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The Effect of *Aspergillus Niger* Fungus on the Development of Fungus Defect in Matured Raw Meat

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ABSTRACT

Meat is a source of complete proteins of animal origin, which is necessary for the construction of human body tissues, synthesis and exchange of substances. In the RA, serious attention is paid to obtaining meat raw materials, sanitary and hygienic requirements and storage. However, even a high level of control does not allow consumers to be protected from the presence of low-quality and defective meat raw materials at consumption points. Sometimes they occur in meat raw materials of non-slaughterhouse origin, sometimes as a result of violating the rules of storage and transportation. The purpose of the work is to select and separate defective beef raw materials and to find out the defect causes.

Introduction

Raw meat makes up 60-70 % of the diet of the population in the Republic of Armenia and it is also of strategic importance. Today, in our country, attention is paid to obtaining meat raw materials, sanitary-hygienic requirements and storage. Meat is a source of complete proteins of animal origin, which is necessary for the construction of human body tissues, synthesis and exchange of substances, it is also a source of phosphorus (www.fitaudit.ru). Nutrients present in meat take part in the physiological functions of nervous tissues, fats, vitamins of group B, microelements. Beef consists of protein, carbohydrates, fat, water, enzymes, vitamins, extractive substances (Hambardzumyan, et al.,).

Meat belongs to the category of perishable foods,

therefore, when stored in unfavorable conditions, undesirable changes may occur in it. Some of them are caused by physicochemical factors, others are the result of the biological activity of microbes. The speed, nature and depth of such changes depend on a number of factors:

1. Pre-slaughter state of the animal
2. Sanitary and hygienic condition of meat processing and storage
3. Nature of microbial flora, etc. (Irkitova, 2017).

The meat mold process depends on the degree of accumulation of mold spores on the surface of the raw meat. Contamination of meat with mold can occur from air, refrigerators, during violation of storage and transportation conditions. Fungi are aerobic; therefore,

they develop more often on the surface of meat. Fungi can develop in an acidic environment ($pH=5.0-6.0$), relatively low air humidity, low temperature and lack of ventilation.

Some mold species grow at 1-2 °C, even below 0. Fungi develop more slowly, so their development occurs during long-term storage of meat (Krasnikova, 2016).

Molding is accompanied by the breakdown of proteins, formation of amino acids, deamination of the latter and the ammonia formation. In connection with that circumstance, the reaction of the meat environment shifts to the basal, which creates favorable conditions for the development of spoilage microbes (Irkutova, 2017).

Using such meat in industry causes serious difficulties for producers. In this case, sometimes excessive preliminary heat treatment is required, but it is necessary to change the compositions and thermal parameters of some technological processes, which creates an excessive burden for the manufacturer (Krasnikova, et al., 2016).

However, even a high control level does not allow avoiding the presence of low-quality and defective meat raw materials at the points of consumption. Sometimes they occur in meat raw materials of non-slaughterhouse origin, sometimes as a result of violating the rules of storage and transportation (Borodina, et al., 1980).

Materials and methods

As a result of the raw meat market investigation, we faced some simple problems, namely the presence of defective meat at the points of consumption, processing of defective meat, presentation of defective meat instead of fresh, without predicting the consequences. Therefore, there was a demand to study meat defects in the market, to explain their causes and to develop measures to eliminate or prevent them. As a result of the surveys, it became clear that the majority of consumers buy and use mostly beef; so beef, regardless of its category, became the object of the current work. The purpose of this work is to select and identify defective beef raw materials from consumer points (market, supermarkets) and carry out laboratory research to find out the causes of defects. To this end it was determined to conduct the following investigations:

- chemical composition, properties and pH of raw meat, particularly beef
- microbiological indicators of meat raw materials
- identifying defect type
- investigating sensory, physicochemical and microbiological indicators of defective raw meat

- developing the ways of defect elimination.

The pH of beef (category I), content of fungi/yeasts, particularly *Aspergillus niger*, which develop mainly in the folded parts of the meat surface and in an airless environment, were studied. Sampling was carried out from different points of consumption: two samples from the market, two samples from supermarkets. To perform the experiments the sampled meat raw material was kept at 0-4 °C for 24 hours.

Microbiological studies of the samples were carried out in the laboratory of the Faculty of Biology of Yerevan State University, while physicochemical studies and pH determination were carried out in the laboratory of the Chair of Animal-Based Food Products Processing Technology of the Armenian National Agrarian University. The experiments were performed in triplicate, and the arithmetic mean value was taken as the result. It should be noted that the research of the samples was carried out with meat tenderloin on 1, 3, 5 days of storage.

In order to determine the amount of fungi, samples were prepared and kept in a thermostat for 5 days at 37 °C, which is a favorable environment for the rapid growth of fungi, then the CFU of fungi, particularly *Aspergillus niger*, were calculated (GOST 54354-2011, GOST 21237 -75).

Results and discussions

Determination of chemical composition of beef was carried out in accordance with MM TC 034. As it was mentioned, the category I beef samples from the market (Sample I, II) and supermarket (Sample III, IV) were tested and the results are recorded in Table 1.

Table 1. Chemical composition of beef*

| Category I beef | In 100 grams of the product | | | |
|-----------------|-----------------------------|-------------|---------|--------|
| | Water, % | Proteins, % | Fats, % | Ash, % |
| Sample I | 64.5 | 18.6 | 16.0 | 0.9 |
| Sample II | 64.8 | 17.9 | 16.5 | 0.8 |
| Sample III | 65.7 | 18.4 | 15.0 | 0.9 |
| Sample IV | 66.1 | 17.6 | 15.4 | 0.9 |

*Composed by the authors.

As can be seen from the results of Table 1, the sampled meats have almost the same chemical composition, which means that the changes taking place in them can be basically the same. Determination of the pH in the folded part of the samples will reveal the degree of the raw meat maturation. For this purpose, the samples were kept at 0-4 °C for 1, 3, 5 days. The average numerical values of the performed studies are presented in Table 2.

Table 2. pH indicators in the folded part of tested samples*

| Sample number | Ph |
|----------------------|-----|
| Sample I / day 1 / | 6.3 |
| Sample II / day 3 / | 6.0 |
| Sample III / day 5 / | 5.8 |

*Composed by the authors.

As the results of Table 2 show, during the storage period of 1, 3, 5 days, there are changes in the meat pH, in a decreasing order (Figure). Such a change occurs as a result of the breakdown of glycogen during storage, when lactic acid accumulates, as a result of which the pH index decreases (Velichko and Mashanov, 2019). This is a normal process of meat maturation, but depending on the storage conditions, microbiological changes, particularly fungal ones, can damage the quality of meat raw materials and become a threat to the further meat preservation (Antipova and Zharebtsov, 1991).

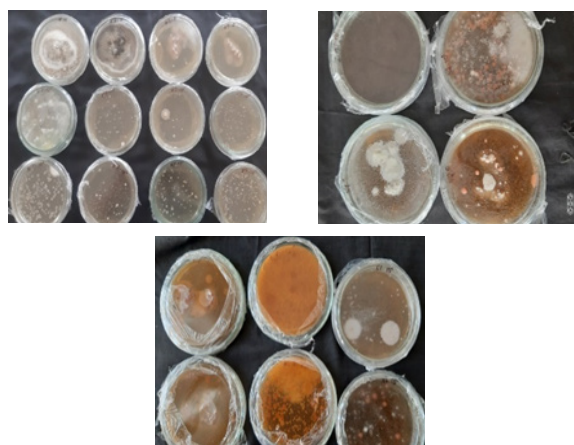


Figure. Samples on the days of 1, 3 and 5.

Table 3. Determination of the fungi/mold amount in the folded part of raw meat*

| Sample number | Aspergillus niger CFU/gram |
|---------------------|----------------------------|
| Sample I /Day 1 / | 2.4 x 10 ⁴ |
| Sample II /Day 3 / | 2.5 x 10 ⁴ |
| Sample III /Day 5 / | 7.8 x 10 ⁴ |

*Composed by the authors.

The analysis of Table 3 shows that the meat storage conditions have a rather serious effect on the microbiological indicators, because after 5 days of storage, the amount of fungi in the folded area increases and reaches 7.8 x 10⁴ CFU/g. As we know, frozen beef reaches its best taste and quality indicators during storage at 0-4 °C for 5-10 days, but it is important to maintain all storage parameters: relative air humidity, movement speed and temperature (Velichko and Mashanov, 2019). Under these conditions, the meat raw material keeps its original properties and becomes a high-quality raw material for meat processors. The analysis of the table enables to state that it is not possible to provide such storage conditions in household refrigerators at home, as a result, meat raw materials become not only of poor quality, but can also be a source of growth and development for various types of fungi, making meat raw materials unsafe for consumption.

Conclusion

In order to obtain safe and high-quality meat raw materials, it is necessary to control not only the receipt of meat raw materials in slaughterhouses, but also its preservation, ensuring clear conditions for cold storage.

Summing up the scientific work, we can draw the following conclusions:

- Meat sampling was conducted and the chemical composition depending on its type was studied.
- Changes in the pH of raw meat during storage were determined and it was substantiated that the pH changes in raw meat during storage, even in folded parts, proceed according to the regular principles, in descending order.
- The growth of *Aspergillus niger* fungi in the folded part of raw meat during storage was determined during 1, 3, 5 days of storage.

- It was found out that in the folded parts of raw meat, even in case of acidic range of the pH index, the mold defect occurs, this can be proved by the high amount of *Aspergillus niger* fungus – 7.8×10^4 CFU/g.

The correct storage of raw meat has been known for a rather long time and despite this, we still encounter various raw meat defects in markets and supermarkets. Based on the above, we suggest organizing a strict control of the storage conditions, depending on the heat treatment, the correct arrangement of the meat, in order to exclude the occurrence of possible defects.

References

1. Antipova, L.V., Zherebtsov, N.A. (1991). "Biochemistry of Meat and Meat Products", Voronezh, - 246 p. (in Russian).
2. Borodina, Z.V., Grimm, A.I., Danilov, M.M. (1980). Research on Food Products. Economy, - 272 p.
3. GOST 21237-75. Meat. Methods of Bacteriological Analysis.
4. GOST R 54354-2011. Meat and Meat Products. General Requirements and Methods of Microbiological Analysis.
5. Hambardzumyan, V., Harutyunyan, Zh., Khachatryan, N. (2008). Food Expertise, Yerevan, - 127 p. (in Armenian).
6. <http://www.fitaudit.ru/food/167937>. FitAudit (accessed on 18.10.2022).
7. Irkitova, A. N. (2017). Microbiology of Products of Animal Origin. Manual / A. N. Irkitova; AltGU. - Barnaul, - 152 p.
8. Krasnikova, L.V. (2016). Microbiology of Products of Animal Origin. Manual / Krasnikova L.V. — Saint-Petersburg: Trinity Bridge, — 296 p.
9. Technical Regulation of EAEU Customs Union 034. "On the Safety of Meat and Meat Products".
10. Velichko, N.A., Mashanov, A.I. (2019). "Technology of Meat and Meat Products" - Krasnoyarsk, - 345 p.

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