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The collective monograph describes the priority areas for development of scientific research: domestic and foreign experience. The general issues of the medical, biological and veterinary sciences, etc. are considered. The publication is intended for scholars, teachers, postgraduate students, and students, as well as a wide readership.

CHAPTER «VETERINARY SCIENCES»

ASSESSMENT OF SAFETY AND FAT QUALITY OF BIRDS 'CARCASES DURING THEIR PRODUCTION AND STORAGE ACCORDING TO DEVELOPED METHODS

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Abstract. The urgency of the work is the need to establish criteria for assessing the safety and quality of poultry meat at facilities for its production and storage, due to the development of new express and improved common methods of controlling the safety and quality of poultry meat for risks (biological, chemical, physical) their life cycle. Studies have assessed the safety and quality of poultry carcasses using new and improved methods for determining the acid and peroxide levels of fat compared to conventional methods for determining the degree of freshness of poultry meat.

Organoleptic evaluation of fresh poultry meat was established – for storage in a refrigerated chamber at a temperature of 0−4 °C for 5 days; doubtful degree of freshness – birds for storage in a refrigerator at a temperature of 0−4 °C for 6–7 days; stale – for storage in a refrigerator at a temperature of 0−4 °C for more than 7 days on the appearance of the carcass, color, odor on the surface of the carcass and near the bones, the state of the thoracic cavity, subcutaneous and internal adipose tissue, muscle consistency, broth for cooking samples.

There is a high probability of acid number of poultry fat of moderate freshness – 1.76±0.12 mg of *NaOH* ($p \leq 0.001$) and stale fat – 2.83±0.07 mg

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of *NaOH* (p≤0.001) compared to the acid number of fresh fat poultry (0.72±0.04 mg *NaOH*), as well as indicators of volatile fatty acids (VFA) in poultry meat of moderate degree of freshness – 6.62±0.43 mg *KOH* (p≤0.001) and stale fat – 11.05±0.37 mg *KOH* (p≤0.001) compared to the content of VFA of fresh poultry meat (2.61±0.24 mg *KOH*). Studies have established a high reliability of determining the indicators of volatile fatty acids in poultry meat – in 98.2–99.7% and the results of studies on the indicators of the microscopic method for determining the number of bacteria in poultry meat – in 98.5–99.8% compared to the acid number as determined by the developed method. The reliability of the indicators for determining the acid number of poultry fat was according to the developed method was 99.9%.

Therefore, the developed method for determining the acid number of poultry fat can be used to determine the quality of poultry meat, because the quality of meat depends on the quality of fat: the acid number of fresh poultry fat – up to 1.0 mg of *NaOH*; questionable degree of freshness – from 1.1 to 2.5 mg of *NaOH*; stale – more than 2.5 mg of *NaOH*.

There is a high probability of peroxide content of poultry fat of the appropriate degree of freshness – 0.029 ± 0.002% J (p≤0.001) and stale fat – 0.063±0.003% J (p≤0.001) compared to the peroxide value of fresh poultry fat (0.010±0.0007% J), as well as indicators of volatile fatty acids (LFA) in poultry meat of moderate degree of freshness – 6.40±0.48 mg *KOH* (p≤0.001) and stale fat – 10.43±0.23 mg *KOH* (p≤0,001) compared to the VFA content of fresh poultry meat (2.58±0.23 mg *KOH*). The results showed that more reliable data compared to the results of studies for the determination of volatile fatty acids in poultry meat – 98.5–99.7% and the results of studies on the indicators of the microscopic method for determining the number of bacteria in poultry meat – 99.0–99.6% were obtained using the developed improved method. The reliability of the indicators for determining the peroxide value of poultry fat according to the developed improved method was 99.9%.

Therefore, the developed improved method for determining the peroxide value of poultry fat can be used to determine the quality of poultry meat, because the quality of meat depends on the quality of fat: peroxide value of fresh poultry fat – up to 0.010% iodine of questionable degree of freshness – from 0.010 to 0.040% iodine; stale – more than 0.040% iodine.

The developed methods for determining the safety and quality of poultry carcass fat can be used by state veterinary inspectors as simple test methods to carry out appropriate state risk-based control of poultry meat production and storage facilities.

1. Introduction

The development of the agro-industrial complex of Ukraine, in particular the production, storage and circulation of poultry meat is currently one of the most promising branches of agriculture in our country. The principles of a market economy, the focus on Ukraine's accession to the European Union and the integration of the country's agro-industrial production into the relevant European structures require the production of safe and high-quality raw meat in compliance with the legislation on their control over the implementation of the HACCP system [1, p. 23; 2, p. 10].

With Ukraine's accession to the WTO and its gradual accession to the European Community, the government has set itself the task of taking steps to gradually transition to new international requirements, including state risk-oriented control of dangerous factors in poultry meat production and circulation. Modern risk-oriented control over the safety of poultry meat during the implementation of the HACCP system at the facilities for production and processing of poultry meat, as well as during storage at wholesale bases, sales in agri-food markets, supermarkets, shops will ensure high quality food, as well as compliance with proper control of hygiene and sanitation for the production and circulation of poultry meat, veterinary examination and evaluation of poultry slaughter products [3, p. 218].

For the production and storage of poultry meat it is necessary to comply with sanitary and hygienic requirements in accordance with the requirements of applicable regulations [4, p. 13; 5, p. 17; 6, p. 23].

Today the legal basis for ensuring the production of safe and quality products in Ukraine is formed by a set of national and international regulations [7, p. 36]. The problem of the study is the need to establish criteria for assessing the safety and quality of poultry meat during its production, as well as the development of new rapid and improved generally accepted methods of controlling the safety and quality of poultry meat for risks (biological, chemical, physical) during their life cycle [8, p. 136].

Risk-oriented control of the enterprise for production and storage of poultry carcasses is carried out according to the criteria for determining the risks associated with poultry, food products, market operator and violation of sanitary and hygienic requirements during the production and storage of poultry meat [9, p. 38].

Foreign and domestic researchers have paid considerable attention to the development and application of new and improved methods of food safety and quality control, namely the detection of falsification of meat products – Doosti A., Ghasemi D. P., Rahimi E. J. [10, p. 150], improved qualitative analysis of meat and meat products – Sakalar E., Abasiyanik M. F. [11, p. 9383], Hird H., Chisholm J., Sanchez A. [12, c. 647], determining the degree of freshness of minced meat – Yatsenko I.V., Bogatko N.M. [13, p. 27], establishing the degree of freshness of animal fat according to the developed express methods – Bogatko N.M., Fotina T.I., Savchuk G.V. [14, p. 41].

The **purpose** of the work is to establish criteria for assessing the safety and quality of poultry carcass fat according to the developed and improved methods for determining the freshness of freshness according to the acid and peroxide number of poultry fat.

The **task** is to assess the safety and quality of poultry carcasses using new and improved methods for determining the acid and peroxide levels of fat compared to generally accepted methods for determining the degree of freshness of poultry meat.

2. Materials and methods

The material was chilled carcasses of gutted birds and their fat in a total of 36 samples of different degrees of freshness: fresh carcasses − for storage in a refrigerator at a temperature of 0−4 °C for 5 days; doubtful freshness − for 6−7 days for storage in a refrigerator at a temperature of 0−4 °C; stale − more than 7 days for storage in a refrigerator at a temperature of 0−4 °C. The acid and peroxide number of fat and the degree of freshness of poultry meat were determined according to the developed methods according to organoleptic parameters [15, p. 35], the content of volatile fatty acids, microscopy of smears-imprints from the deep layers of meat, the reaction with copper sulfate by conventional methods [16, p. 12; 17, p. 7].

3. Organoleptic studies of poultry carcasses to establish the degree of freshness

The quality of poultry meat depends not only on the quality of feed, types of feed, poultry slaughter, but also on the production of poultry meat at the facilities and storage in compliance with sanitary and hygienic requirements, especially the shelf life and temperature.

Characteristics of poultry carcasses: muscles are well developed, the shape of the breast is rounded, the keel of the sternum does not stand out, deposits under the skin fat in the lower abdomen are insignificant; the skin is clean without tears, scratches, bruises and hemorrhages; skin color pale yellow with or without a pink tinge; skeletal system without deformation, the sternum is cartilaginous, easily bent.

Organoleptic parameters of fresh poultry carcasses for storage in a refrigerator at a temperature of 0–4 °C for 5 days were: the surface of the carcass is dry, whitish-yellow with a pink tinge, odor on the surface of the carcass and near the bones, as well as the thoracic cavity pleasant and characteristic of this species of bird, without foreign odors, the surface of the carcass is yellow-pale; subcutaneous and internal adipose tissue – pale yellow or yellow; thoracic serous membrane pale pink, odorless; pectoral and hip muscles slightly wet when cut, the consistency of the meat is elastic (the hole when pressed with a spatula in the chest muscles quickly leveled off), the color of the muscles is pale pink; for cooking samples the broth is transparent, pleasant aroma, on the surface of the broth a significant number of fat globules.

Organoleptic parameters of the questionable freshness of poultry carcasses when stored in a refrigerator at a temperature of 0–4 °C for 6–7 days were: the surface of the carcass in places wet, sticky under the wings, in the armpits and skin folds; whitish-yellow color with a gray tinge, the smell on the surface of the carcass and near the bones, as well as the thoracic cavity is acidic, slightly musty, unpleasant and inherent in questionable freshness, the surface of the carcass is yellow-dull color; subcutaneous and internal adipose tissue – pale yellow; thoracic serous membrane pale gray, with a musty odor; pectoral and hip muscles when cut wet, slightly sticky, the consistency of the meat is less elastic (the hole when pressed with a spatula in the chest muscles leveled up to 1 minute), the color of the muscles pink-gray; during cooking samples, the broth is

cloudy, with a slight unpleasant odor, on the surface of the broth a small number of fat globules.

Organoleptic characteristics of stale poultry carcasses when stored in a refrigerator at a temperature of 0–4 °C for more than 7 days were: the surface of the carcass is covered with mucus, especially under the wings; in the armpits and folds of the skin whitish-yellow with a gray tinge, in places with dark or greenish spots, the smell on the surface of the carcass and near the bones, as well as the thoracic cavity musty, unpleasant and characteristic of stale, the surface of the carcass dull color; subcutaneous and internal adipose tissue – pale yellow, and the internal yellowish-white with a gray tinge; thoracic serous membrane of gray color, with a musty odor, the presence of a mucous odor was detected; pectoral and hip muscles are significantly moist when cut, sticky, the consistency of the meat is not elastic, flabby (the hole when pressed with a spatula in the chest muscles is not aligned), the color of the muscles is gray; during cooking samples the broth is much turbid, with a large number of flakes, a sharp musty rotten smell, there are no fat balls on the surface of the broth.

4. Evaluation of safety and quality of poultry carcass fat according to the developed method of determining the acid number of fat

Studies have established the degree of freshness of poultry meat and fat according to the developed methods for determining the acid number of poultry fat and improving the determination of the peroxide value of fat and conventional methods. The research results are shown in tables 1, 2.

The method of determining the acid number of poultry fat using an alcohol-benzene mixture was based on processing the test sample of domestic poultry fat melted in a water bath at 100 °C, neutralized alcohol-benzene mixture and subsequent titration of free fatty acids with sodium hydroxide solution 0 wt. 1 mol/dm^3 to obtain a stable pink color and subtract the acid number of poultry fat in mg *NaOH* according to a given formula [18, p. 3].

$$X = \frac{V \cdot K \cdot 4,00}{m}$$

X – is the acid number of poultry fat, mg *NaOH*;

V – is the volume of sodium hydroxide solution with a mass concentration of 0.1 mol/dm^3 used for titration of the test sample, cm^3;

K − is the correction factor of sodium hydroxide solution with a mass concentration of 0.1 mol/dm^3;

4.00 − the amount of mg of sodium hydroxide contained in 1 cm^3 of sodium hydroxide solution with a mass concentration of 0.1 mol/dm^3;

m – is the mass of the experimental sample of poultry fat, g.

The results of tests of generally accepted methods for determining the quality of poultry meat and the developed method for determining the acid number of poultry fat are presented in table 1.

Table 1

Indicators of the acid number of poultry fat and the quality of poultry meat by conventional methods at different degrees of freshness (M±m, n=36)

Indicators	The degree of freshness of poultry fat and meat		
	fresh (n=12)	questionable freshness (n=12)	stale (n=12)
Acid number of poultry fat, mg *NaOH*	0.72±0.04 (to 1.0)	1.76±0.12*** (1.1−2.5)	2.83±0.07*** (more than 2.5)
The amount of VFA (volatile fatty acids) in poultry meat, mg *KOH*	2.61±0.24	6.62±0.43***	11.05±0.37***
Smear microscopy (number of bacteria in poultry meat)	6±1	18±2*	51±3***
Reaction with copper sulphate (evaluation of poultry broth after addition of copper sulphate solution)	the broth is transparent	turbidity of the broth	in the broth significant turbidity, the formation of a jelly-like precipitate

Note. * − p≤0.05, *** − p≤0.001; VFA content for fresh meat − up to 4.50 mg *KOH*; of doubtful freshness – 4.50−9.00 mg *KOH*; stale − more than 9.00 mg *KOH*; rate of microorganisms for fresh meat − single microorganisms or up to 10; questionable freshness − from 11 to 30 microorganisms; stale − more than 30 microorganisms per 1 average field of view.

Analyzing table 1, it is necessary to note the high probability of acid number of poultry fat of moderate degree of freshness − 1.76±0.12 mg of *NaOH* (p≤0.001) and stale fat − 2.83±0.07 mg of *NaOH* (p≤0.001) compared to indicators of the acid number of fresh poultry fat (0.72±0.04 mg of *NaOH*), as well as indicators of volatile fatty acids (VFA) in poultry

meat of moderate freshness − 6.62±0.43 mg *KOH* (p≤0.001) and stale fat − 11.05±0.37 mg *KOH* (p≤0.001) compared to the content of VFA of fresh poultry meat (2.61±0.24 mg *KOH*).

When determining the number of microorganisms in poultry meat, the high probability was the value in stale meat − 51±3 (p≤0,001) compared to fresh poultry meat (4±1), and in meat of questionable freshness, this figure had a low probable difference − 18±2 (p≤0.05). The quality of the reaction with copper sulphate corresponded to the given degrees of freshness of poultry meat.

The results showed that more reliable data compared to the results of studies for the determination of volatile fatty acids in poultry meat − 98.2−99.7 % and the results of studies on the indicators of the microscopic method for determining the number of bacteria in poultry meat − 98.5–99.8 % were obtained using the developed method for determining the acid number of poultry fat. Also, the highest stability of the indicators for determining the acid number of poultry fat was according to the developed method was 99.9 %.

Studies have shown that the data on the determination of the acid number of poultry fat by the developed method for determining the degree of freshness were stable and reliable − this is confirmed by the indicators of conventional methods for determining the quality of poultry meat, which are listed in Table 1.

Therefore, the developed method for determining the acid number of poultry fat can be used to determine the quality of poultry meat, because the quality of meat depends on the quality of fat: the acid number of fresh poultry fat − up to 1.0 mg of *NaOH*; questionable freshness − from 1.1 to 2.5 mg of *NaOH*; stale − more than 2.5 mg of *NaOH*.

5. Evaluation of safety and quality of fat of poultry carcasses according to the developed improved method of determination of peroxide number of fat

We have also developed an improved method for determining the peroxide value of poultry fat. The method of improving the determination of the peroxide value of poultry fat was based on the use of a test sample of poultry fat melted in a water bath, treated with a mixture of acetic glacial acid and chloroform in the presence of saturated potassium iodide solution

with a mass concentration of 30 %, in the presence of an indicator of starch solution in the amount of 0.6–0.8 cm^3 with a mass fraction of 1.0 %, added to 25.0–26.0 cm^3 of distilled water, sodium thiosulfate solution with a mass concentration of 0.01 mol/dm^3 until disappearance blue color and subtracting the peroxide value of rabbit fat in % iodine according to a given formula [19, p. 4].

$$X = \frac{(V - V_1) \cdot K \cdot 0,00127 \cdot 100}{m}$$

X – is the peroxide value of poultry fat, % J;

V – is the volume of sodium thiosulfate solution with a mass concentration of 0.01 mol/dm^3 used for titration of the test sample, cm^3;

V_1 – is the volume of sodium thiosulphate solution with a mass concentration of 0.01 mol/dm^3 used for titration of the control sample (without fat sample; to check the quality of the reagents), cm^3;

K – is the correction factor for conversion to the exact sodium thiosulfate solution with a mass concentration of 0.01 mol/dm^3;

0.00127 – the number of grams of iodine is equivalent to 1 cm^3 of sodium thiosulfate solution with a mass concentration of 0.01 mol/dm^3;

m – is the mass of the experimental sample of poultry fat, g.

The results of tests of generally accepted methods for determining the quality of poultry meat and the developed improved method for determining the peroxide value of poultry fat are presented in table 2.

Analyzing table 2, it is necessary to note the high probability of peroxide counts of poultry fat of the appropriate degree of freshness – 0.029±0.002 % J ($p \leq 0.001$) and stale fat – 0.063±0.003 % J ($p \leq 0.001$) compared to peroxide counts of fresh poultry fat (0.010±0.0007 % J), as well as indicators of volatile fatty acids (VFA) in poultry meat of moderate freshness – 6.40±0.48 mg *KOH* ($p \leq 0.001$) and stale fat – 10.43±0.23 mg *KOH* ($p \leq 0.001$) compared to the content of VFA of fresh poultry meat (2.58 ± 0.23 mg *KOH*).

When determining the number of microorganisms in poultry meat, the high probability was in the meat of questionable freshness – 13±1 ($p \leq 0,001$) compared to fresh poultry meat (4±1), and in stale meat, this figure had no significant difference. The quality of the reaction with copper sulphate corresponded to the given degrees of freshness of poultry meat.

Table 2

Indicators of the peroxide value of poultry fat and the quality of poultry meat by conventional methods at different degrees of freshness (M±m, n=36)

Indicators	The degree of freshness of poultry fat and meat		
	fresh (n=12)	questionable freshness (n=12)	stale (n=12)
Peroxide value of poultry fat, % J (% iodine)	0.010±0.0007 (to 0.010)	0.029±0.002*** (0.010–0.040)	0.063±0.003*** (more than 0.040)
The amount of VFA (volatile fatty acids) in poultry meat, mg KOH	2.58±0.23	6.40±0.48***	10.43±0.23***
Smear microscopy (number of bacteria in poultry meat)	4±1	13±1***	50±5
Reaction with copper sulphate (evaluation of poultry broth after addition of copper sulphate solution)	the broth is transparent	turbidity of the broth	in the broth significant turbidity, the formation of a jelly-like precipitate

Note: *** − p≤0,001; VFA content for fresh meat − up to 4.50 mg *KOH*; of doubtful freshness − 4,50−9,00 mg *KOH*; stale − more than 9.00 mg *KOH*; rate of microorganisms for fresh meat − single microorganisms or up to 10; questionable freshness − from 11 to 30 microorganisms; stale − more than 30 microorganisms per 1 average field of view.

The results of research showed that more reliable data in comparison with the results of studies for the determination of volatile fatty acids in poultry meat − in 98.5−99.7 % and the results of studies on the indicators of the microscopic method for determining the number of bacteria in poultry meat − 99.0–99.6 % were obtained using the developed improved method. Also, the highest stability of the indicators for determining the peroxide value of poultry fat was according to the developed advanced method was 99.9 %.

Studies have shown that the data on the determination of the peroxide content of poultry fat by the advanced method for determining the degree of freshness were stable and reliable – this is confirmed by the indicators of generally accepted methods for determining the quality of poultry meat, which are shown in Table 2. Therefore, the developed improved method for determining the peroxide value of poultry fat can be used to determine the quality of poultry meat, because the quality of meat depends on the

quality of fat: peroxide value of fresh poultry fat − up to 0.010% iodine; questionable freshness − from 0.010 to 0.040% iodine; stale − more than 0.040% iodine.

In addition, it should be noted that the developed new and improved methods are effective and economical in the preparation of reagents, and their results gave specific quantitative indicators for the content of acid and peroxide numbers of poultry fat. Our methods are proposed in state veterinary laboratories as quantitative methods for determining the acid and peroxide levels of poultry fat, along with other methods for determining the quality and safety of poultry meat – determination of volatile fatty acids, microscopy and smear reactions with copper sulfate. We recommend the developed methods for determining the safety and quality of poultry carcass fat to state veterinary inspectors, as simple test methods, for the implementation of state risk-oriented control of poultry meat production and storage facilities.

6. Conclusions

1. The acid number of fresh fat of poultry − up to 1.0 mg of *NaOH*; questionable freshness − from 1.1 to 2.5 mg of *NaOH*; stale − more than 2.5 mg of *NaOH*; peroxide value of fresh poultry fat − up to 0.010% iodine; questionable freshness − from 0.010 to 0.040% iodine; stale − more than 0.040% iodine. The reliability of the developed methods was 99.9%.

2. The developed methods for determining the acid number of poultry fat and improving the determination of peroxide number of fat can be used in production laboratories for production and processing of poultry meat and meat products, wholesale bases, supermarkets, state laboratories of veterinary medicine and laboratories of veterinary and sanitary examination in agro-industrial markets, along with the generally accepted methods of controlling the degree of freshness of poultry meat during production and storage.

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