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Development of device for electromagnetic treatment of raw meat and starter cultures.

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ABSTRACT

The article presents the results of the development of the device for electromagnetic treatment of raw meat and starter cultures. Explains the basic parameters of the device, justified the choice of electromagnetic processing of meat raw material parameters and starter cultures. The work was performed as part of the grant RFFR № 16-48-230543/16 from 14.04.2016 and support fundamental research projects of the agreement administration of Krasnodar Region № 47.05.01/7-11.3 from 6.04.2016.

Keywords: electromagnetic treatment, starter cultures, meat raw materials, coil, emitter

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INTRODUCTION

During the production of raw sausages microbiological contamination of raw meat may increase due to hit the outside of the microflora and beyond. This can significantly reduce the quality of meat raw materials and finished products [1, 2].

Silliker John H, Vogel Paul W [3] was developed method of treating fresh meat. This method provides a reduction in the number of surface bacteria, thus increasing the shelf life of meat. This method is as follows, meat is placed in a chamber at 100 °C, and the steam is fed in such an amount and duration, which reduces the amount of vegetative bacteria. It is necessary to monitor the temperature and denaturation occurring on the surface of the meat. Cutting carcasses is carried out in adverse conditions for the development of psychophilic bacteria [1, 3].

Next researchers [4, 5] have proposed a method of processing raw meat electromagnetic field of low frequency (EMF LF). Their work indicates the possibility of using EMF LF to reduce microbiological contamination. In their work the authors present a number of frequencies, the action of which a reduction in microbial activity [4].

Russian scientists (D.A. Maksimov, P.I. Plyasheshnikov) and the other method has been proposed EMF applications for pasteurization and produce coagulate blood of slaughtered animals [6].

Reduction of microbiological contamination during processing of blood observed with increasing intensity of treatment and the specificity of microorganisms [7]. The susceptibility of microorganisms to EMF depends on the characteristics of the cell membranes and cell sizes. The more cells, so it is more susceptible to EMF. During many experiments [8, 9] was made the following conclusion: gram-negative organisms are more susceptible to EMF than gram-positive.

The aim of this work is the study and development of devices for the treatment of low-frequency EMF starter cultures and raw meat.

MATERIALS AND METHODS

The number of mesophilic aerobic and facultative anaerobic microorganisms was determined in accordance with GOST 10444.15-94 [10].

Electrophysical indicators the devices. Studies metrological conducted to determine the load capacity, the nature of the load and power supply checked parametric capabilities. The metrological analysis used the following measuring devices that have passed the pre-metrological verification:

1. For current measurement using ammeter type M 2015. This coil instrument accuracy class 0.2. Multirange and magnetoelectric voltmeter, type M 2004, accuracy class 0.2. Single-phase counter type CO-I446, with accuracy class 2.5. All these devices are used for power measurement when pulsations DC to 150 Hz, the magnetic field strength was measured by "Impuls" company Soeks.

2. Indications switch devices duplicated electronic two-channel oscilloscope type ACK 2023 (Aktakom) and a four-channel digital storage oscilloscope series TDS2014 (Tektronix).

The first stage: the development and justification of the main parameters of the electric power supply circuit for an electromagnetic emitter.

For processing EMF LF at the chair the use of electric energy the Kuban State Agrarian University, electromagnetic installation was designed, the electric power supply which is a schematic diagram in Figure 1.

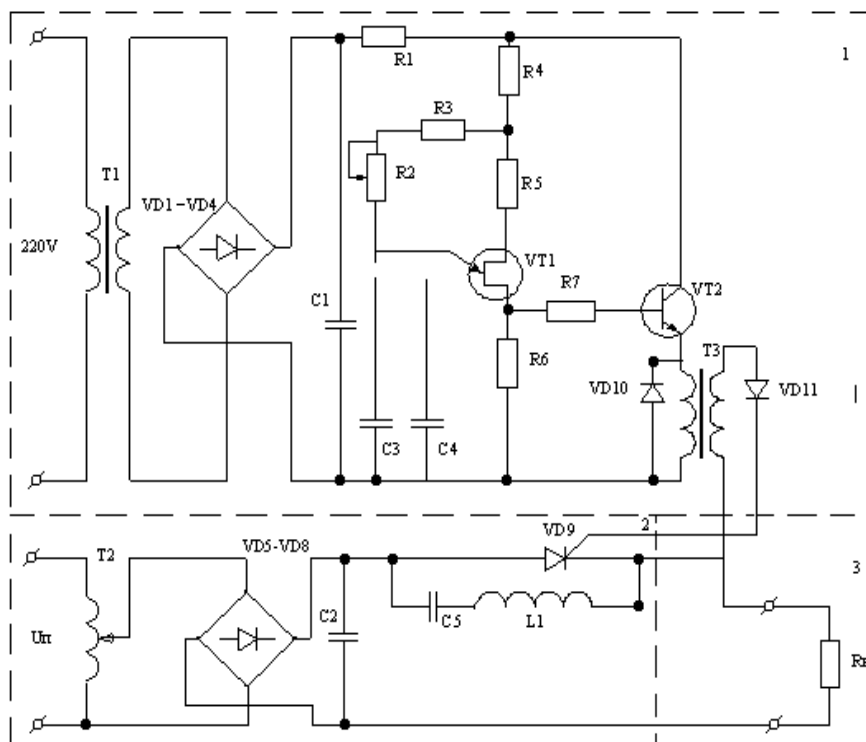


Figure 1: Schematic diagram of the power supply of the electromagnetic installation

An apparatus for processing consists of EMF LF pulse generator and control circuit.

The control circuit is designed to control thyristor VD10. The pulse generator consists of a source of low-frequency electrical oscillations and emitter of electromagnetic pulses in the form of a solenoid. As a source of radiation used unipolar generator triangular wave that can generate frequencies in the range 10-200 Hz. The solenoid has a ferrite core, which makes it possible to generate energy with a frequency of 4.5 kcal / mol.

To study the EMF LF influence on the development of mesophilic aerobic and facultative anaerobic bacteria, yeasts and molds using chilled first-class beef and chilled pork demibold. In our study we were investigated the frequency of 10 to 110 Hz. The samples of raw meat were placed in a shielded chamber with built-in emitter. On the meat was generated signal triangular shape in the range of 10-110 Hz for 15, 30, 45 and 60 minutes.

RESULTS AND DISCUSSION

Development microflora increases with approach to the treatment frequency of 35 Hz and decreases the processing frequencies over 50 Hz. Maximum peak microflora development occurs during processing EMF LF with a frequency of 45 Hz and a duration of 60 minutes, we got the result in $8,1 \times 10^7$ CFU / g, which differs substantially from the nearest maximum during processing with a frequency of 40 Hz ($1,9 \times 10^6$ CFU / g) and 50 Hz ($2,3 \times 10^7$ CFU / g) 60 minutes.

With further increase in the frequency of observed significant inhibition of the growth of microflora, which occurs when the raw material processing rate from 95 Hz and 60 minutes. Suppression of decline in the processing occurs with a frequency of 105 Hz and duration of 60 minutes. Peak inhibition of microflora is the frequency of 100 Hz with a duration of 60 minutes ($2,8 \times 10^2$ CFU / g).

When analyzing data obtained by the processing of beef and pork with a frequency of 100 Hz can be seen that the total difference between microbial indicators processing time from 30 minutes to 60 minutes are not essential. Given that long-term treatment of raw meat can affect processing speed, line production and

economic performance of the production of the finished product, were proposed to carry out the processing of raw meat with a frequency of 100 Hz and a duration of 30 minutes.

Analysis of color photography of the spectra (Figure 2) of photons reflected from the processing of the product, shows that treating the product with a frequency equal to 45 Hz, the effect of intensifying the microflora growth is maximum.

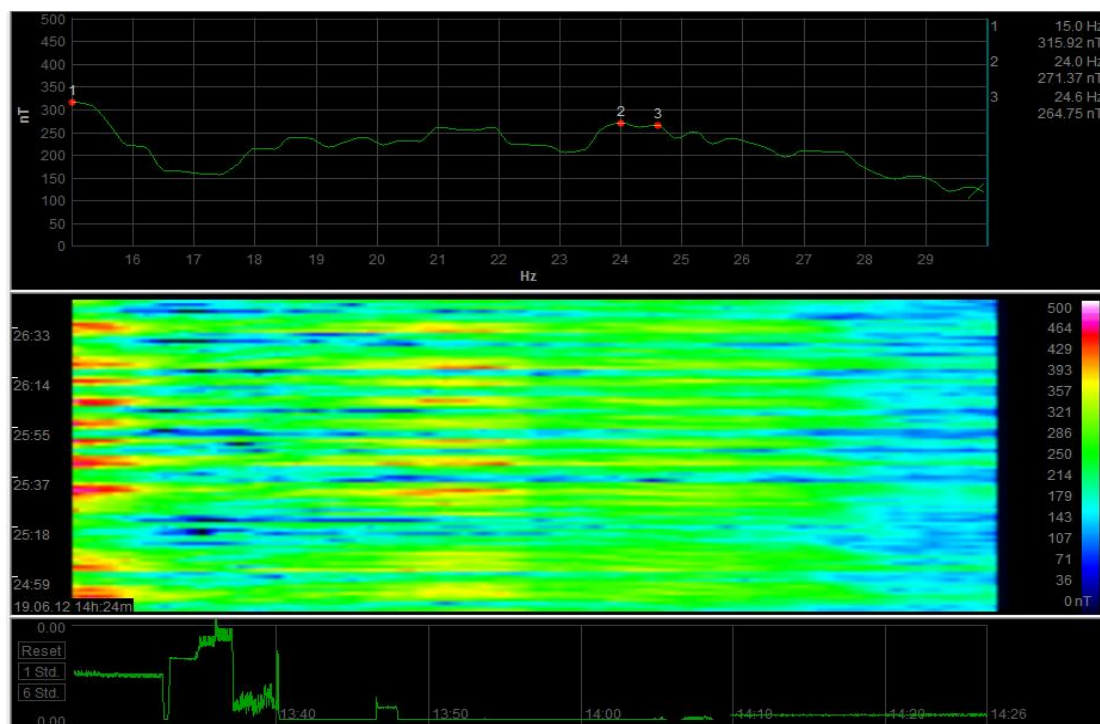


Figure 2: The spectrum of the reflected photons from a processed product in the processing of a frequency of 45 Hz and a duration 60 minutes

Photo fixed the processing of color from pale violet to the red part of the spectrum, which formed the photons emitted by the electronic processing of the product.

Effect of electromagnetic rays primarily exposed membrane bounding different intracellular components. Functional and morphological disorders of cell membranes appear almost immediately after EMF LF processing. These changes contribute to the emergence of the ionic composition of proliferative processes. During processing EMF LF varies permeability of biological membranes, accelerated transport of sodium cations [1, 11].

Some researchers [1, 12] believe that the individual structural elements are liquid crystal structure. In this regard for their anisotropy is characterized by magnetic properties. Our results suggest that these liquid crystal elements are guided by the magnetic field, being responsible for the permeability of the membrane, which in turn regulates the biochemical processes occurring within a cell [13].

In addition to influence on the crystal structure of the membranes, EMF LF affects the physicochemical properties of water, such as viscosity, surface tension, light absorption, dielectric constant, electrical conductivity. EMF LF, changing the energy of weak interactions, can have an impact on the supramolecular organization of living structures [1, 5]. This causes a change in chemical reactions, some of which occur with enzymes. Therefore, different frequencies can cause different effects. Some of the frequencies can activate and suspend some biological processes within the cell. Despite the different effects from the action of EMF LF, it is based on a rotating electromagnetic field.

It should be noted that the electromagnetic fields that are produced around the ferromagnetic particles are variables and their impact on biological objects may differ materially.

Depending on various factors, the movement of the ferromagnetic particles may vary. These factors include: the mass, shape, and intensity of the rotational magnetic field strength, size and viscosity of the medium and the magnetic properties of the particles.

Various movements, rotational, vibrational, translational ferromagnetic particles, and swirling motion generated EMF LF, it stimulates intensive mixing the substances in the cell and outside it, in the micro - to macro and volumes [1, 14]. Such conditions create the possibility for the occurrence of physical and chemical processes, which is not always possible or impossible in vivo. Thus, the effect of EMF LF with a frequency of 45 Hz for 60 minutes intensifies the physical and chemical processes occurring within a cell, which helps speed up the growth of the microflora.

Analysis photo photon spectra are shown in Figure 3 shows that the frequency of the signal, the processed product, equal to 100 Hz, disinfecting effect is maximal.

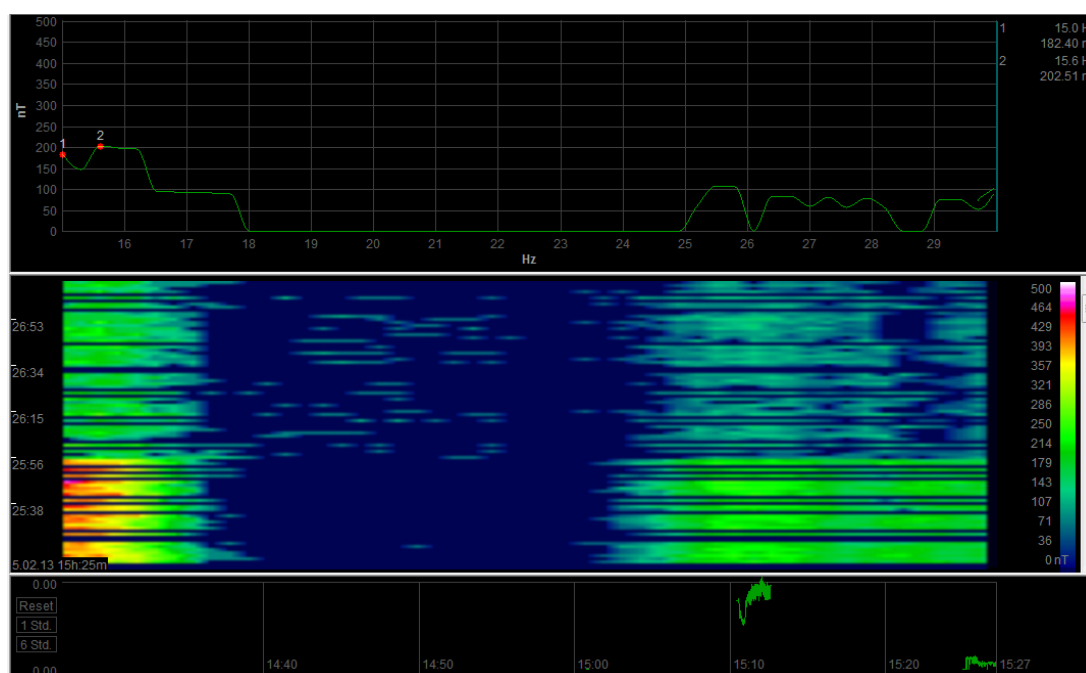


Figure 3: The reflection spectrum of photons from the processed product at the processing frequency of 100 Hz and a duration 30 minutes

In the photo recorded purple part of the spectrum, which formed the photons emitted by the electronic processing of the product.

The frequency of the experimental pulse 100 Hz. Given that the resonance occurs at the coincidence of the amplitude fluctuations, it is possible at times the ratio of the natural frequencies of oscillations of the electrons and the frequency of external influence, so the frequency of the emitted photons must be an integer. Since the color of the reflected signal from the object to be processed (meat), corresponding to the most efficient mode, blue, it means that the wavelengths of emitted photons are integers. On this basis there is reason to believe that the frequency of the photons, emitted by electrons the material being processed vary in the range $(6,0 \times 10^{14} \dots 7,0 \times 10^{14}) \text{ Hz}$. This is the photons of light violet region of the spectrum band.

CONCLUSION

When exposed on raw meat with a frequency of 45 Hz and a duration of 60 minutes there is the accelerated development of the microflora by reducing the period of lag phase.

From these data it follows that under the influence of a frequency of 100 Hz and a duration of 30 minutes there is a resonance frequency EMF LF external and internal frequencies. This statement explains the decrease of microflora activity for a given treatment. With the advent of internal resonance in microflora, analogous of the same resonance occurs in the cells of raw meat, which in turn may lead to a complete or partial destruction of the cellular structure of the raw meat.

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