscular tissue space to fibres space proper. Resultant data were indicative of considerable differences in qualitative and quantitative microstructural characteristic indices of various muscles. On the basis of structural indices received for the meat quality and the level of the progressive growth of the connective tissue frame all muscles tested were combined into 4 groups in accordance with various technological properties.

Intensive development of the cattle breeding, prevalence of breeds sensitive to the stress side by side with long time transportation of animals lead to the formation of defects in raw meat quality. Because of the heterogeneity of the autolytic process serious deviations from the standard meat quality arise, particulary in DFD and PSE meat (Van der Wall P.G. et al., 1988; Klosowska D. et al., 1985). Manufacture of meat delicacies calls for the necessity to carry out the differentiated approach to the choice of raw materials as various muscles have very specific anatomical structure (Cherniavsky M.V., 1977). As to the technology, the level of progressive growth of the connective tissue frame became the more essential factor. It is clear that microstructural features of any concrete muscle determine the quality and consumer characteristics of the end product.

The purpose of the study was to carry out a comparative histological analysis of 12 various muscles cut from cattle animals with normal pH and with PSE and DFD meat quality defects.

For the analysis the researchers used samples of beef muscles: Normal, PSE, and DFD. The following beef muscles were subjected to the test: m. Longissimus dorsi, m. Glutaeus medius, m. Adductor femoris, m. Brachiocephalicus, m.Biceps femoris, m. Triceps brachii, m. Supraspinatus, m. Quadriceps femoris, m.Semimembranosus, m.Semitendinosus, m. Infraspinatus, m. Pectineus.

Histological sections were prepared according to the conventional methodology. Morphometric analysis was made in the "Magiscan" image analyser. Fibre diameters, connective tissue contents and the spacing were measured in percent.

Analyzed muscles were divided into four groups taking into account the progressive growth level of the connective tissue frame and the thickness of muscle fibres.

The group 1 included: m. Longissimus dorsi, m. Glutaeus medius, and m. Adductor femoris. When pH had the normal level, all three types of fibres were in heterogenous state, and the cross section and longitudinal section of the fibre structure were clearly seen. In some cases, it was observed that the fiber integrity became broken and cross disruptions appeared. While making analysis of the PSE meat, it was found that the meat texture occured to be looser and fibres were of smaller diameter. It is known that autolytic process in the PSE meat proceed more intensively and followed by more disruptions of muscle fibers than it was observed in the meat with normal pH. As to the meat with DFD defects, the reverse situation was observed and meat aging processes proceeded considerably slower (Khvylya S.I. et al., 1992). Actually, the intensity of defects in all three classes - NOR, PSE, and DFD - was approximately the same. These muscles were characterized by the moderate development of connective tissue frame. The group 2 included: m. Biceps femoris, m. Triceps brachii, m. Quadriceps femoris, and m. Semimembranosus (all of them were similiar by their structure and rates of aging). Relating to NOR muscles, all fibres were clearly seen and destructive processes were faintly expressed. In PSE muscles, fibres were loosely disposed and destructive processes occured to be more intensive. In DFD muscles, apparent features of aging were extremely poor. In muscles of the last group , meat defects became less apparent than in muscles of the first group. Fiber diameters were closer to those of the first group. The connective tissue frames of the first group muscles were more pronounced (Fig.1). The following muscles were included into the group 3: m. Infraspinatus, m. Supraspinatus, m. Semitendinosus, and m. Pectineus. In the given group, muscle fibres had different degrees of contraction and all boundaries were quite distinctive. Autolytic changes of PSE meat and DFD meat were similiar to those of the first and second groups. Nevertheless autolytic processes occured to be less intensive, and diameters of muscle fibres were smaller. The most apparent peculiarity of muscles in the group 3 appeared to be the pronounced formation of connective tissue frames. The group 4 contained only m. Brachiocephalicus which was characterized by the even formation of connective tissue frames and greater diameters of muscle fibres as compared with similar indices of other groups. The texture frame was evidently cellular and contained numerous collagen fibres. Cervical muscles had fibres of relatively smaller size, but differences among NOR, PSE, and DFD muscles were similar to described above. Taking into account differences in the texture formation, the group sorting of muscles was carried out. For this purpose such main features as the degree of formation of connective tissue frames and fiber diameters were taken into account. Indices received appeared to be essential for determining mechanical, technological, and organoleptic properties of end products.

All groups of PSE muscles were characterized by high spacing, smaller diameter of fibres, and pronounced destructive processes.

DFD meat contained swollen fibres, low spacing and greater diameter of muscle fibres. Quality defects did not influence on the quantity of the connective tissue. However DFD and PSE defects influenced faintly on textural characteristics in groups 3 and 4. The tendency to more intensive aging within muscles with poorly formed connective tissue frame was exhibited.

On the basis of histological tests all muscles analyzed may be divided into four groups independent on quality defects:

1. m.Longissimus dorsi, m. Adductor femoris, m. Glutaeus medius;
2. m. Biceps femoris, m. Triceps brachii, m. Quadriceps femoris, m. Semimembranosus;
3. m. Semitendinosus, m. Supraspinatus, m. Infraspinatus, m. Pectineus;
4. m. Brachiocephalicus.

Reference.

1. Cherniavsky M.V. "Anatomo-topographic principles of the technology and veterinary and sanitary inspection of products of slaughter animals". M. Pischevaya promyshlennost., 1977.

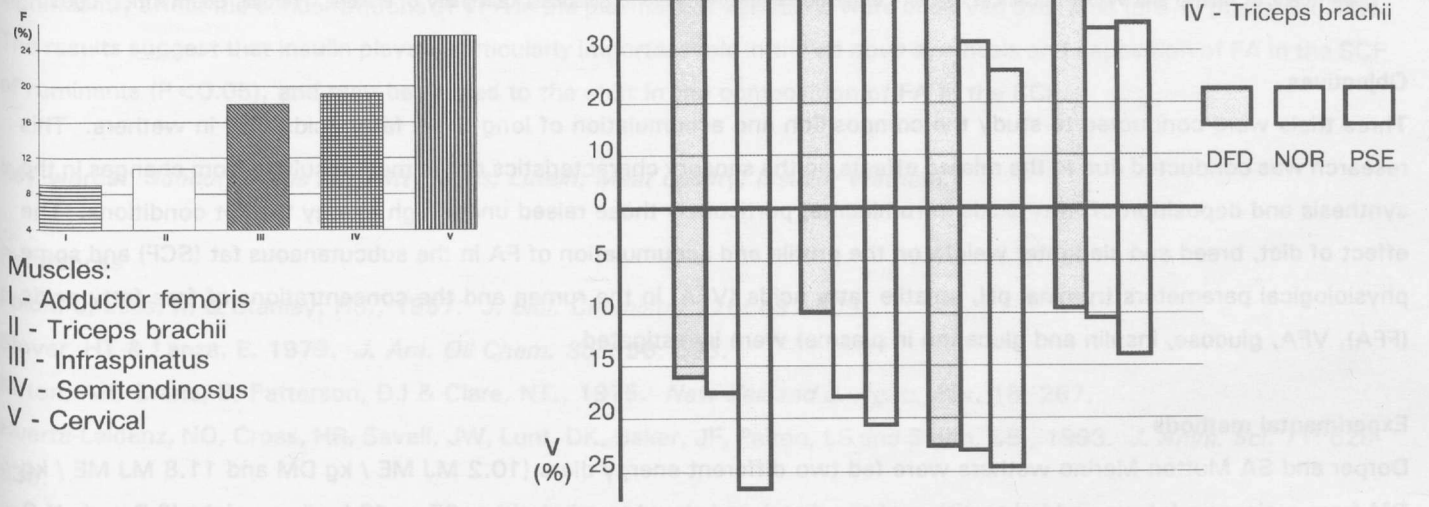

Fig1. F - content of the connective tissue;
D - diameter of muscle fibres;
V - spacing of the muscular tissue.

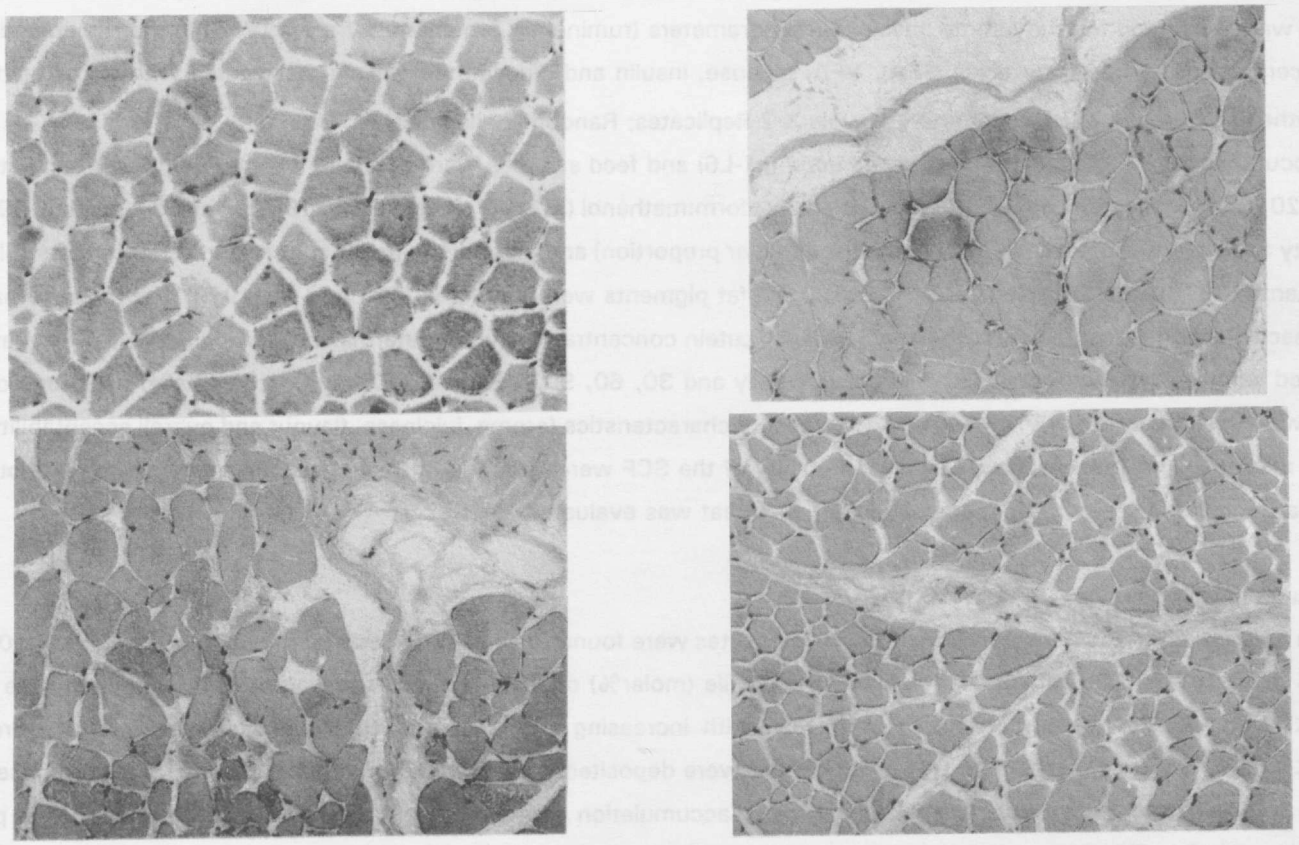

Fig 2. Microstructure of muscles.
A - m.Longissimus dorsi, B - m.Triceps brachii, C - m.Semitendinosus (cross section), D - m.Brachiocephalicus