EFFECT OF THE INTENSIVE MECHANICAL TREATMENT ON MICROSTRUCTURAL CHANGES IN MUSCLE TISSUE

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The aim of this study was to determine the effect of the intensive mechanical treatment (vibration) on muscle microstructure in the process of massaging (frequency -16 Hz, amplitude - 3 mm, time - 30 m).
Histological analysis was performed on samples of the muscle (1,5 x 1,5 x 2,5 mm) taken from surface layers of raw material treated and fixed in 20% normalized formalin; 7-10 μm sections were stained with hematoxilin-eosine and by Van-Guison method. Ultrastructural changes were studied on muscle samples fixed in epone-araldyte. Muscle sections of $(2.0 - 4.0)10^{-2}$ μm thick cut by MKB-4800 ultramicrotome were analyzed using electron microscopy.

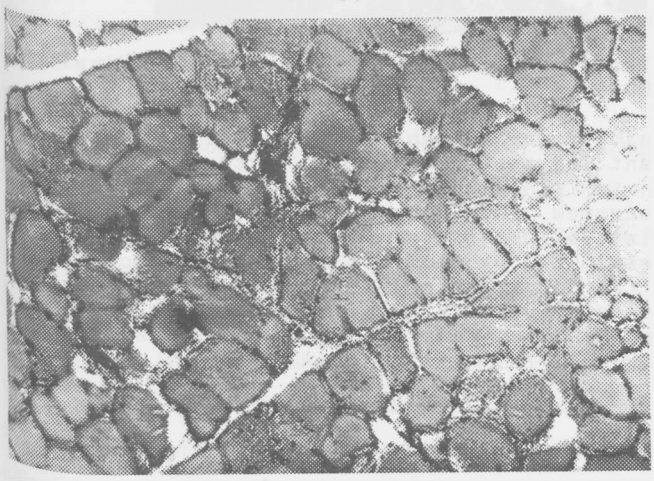

Fig. 1. Microstructure of the muscle surface layer after vibration massaging.

Microstructural study of muscle samples treated by vibration massaging revealed some morphological changes in surface layers characterized by the availability of fine-grained protein mass layer containing broken muscles and fibres and disposed in most cases under the sarcolemma.
At cross sections muscle fibres of polygonal form were freely disposed relative each other. Some of them demonstrated the loosening of myofibrillas with the break of sarcolemma and partial release of fine-grained protein mass into the connective tissue space. In general, the breakdown of muscle fibres structures was characterized by formation of cross-cracked spaces and microcracks (Fig. 1).

As to deeper layers, the destruction was exhibited to a less degree.
The present study showed that destructive changes that had taken place in fibres, especially those relating to the degree of swelling, were greater during vibrational massaging as compared with usual massaging. Analysis of samples by scanning and electrone microscopy confirmed the results.
Electronscopic analysis showed that the process of intensive mechanical treatment called forth the loosening of myofibrillar proteins and partial breaking of links between actin and protofibrils of myosin. Local violation of membrane structures, fragmentation of single myofibrillas along Z-plates and L-discs were detected in some areas (Fig. 2).
The loosening of myofibrillar substance with some disrupted miofibrillas is clearly seen in the scanning diagram.

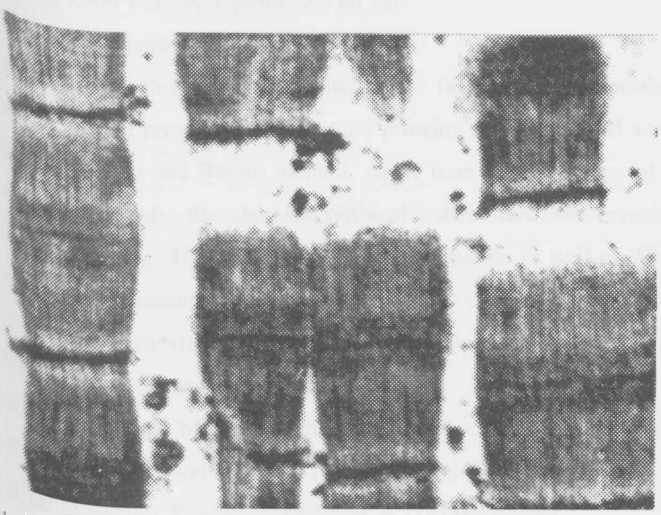

Fig. 2. Ultrastructure of a muscle fibre area after vibration massaging (* 25000).

Use of vibration in the process of massaging leads not only to the appearance of microcracks and disruptions within muscle fibres, but to the loosening of the protofibrillar apparatus promoting the marked swelling of protofibrils (Fig. 3a, b).
The results of microstructural studies showed that the combination of massaging and vibration led to significant structural changes in the muscle tissue for a shorter period of time as compared to the usual method of massaging. It was observed that simultaneously with degradation of myofibrillar substance, the process of vibration massaging called forth significant breaking and disintegration of membrane structures in muscle fibres, promoting the release of a number of enzymes participating in the meat ageing process.

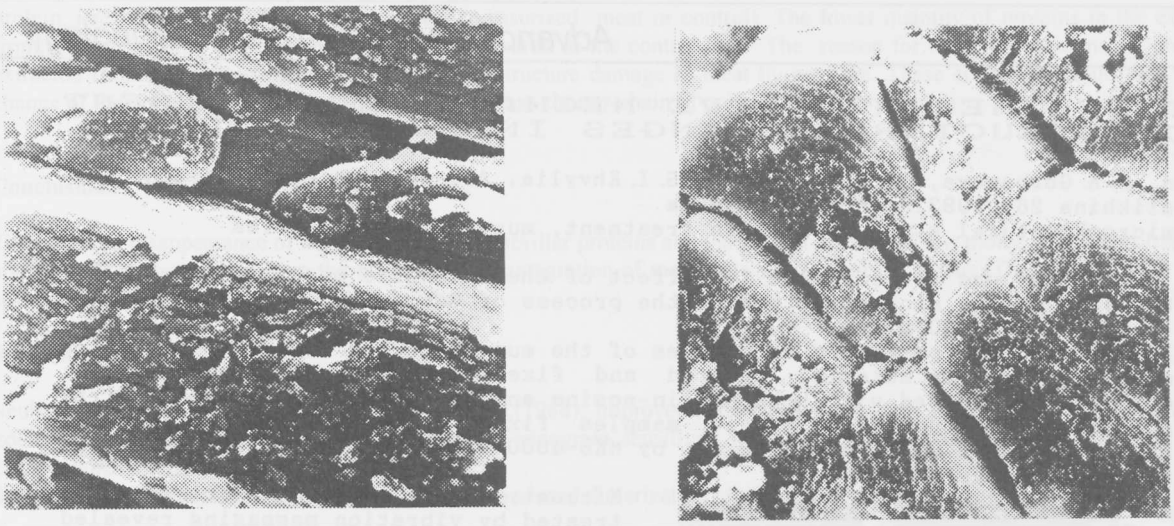

Fig. 3. Diagram of scanning the muscle tissue after vibration massaging: a - longitudinal section (* 2000); b - cross section (* 2000).

Natural antolytic processes proceed more intensively during subseguent period of ageing of cured half-finished products, that is important for the formation of texture, flavour and aroma of finished products.

In the process of vibration massaging, tissue enzymes and microorganisms, especially lactic-acid bacteria, contained in the curing mixture, penetrated into considerable number of microcracks and slot-like spaces; as a result the proteolysis of proteins accelerated and a number of free amino-acids appeared (as compared to usual treatment). Under the effect of this treatment, myofibrillar proteins acquired higher solubility, sulfhydryl, disulfide (and other) groups became more accessible, and plasticity and tenderness of the muscle tissue are improved.