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Effect of low frequency electromagnetic treatment on raw meat.

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ABSTRACT

The paper presents results of studies about effects of low frequency electromagnetic fields on muscle tissue of pork and beef. There are show the histological images of treated muscle, and comparison and substantiation of the results. The work was perform as part of the grant RFFR № 16-48-230543 / 16 from 14.04.2016 and the agreement on the support projects of fundamental scientific research administration the Krasnodar region № 47.05.01 / 7-11.3 from 06.04.2016.

Keywords: histology, muscle tissue, electromagnetic effects, tissue structure, the fiber, the core

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INTRODUCTION

Analysis of published data shows that today one of the promising areas of intensification of the technological process of raw sausage is the use of low frequency electromagnetic field (EMF LF) [1-3]. However, the use of low-frequency EMF due to the necessity of studying the optimal frequency selection, safety for humans, the use of low-frequency EMF at work, studying the effect of EMF LF meat raw materials [4-6].

The purpose of this paper is a histological study of the effect of low-frequency treatment on the muscle tissue of pork and beef.

MATERIALS AND METHODS

In the study, we used the premium beef and pork bold. For histological examination of the meat were have fixed in 10% neutral formalin aqueous solution for 24 hours. Washed in cold tap water 12 hours and was have encased in gelatin according to the conventional technique. Material cut into microtome-cryostat «MIKROM - HM 525» (Germany) at -20 ° C receiving 10-15 micron thick slices. Sections were prepared sausage at a temperature in the cryostat chamber of -28 °C [7, 8].

Sections were have stained with hematoxylin Ehrlich and 1% freshly prepared aqueous-alcoholic eosin; concluded under coverslips in a glycerol-gelatin, previously melting it in a water bath.

The study of the microstructure of samples for histological specimens and their photographs on digital photo equipment was performed on a light microscope "AXIOIMIGER.A1" (Carl Zeiss, Germany) with a connected system of image analysis "AXIOVISION" using the appropriate morphological computer program at magnifications of lenses from x2 to x63 [9, 10].

Preparation of raw meat for processing EMF consisted of the following: beef top grade and pork in pieces weighing up to 300 grams were have placed in cars, while the layer thickness was 30 cm. Packed in cars raw material processed by electromagnetic effects within 30 minutes with frequency of 100 and 30 Hz. After treatment compared the result with the help of microstructural analysis [7].

RESULTS AND DISCUSSION

Histological study pork without processing EMF LF, were obtain the date (Fig. 1).

Muscle fiber length of the back muscles are in a stage after rigor mortis. The main part of the muscle fiber is have stretched and has a linear shape. Fewer has crimped fibers, slightly undulating shape, which agrees with the source data [8]. Striated muscle fibers in the well expressed in some areas weakened by the existence of zonal post-mortem muscle contractions. The kernels are have well painted with a clearly detectable chromatin, oval, located throughout the volume of sarcoplasmic muscle fiber. Connective layer wavy with clearly differentiate cellular elements endomysium, which is consistent with the authors of these S.I. Khvylya, V.A. Pchelkina, T.M. Giro [8, 9].

On the longitudinal sections in the muscle fibers revealed distinct transverse striations, although in some areas it is replaced by a longitudinal (Fig. 2). The cell nuclei are oval with clearly distinguished chromatin located directly under the sarcolemma. Autolytic changes in the muscle tissue is practically not expressed, cross-slotted compromising the integrity of muscle fibers that are typical of developed autolysis, no such changes were described in the works of A.A. Nesterenko [1].

Between bundles of muscle fibers are revealed nerve conductors (Fig. 3), and blood vessels of the arterial and venous types.

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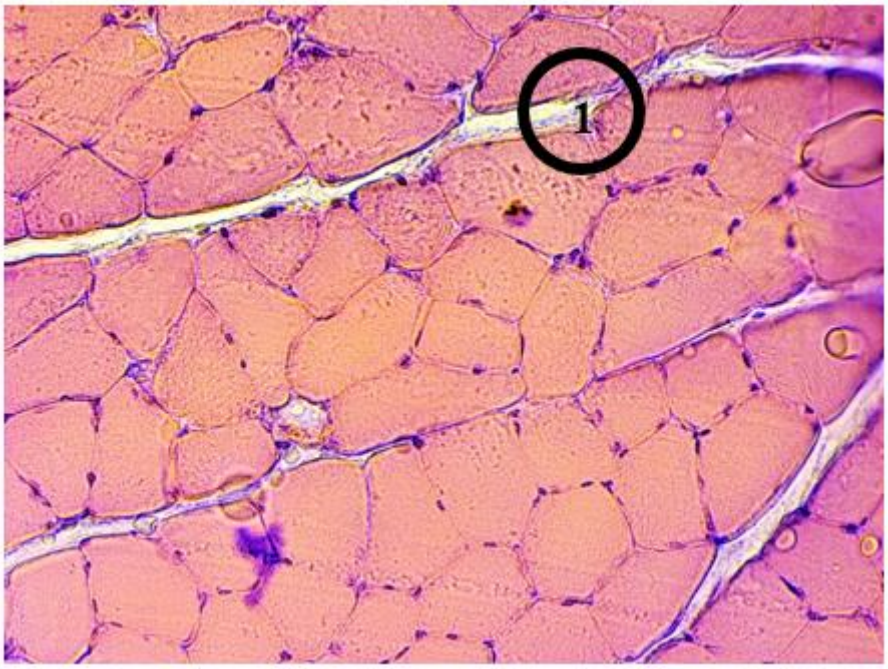

Figure 1: Cross section muscle tissue of chilled pork.
Dyed hematoxylin-eosin. Increased ×200 (1 – peremizy).

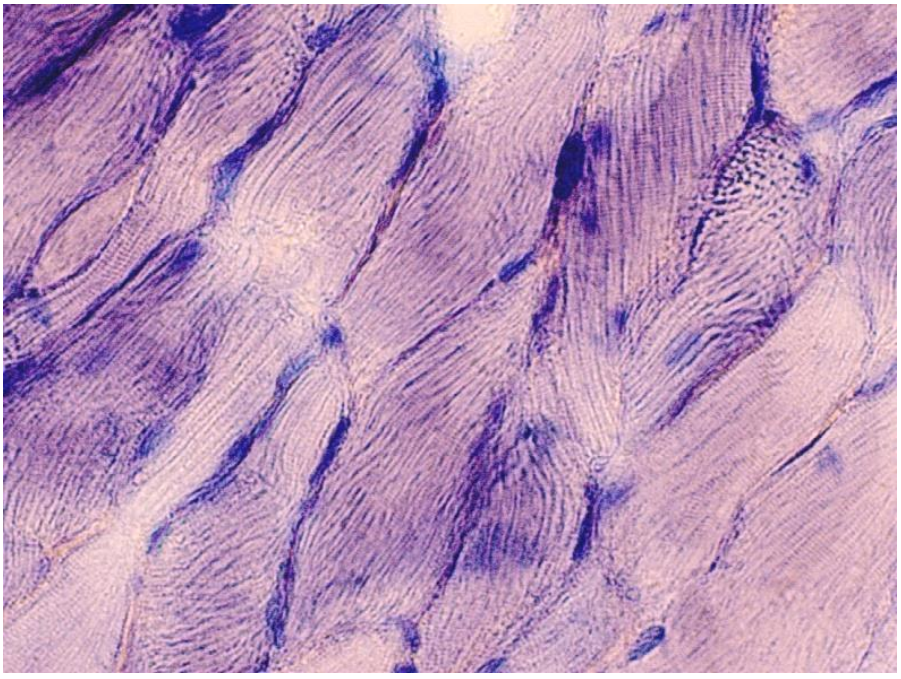

Figure 2: Longitudinal cut muscle tissue of pork.
Dyed hematoxylin-eosin. Increased ×400

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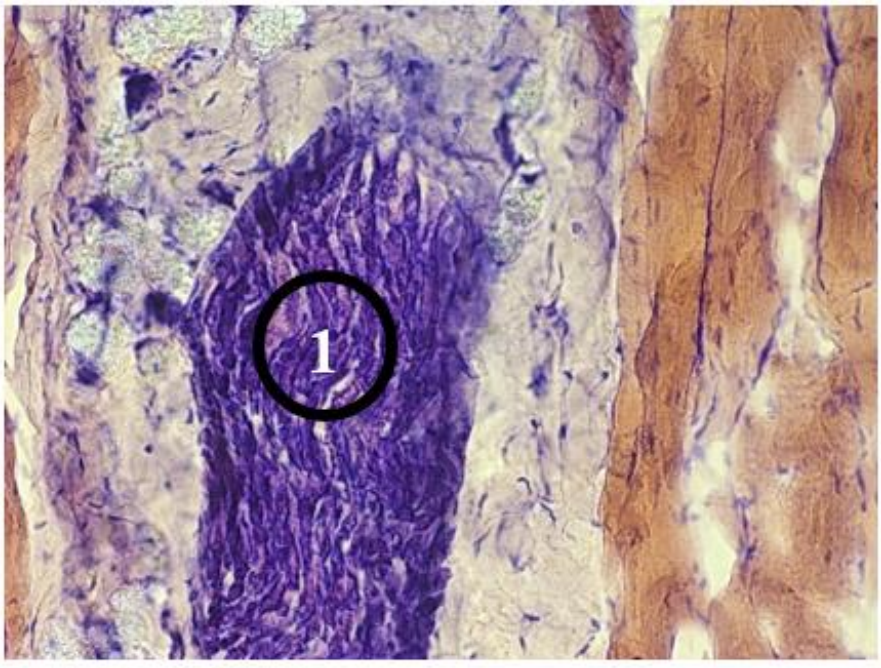

Figure 3: Nerve trunk in perimysium muscle tissue of chilled pork.
Dyed hematoxylin-eosin. Increased ×200 (1 – nerve trunk)

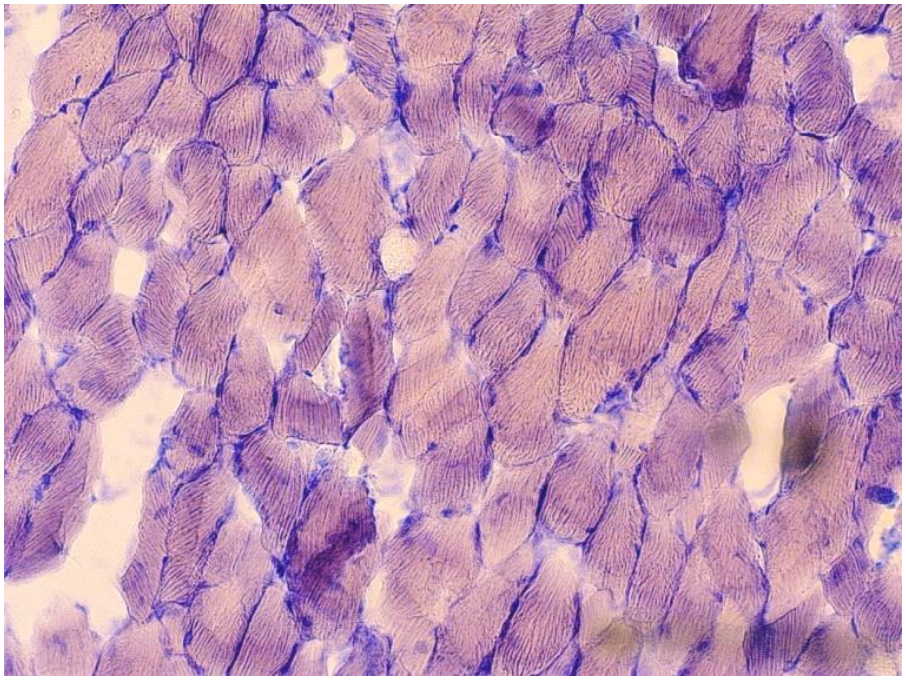

Figure 4: Cross section of beef.
Dyed hematoxylin-eosin. Increased ×200

In the study of beef without EMF treatment were obtain the data (Fig. 4).

The muscle fibers are in a different functional and morphological state. Most of them are characterized by wide amplitude undulations, the others have the form of rectification. In most of the muscle fibers transverse striations moderately expressed. Mostly revealed fibers with strong tortuosity. The nuclei stain well and are have characterized by distinct chromatin. Located in the nucleus is much more mass near the sarcolemma [9, 10]. Connective layer wavy, close fitting to the bundles of muscle fibers, more advanced

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compared to the pectoral muscles, which corresponds to the description of the authors S.I. Khvylya, V.A. Pchelkina [8].

The main part of the muscle fiber is have stretched and has a linear shape. Fewer has crimped fibers, slightly wavy form. Striated muscle fibers in the well expressed in the individual zones is have less pronounced because of post-mortem manifestation zonal muscle contraction. A cross section of a polygonal shape of the muscle fibers (Fig. 5, 6).

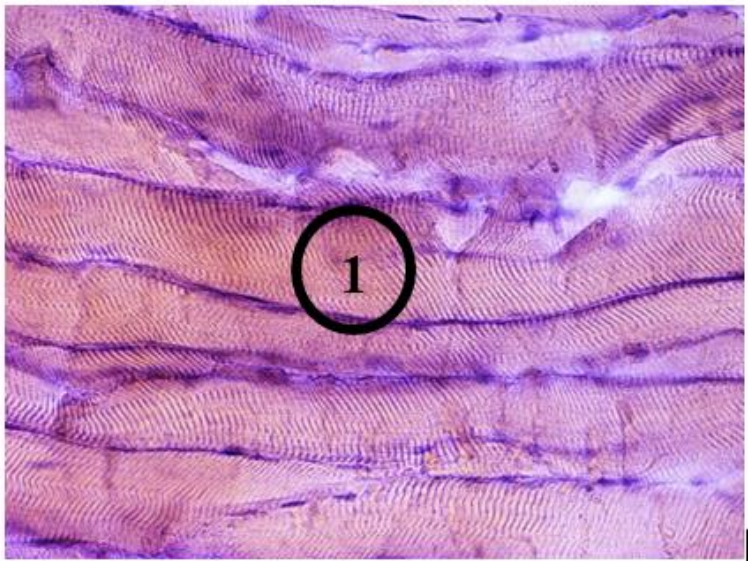

Figure 5: Longitudinal section muscle tissue of chilled beef.
Dyed hematoxylin-eosin. Increased ×400 (1 – transverse striations)

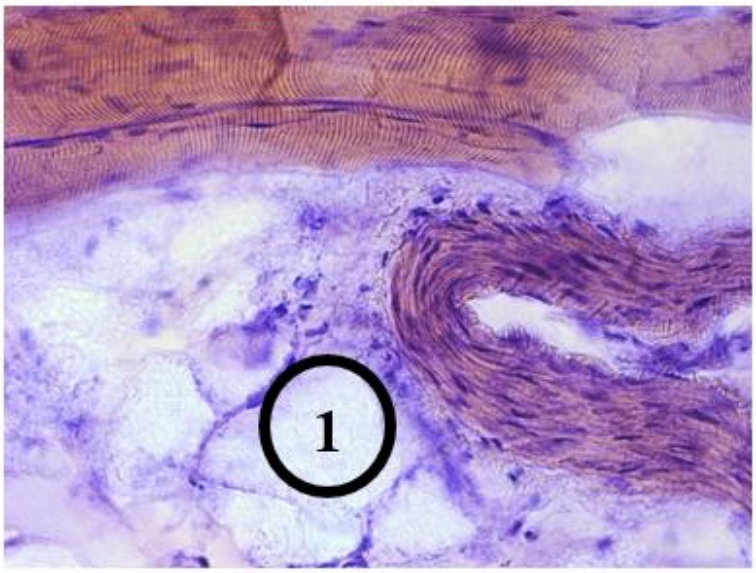

Figure 6: Adipose tissue and blood vessels in perimysium.
Dyed hematoxylin-eosin. Increased ×400 (1 – adipose tissue)

The nuclei of muscle tissue cells are have well stained with clearly detectable chromatin, oval, located at the periphery of the muscle fiber. Connective layer wavy with clearly differentiate cellular elements endomysia and moderately developed amorphous substance.

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Collagen and elastin fibers in the muscle as part of a moderate amount of endomysium. More powerful layers of collagen fibers are found only in epimysia. The composition found perimysium intramuscular fat cells and blood vessels (capillaries, arteries and veins) of different diameter (Fig. 6).

Influence by low-frequency EMF at a frequency of 100 Hz and a duration of 30 minutes pork muscle tissue characterized by containing numerous, several large spaces in interfascicular and perimysium, bright spaces, and associating with connective muscular frame structures. Between the muscle fibers is less developed muscle connective tissue framework. There much more advanced processes of destructive changes, accompanied by damage to the sarcolemma and fragmentation of muscle fibers. A small part of the muscle fibers is have characterized by significant cross-slotted impaired integrity and breaks. Along with the primary beam with a loose arrangement of fibers found sealed bundles of muscle fibers [11, 13]. The degree of deformation of the muscle fibers themselves bounded (Fig. 7).

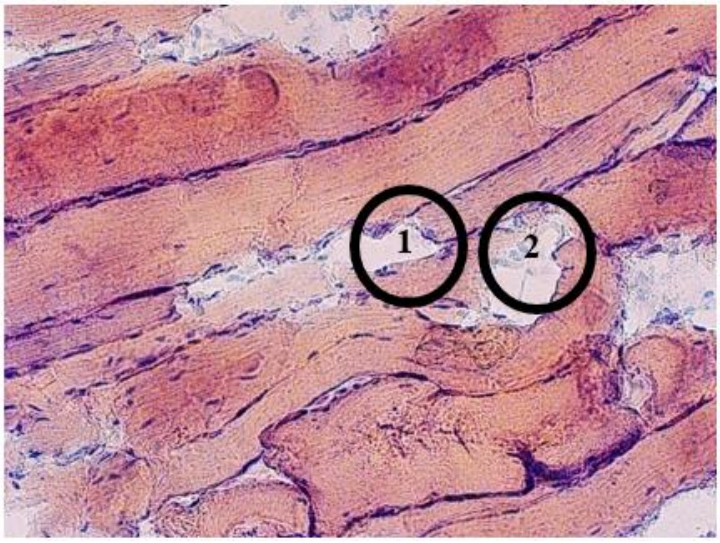

Figure 7: Longitudinal section muscle fibers of chilled pork.
Transverse fracture and fragmentation. Dyed hematoxylin-eosin. Increased ×200
(1 – epimiziya discontinuities; 2 –fragmentation of muscle fibers)

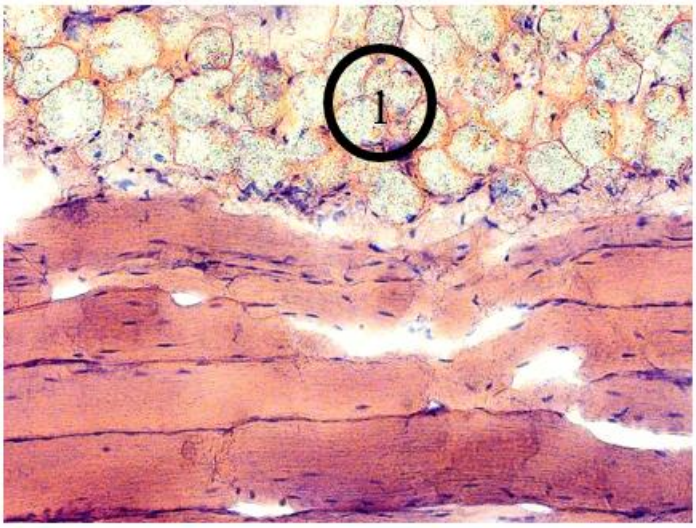

Figure 8: Longitudinal section of chilled pork.
Dyed hematoxylin-eosin. Increased × 400(1 – adipose tissue)

Muscle fibers get have disconnected quite often due to the appearance around them of a light painted with hematoxylin and eosin space or closely spaced together. Between the muscle fibers, primarily in the areas of primizie, there are small groups of fat cells having different sizes. Muscle fibers are have characterized by moderate tortuosity with marked manifestations of the processes of maturation and autolysis, which is have expressed in numerous transverse slit-like violations of integrity and fractures [11, 12]. In this nucleus is have well stained, in some cases, localized in not typical for muscle tissue areas (Fig. 8).

Analyzing the level of light microscopy after beef chilled electromagnetic treatment with a frequency of 100 Hz and duration of 30 minutes is set as follows: the sections on the longitudinal muscle fibers in transverse striations reveals indistinct and, in some areas it is have replaced on the longitudinal. Amid predominant linear form, muscle fibers can be detected moderately wavy fibers or fragments thereof. Sarcolemma does not preserve its continuity over a large area of muscle fiber tears and destruction of muscle fibers are have found quite often. In transverse sections of muscle fibers form a polygonal, limited rounding or round (Fig. 9).

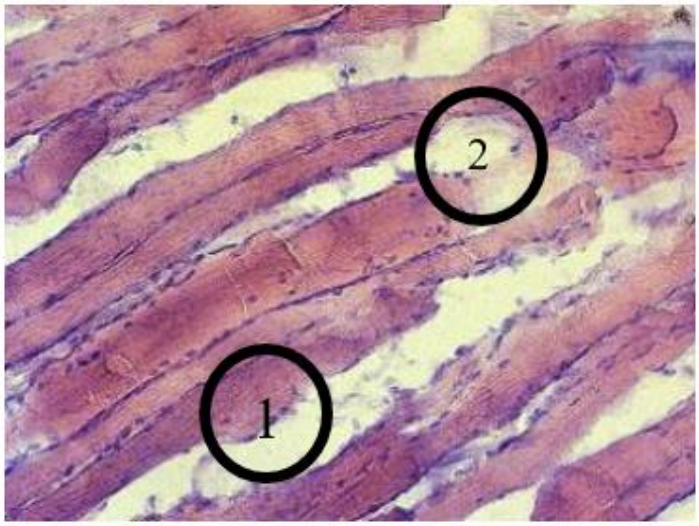

Figure 9: Longitudinal section muscle fibers of beef. Dyed hematoxylin-eosin. Increased ×200 (1 – loosened myofibrillar bundles; 2 – fragmentation of muscle fibers)

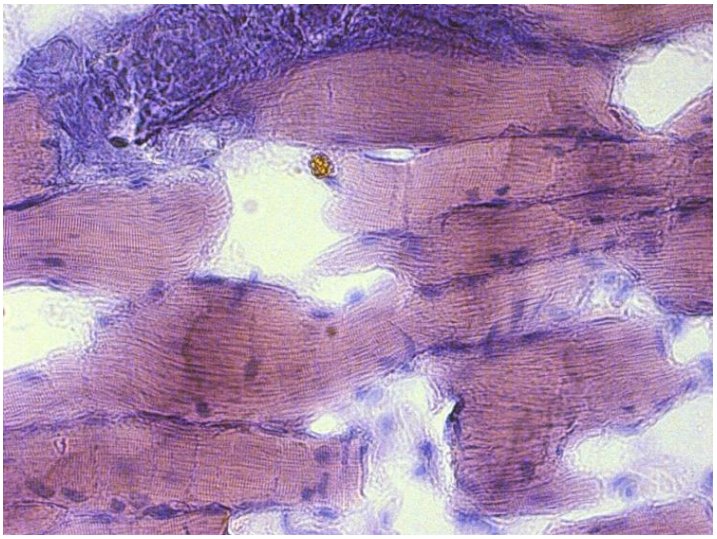

Figure 10: Longitudinal section fragmented muscle fibers of beef. Dyed hematoxylin-eosin. Increased ×200.

The layout of the individual fibers in the primary beam is quite loose, with a noticeable bright space in Indonesia. Not always clearly distinguishable boundary between the individual muscle fibers. The nuclei of connective tissue cells and muscle fibers in most cases oval with fuzzy eye-catching chromatin are located directly under the sarcolemma. Destructive changes in muscle tissue as a result of electromagnetic effects are expressed quite significantly (Fig. 10).

It was had found that when processing EMF LF beef and pork with a frequency of 100 Hz and a 30-minute muscle tissue is characterized by significant structural changes, expressed partial or total destruction of the muscle fibers. At the same time the pH of both the muscle tissue samples shifted to the acid side, reduced water binding capacity varies test sample weight and reduced microbiological contamination of raw materials [9, 10, 14].

CONCLUSION

When processing EMI 100Hz results in a significant change in muscle structure. According to our hypothesis, these changes are due to achieve the resonance frequency of the internal cells and external influence on it. Cell structure integrity violations can lead to changes in pH and changes tissue composition of tissue protein.

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