CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.3243566

Available online at: http://www.iajps.com *Research Article*

MORPHOLOGICAL FEATURES OF THE MEAT OF VARIOUS SPECIES OF ANIMALS IN ASSESSING THE THERMAL STATE

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Article Received: April 2019 **Accepted:** May 2019 **Published:** June 2019

Abstract:
The chemical composition and nutritional value of meat depends on its thermal state. It is known that the content of nutrients and biologically active substances is higher in chilled products. Methods for determining the thermal state of raw meat and identifying repeatedly defrosted products are based on an assessment of organoleptic characteristics, especially such as the color of meat and its consistency, as well as the transparency of the broth when the sample is cooked. In this regard, it is necessary to find an affordable and reliable method that allows, in the shortest possible time under production conditions, to assess the thermal state of meat and, first of all, to establish signs of single or multiple defrostation. We have proposed a compressor method for studying native muscle tissue preparations stained with hematoxylin-eosin, which makes it possible in the shortest possible time, namely, the study takes no more than 20 minutes to assess the thermal condition of the meat and identify signs of defrostation, which will establish the fact of falsification of chilled meat frozen. Samples of chilled and defrosted beef, mutton, pork, elk, wild boar, bear, and nutria were examined. Research results indicate the possibility of using the method of microscopy of native muscle tissue preparations in order to identify the thermal state of the meat of various animal species. Processing raw meat with low temperatures leads to structural changes in muscle fibers, which are visualized in preparations made by the compressor method, and include violation of the integrity of the fibers, the presence of multiple gaps, and the release of sarcoplasma beyond the muscle cells.

Keywords: *chilled meat, defrosted meat, veterinary-sanitary examination, histological examination, rapid method.*

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Please cite this article in press Diana Orlova et al., ***Morphological features of the meat of various species of animals in assessing the thermal state.,*** *Indo Am. J. P. Sci, 2019; 06[06].*

INTRODUCTION:

Meat is one of the main sources of nutrients for humans. In addition to meat of farm animals, meat of wild game animals, which include the meat of elk, bear, wild boar, nutria, etc., is very popular. It differs from meat of slaughter animals and poultry in taste and culinary qualities, as well as organoleptic characteristics, morphological, chemical composition, and veterinary and sanitary indicators [1, 11]. In the meat of wild animals, fatty deposits between muscle fibers are rare, so the muscles in the cross section are homogeneous and there is no marbling [7, 8, 11]. It is known that meat of wild animals contains 2-4 times more mineral elements than beef and mutton, which contribute to the neutralization of toxic compounds, heavy metals and are an integral part of proteins, nucleic acids, many enzymes, hormones and vitamins [1, 7, 9, 10].

In addition, the chemical composition and nutritional value of meat depends on its thermal state. It is known that the content of nutrients and biologically active substances is higher in chilled products. When it is minus temperatures, free water contained in muscle cells crystallizes and the crystals formed can mechanically damage the sarcolemma, which results in the cytoplasm being released when meat is thawed from damaged muscle fibers [4, 5].

The meat of animals is sold chilled or frozen, and is also used as a raw material in the production of sausages, canned goods and other types of meat products [6, 7]. At the same time, the price of products containing raw materials from wild animals is much higher than that made from meat of farm animals. In addition, when selling and processing, it is likely that chilled meat will be replaced by defrosted, which is a violation of the legislation of the Russian Federation and consumer rights [3, 9].

Currently, subjective and objective methods for determining the species of meat have been introduced into the product quality and safety assurance system. First of all, they are based on the structural features of the bones of the skeleton, internal organs, and in the study of meat products, the serological method with species-specific sera is reliable [4]. Methods for determining the thermal state of raw meat and identifying repeatedly defrosted products are based on an assessment of organoleptic characteristics, especially such as the color of meat and its consistency, as well as the transparency of the broth when the sample is cooked. In connection with this, there arises the need to find an affordable and reliable method that allows us to assess the thermal state of the meat in the shortest possible time under production conditions and, first of all, to establish signs of single or multiple defrostation.

MATERIAL AND METHODS:

Structural changes in muscle tissue during processing of meat with low temperatures are found in the study of histological preparations stained with hematoxylin-eosin and include deformation and rupture of muscle fibers, destruction of the sarcolemma with the release of fine-grained protein mass in the intermuscular space [5].

This method has proven to be the most accurate, allowing to fully capture the microstructural changes in muscle tissue in various pathologies and in assessing the good quality of raw meat, its degree of freshness, various treatments, and the introduction of food additives and ingredients. However, in real conditions of production and circulation of raw meat, histological analysis is difficult to apply, because it requires special equipment, additional staff qualifications, and given its long-term performance and shelf life of chilled meat, this method loses its practical significance in terms of production during the input control of raw materials for processing and implementation.

We have proposed a compressor method for studying native muscle tissue preparations stained with hematoxylin-eosin, which makes it possible in the shortest possible time, namely, the study takes no more than 20 minutes to evaluate the thermal state of meat and identify signs of defrostation, which will establish the fact of falsification of chilled meat frozen.

To implement this technique, we used a compressor - two thick glasses fastened together with screws. 3-4 small muscle sections were prepared with curved scissors from the studied meat samples along the muscle fibers with a length of 7-8 mm and a thickness of not more than 2 mm. The muscle sections were placed in a compressor, they were crushed with force, the glasses were fixed with screws and the sections were held under pressure of the compressor for 1-2 minutes. After the screws were unwound, the glasses were opened and neatly crushed sections were removed with tweezers and dissecting needles and placed in porcelain cups. Further, the coloring of native drugs with hematoxylin-eosin was made according to GOST 19496-2013 “Meat and meat products. Method of histological research "[2]. Then the stained sections were again placed in the compressor and viewed under a microscope at 10 magnification of the eyepiece, 4, 10 objective lens and 20.

Samples of beef, lamb, pork, elk, wild boar, bear, and nutria were studied in two stages. First, the microprinter of the native colored preparations of chilled meat made by the above method was evaluated. At the second stage, the test samples were frozen at minus 12 °C, kept in the freezer for 24 hours, then the samples were thawed at room temperature and re-examined by this method, comparing the micro-pattern and structural changes in preparations of chilled and defrosted meat.

RESULTS AND DISCUSSION:

Native muscle tissue preparations prepared in the compressorium and stained with hematoxylin-eosin were well received by special dyes, while the cell nuclei were stained purple and the cytoplasm pink. Microscopy of drugs on the increase of the lens 4, 10 and 20 allowed to view the muscle fibers, their integrity, direction, state of endings, as well as the nucleus of muscle cells, i.e. these are the indicators by which we made the identification of the thermal state of the meat under study.

The presence of cell nuclei indicates the freshness of the material, that is, the detected changes in the muscle fibers are not associated with spoilage of raw materials.

In muscle sections made from chilled meat, smooth, integral muscle fibers with a single direction were observed (Fig. 1). In defrosted meat, areas of muscle fiber breaks were observed, sometimes chaotic in their direction (Fig. 2), which is associated with a weakening of the tissue structure as a result of low-temperature processing.

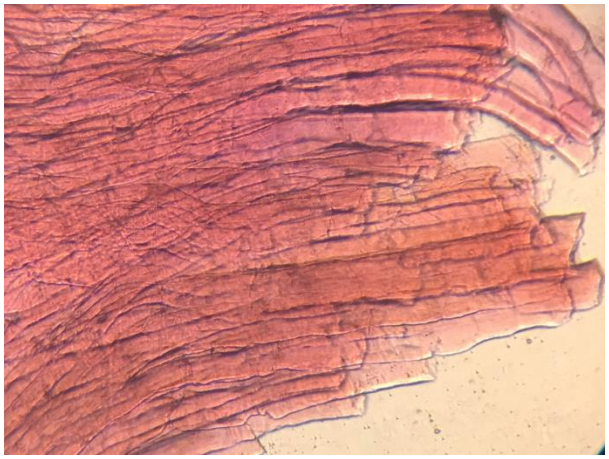

Figure 1: Native preparation of chilled pork muscle tissue

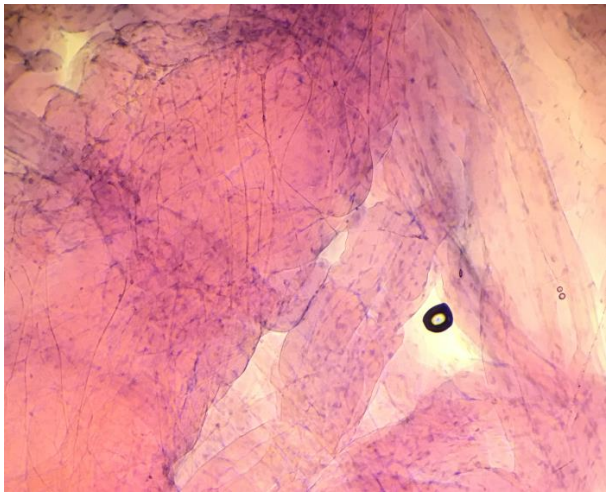

Figure 2: Native preparation of defrosted beef muscle tissue

Special attention was paid to the endings of muscle sections. In the samples of chilled products, the ends of the fibers are smooth, steep, with a clear contour, which indicates the strength of the sarcoplasm in the muscle fiber (Fig. 3). "Freezing" of free water in the cells violates the structure of the intracellular substance, which in defrosting manifests itself by the release of "meat juice" and is accompanied by the loss of meat nutrients. In microscopy, this phenomenon is characterized by the release of sarcoplasm at the ends of muscle fibers, which is clearly manifested in the compression of samples during the preparation of sections in the form of rounded thickenings, stained with eosin in pink (Fig. 4, 5, 6).

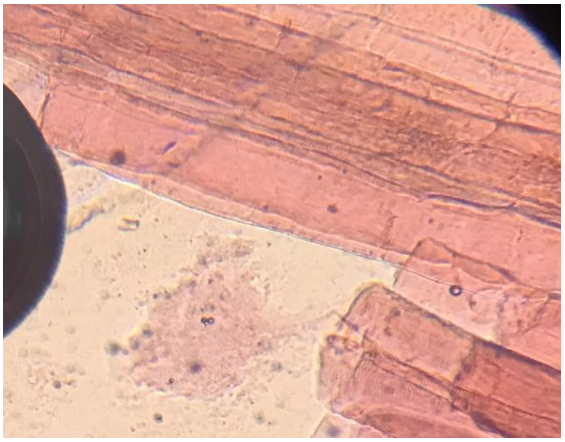

Figure 3: End of muscle fibers in native chilled pork preparations

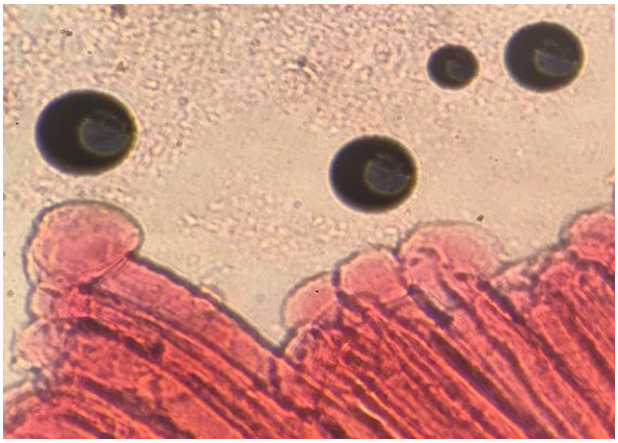

Figure 4: End of muscle fibers in native defrosted beef preparations

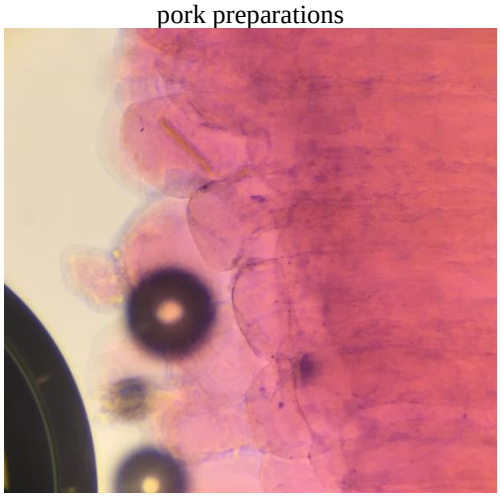

Figure 5: End of muscle fibers in native preparations from defrosted moose meat

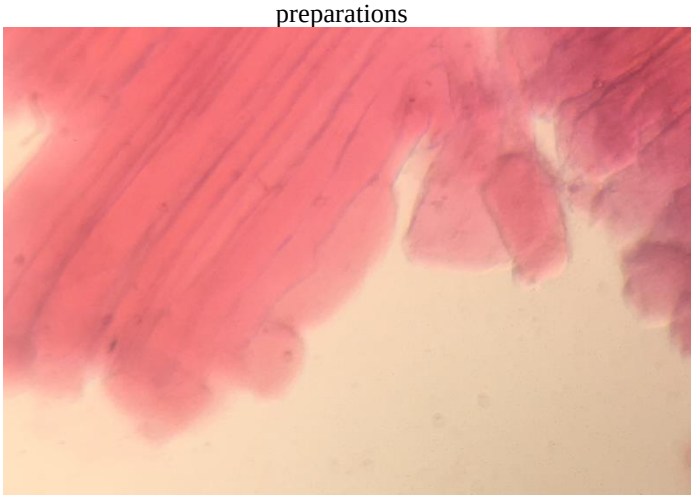

Figure 6: End of muscle fibers in native preparations from defrosted nutria meat

The study of samples of chilled and defrosted meat of different types of agricultural and wild animals showed no differences in the structural changes of muscle tissue, which allows to apply this technique regardless of the type and origin of raw meat.

CONCLUSION:

The results indicate the possibility of using microscopy of native preparations of muscle tissue to identify the thermal state of meat of different species of animals. Processing of meat raw materials with low temperatures leads to structural changes in muscle fibers, which are visualized in preparations made by the compressor method and stained with hematoxylin-eosin and include violation of the integrity of the fibers, the presence of their multiple ruptures, as well as the exit of sarcoplasm beyond the muscle cells [4, 5].

This method is easily and quickly reproducible, does not require expensive equipment and special skills and can be widely used to identify defrosted meat of agricultural, commercial animals and prevent the release of falsified chilled products, including the implementation of incoming control of meat raw materials in the places of its storage and sale, at processing plants, in laboratories of veterinary and sanitary examination of food markets.

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