Assessment of the safety and quality of turkey meat depending on the methods of keeping

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Abstract. The research was carried out on broiler-type turkeys of the BUT-9 cross in the Republic of Mari El and private subsidiary farms. In accordance with our goals and objectives, the objects of research were blood and blood serum, red and white meat obtained from broiler turkeys of industrial type of cultivation and home type of cultivation. The study of turkey meat included: organoleptic studies, tasting evaluation of meat, determination of chemical and physico-chemical composition, energy value, amino acid and fatty acid composition of meat, microbiological studies, determination of meat freshness indicators The quality and nutritional value of meat was studied (anatomical cutting of turkey carcasses, chemical and physico-chemical indicators of meat, amino acid and fatty acid composition of meat, micro content- and macronutrients) the preservation of turkey meat of different content systems at t +2 +4 ° C (organoleptic, chemical, physico-chemical, microbiological indicators) and at t-12-14 ° C (organoleptic, chemical, physico-chemical indicators). White and red meat of the domestic content system is less stable during storage at t+2+4 °C according to such indicators as: pH, acidity/oxidizability coefficient, LFA, amino-ammonia nitrogen, protein, microbiological parameters (KMAFAnM). The study of the storage conditions of turkey meat at t-12-14 °C ensures the safety of meat a home growing system for 72 hours, and an industrial one for 96 hours. The meat of all growing systems, both females and males, had high stability during freezing storage. Study of storage conditions at t -12-14°C ensures the preservation of meat for 6 months without reducing the freshness indicators.

1 Introduction

Poultry farming is one of the branches of agriculture that was the first to get on an industrial basis and in the shortest possible time took a leading position in the production of poultry meat and eggs. Industrial breeding of turkeys as a branch of poultry meat is an important source of increasing meat production and expanding its assortment. In Russia, as in other countries, the transition from extensive seasonal to progressive year-round industrial production of turkey meat has been carried out [1,2]. The industrial technology of turkey

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meat production makes it possible to breed them in almost all regions of the country [3]. Currently, a big problem in industrial poultry farming is maintaining a high immune status of poultry to increase the safety of livestock, poultry productivity and, accordingly, the quality of meat. Scientists and practitioners have recently been paying great attention to the quality of poultry meat with the establishment of its important role in the human food chain and in the etiology of a number of serious human diseases [4,5,6].

In the Republic of Mari El, not only the poultry industry, in particular, turkey breeding, but also the farming industry is actively developing, since compared to other agricultural birds, turkey gives a way out there are several times more products. The farming type of cultivation implies the cultivation of poultry in the open ground with the climatic conditions of the area and with its own food base of the area, which cannot but affect the health of the bird, and hence the quality of meat [7]. Krasnoyarsk Krai is industrially developed, which entails industrial pollution of the environment, which means that farm-type turkeys, like other types of farm animals, are grown in industrial pollution zones, which, in turn, affects the quality of meat and is an urgent problem. Therefore, the study of the quality of turkey meat and its value in the food chain: animal -food - human is an urgent problem. Data on veterinary and sanitary examination and evaluation of turkey meat from different systems of keeping are limited, which is the relevance of this topic [8].

The purpose of our research was to determine the quality and safety of female and male turkey meat obtained under conditions of different cultivation systems in a region with an increased level of environmental pollution (for example, the Republic of Mari El).

2 Materials and methods

The studies were conducted on broiler-type turkeys of the BUT-9 cross at the slaughter age of 120 days of the Republic of Mari El and a private subsidiary farm. Comprehensive studies of meat were carried out in the laboratory of Veterinary and Sanitary Expertise of the Department of Microbiology and Veterinary and Sanitary Expertise with the basics of technology and standardization of animal products and a research and testing center. Determination of the amino acid and fatty acid composition of meat was carried out at the Institute of Biophysics. In accordance with our goals and objectives, the objects of research were blood and blood serum, red and white meat obtained from broiler turkeys of industrial type of cultivation and home type of cultivation.

The study of turkey meat included: organoleptic studies, tasting evaluation of meat, determination of chemical and physico-chemical composition, energy value, amino acid and fatty acid composition of meat, microbiological studies, determination of meat freshness indicators. Meat quality studies were carried out immediately after sampling, as well as during storage (at +2+4 °C and -12-14 °C at 85% relative humidity). The determination of the live weight of the turkey was carried out according to the generally accepted method, weighing on the scales of the second class of accuracy.

To determine the physiological status of the animal, blood was taken from the axillary vein and morphological examination of blood was carried out according to the following indicators: counting of erythrocytes and leukocytes; determination of hemoglobin by the hemoglobin cyanide method; the leukoformula was calculated in smears stained by the Papenheim method; erythrocyte sedimentation rate (ESR) by the Panchenkov method. The total protein was determined by reaction with biuretic blue. Protein fractions were determined by the nephelometric method, on a photoelectrocolorimeter with a red light filter in 10 mm wide cuvettes. The nutritional value of meat was determined by the relative content and ratio of moisture, fat, proteins and minerals in them. Determination of meat productivity - by anatomical cutting of poultry in accordance with the methodological Guidelines for the study of the quality of carcass and subcutaneous fat of slaughter pigs."

Determination of the concentration of hydrogen ions pH was carried out according to GOST R 51478-99 (ISO 2917-74); moisture was determined according to GOST 9793-74; fat according to GOST 23042-86; nitrogen and protein were determined by the Kjeldall method according to GOST 25011-81 and GOST R 50453-92 (ISO 937-78); mineral content (ash) according to GOST R 53642-2009; the content of the mass fraction of magnesium and calcium was determined by the complexometric method (titration with Trilon B in the presence of an indicator of acidic chrome dark blue); phosphorus content was determined by the spectrophotometric method according to GOST R 51482-99 (ISO 13730-96); the content of copper, iron, lead, and cadmium was determined on an atomic adsorption analyzer according to GOST 26931-86, GOST 26928-86, GOST 26932-86, GOST 26933-86, respectively; the amino acid composition of meat was determined on an amino acid analyzer A0326V2 (Knauer, Germany); the lipid and fatty acid composition of meat was determined on a gas-liquid chromatograph with a mass spectrometric detector 6890N /5975 (Agilent, USA).

The energy value of meat was determined by the calculation method according to the formula of Alexandrov V.A.

3 Results and discussion

The morphological composition of the blood is of great diagnostic importance. The morphological composition of blood is influenced by many factors, including the state of the animal's body, in particular, and its health. The ESR index is higher in industrial turkey: in females by 1.37%, in males by 0.33%. The number of erythrocytes and leukocytes in domestic-type females is lower than in industrial-type females by 0.17% and 3.10%, respectively.

In males of the domestic type of cultivation, unlike males of the industrial type, there is a higher content of the number of erythrocytes by 0.26%, however, there is a low content of leukocytes by 2.30%. The number of leukocytes in females of both growing systems is greater than in males.

The industrial cultivation system has a low hemoglobin content. In males of the domestic type of cultivation, unlike males of the industrial type, the hemoglobin content is 3.23% higher. The amount of hemoglobin in the blood is higher in females of the domestic type of cultivation than in the industrial type by 5.18%.

The total protein content in the blood serum of both growing systems is almost 1.5 times less than physiological norms, and in an industrial growing system the content is less than in a home one. At the same time, the females of the industrial system have more total protein than the males, and in the domestic system - on the contrary.

In general, all blood parameters were within the limits of physiological norms, with the exception of total protein in blood serum. In males and females of domestic and industrial types of cultivation, this indicator is slightly lower than normal, which may be explained by insufficiently balanced feeding. To assess the meat productivity, six heads of broiler turkeys (females) and six heads of broiler turkeys (males) of the BUT-9 cross of industrial and domestic types of cultivation (a total of 24 heads) were selected, characteristic of average weight indicators at the age of 120 days. The slaughter was carried out after 12 hours of starvation exposure. As a result of anatomical cutting, we determined the average mass of the carcass, the slaughter yield, the yield of edible and inedible parts. The parts of the carcass obtained during cutting were subjected to deboning. When deboning, the mass of pulp and the mass of bones were taken into account, and the mass of edible parts of the carcass was determined by weighing, expressing them as a percentage of the mass of the carcass.

The live weight of females of the domestic type of cultivation is inferior to the live weight of the industrial type of cultivation by 3.61%, in males - by 10.49%. Killer

the yield of the home type of cultivation is higher than that of the industrial type: in females by 8.80%, in males by 0.1%.

Domestic turkey females outperform industrial turkey females in terms of total carcass weight by 8.44%, gutted carcass weight by 7.35%, total meat weight by 4.19%, as well as separately white meat by 4.36% ($p>0.99$), muscle stomach weight by 0.19%, and consequently, by weight of edible parts by 2.82%($p>0.95$). However, domestic-type females are inferior to industrial ones in terms of such indicators as the mass of red meat by 0.08%, liver by 0.10%, heart by 0.18%, skin and subcutaneous fat by 0.87%, internal fat by 0.51% ($p>0.99$), inedible parts by 1.72%, bones by 3.53%. The ratio of edible parts to inedible parts is higher in domestic-type females compared to industrial by 0.33%. The ratio of the total mass of meat to bones in domestic-type females is higher than in industrial by 0.54% ($p>0.99$).

Males of domestic turkey surpass males of industrial turkey by 2.84% in total meat weight, as well as separately white meat by 1.91%, and consequently, by 2.95% in weight of edible parts, including liver weight by 0.19% ($p>0.95$), heart by 0.16%, muscular stomach by 1.28% ($p>0.99$). However, males of the domestic type of cultivation are inferior to industrial ones in terms of such indicators as the total mass of the carcass by 10.52%, the mass of the gutted carcass by 10.39%, the mass of red meat by 0.05%, skin and subcutaneous fat by 0.20%, internal fat by 0.33%, inedible parts by 3.19%.

Carcasses of domestic-produced females are superior to industrial ones in almost all (total muscle mass, mass of white meat and edible parts) in advantage compared to the industrial type of cultivation. According to the research methodology, the chemical analysis of meat samples was carried out after the control slaughter. White and red muscles were studied separately. The results of our research are presented in Table. The white meat of domestic-produced female and male turkeys has less moisture than that of industrial-produced females and males, respectively, by 1.59% and 3.78. The amount of ash in domestic and industrial females varies in the same range of values. In other indicators of chemical composition, the superiority remains with the home type of cultivation. Poultry meat contains more full-fledged and less hard-to-digest proteins (collagen and elastin), which determines its high nutritional value.

The red meat of females and males of the domestic type of cultivation, compared with industrial, contains less ash - by 0.05% and 0.12%, and moisture - by 3.13% and 3.20%, respectively. According to other indicators of chemical composition, the superiority also remains with the home type of cultivation.

In terms of the amount of energy, females of the domestic type of cultivation, compared with the industrial type, have a value of 6.78% less, and males, on the contrary, have 9.91% more. The indicators of the chemical composition of white and red meat of turkeys of the domestic content system are higher than those of the industrial one, but the indicators fluctuate within the norm.

Table 1. Chemical composition of white and red turkey meat

Indicators	**Industrial**		**Home**	
	Females Males	**Females Males**	**Females Males**	**Females Males**
White meat				
Protein, %	18.89±0.33	19.27±2.54	22.37±2.33	21.49±1.72
Moisture, %	65.37±1.71	66.87±4.56	63.78±0.54	63.09±0.68
Fat,%	2.53±0.26	2.13±0.01	2.95±0.02	2.41±0.11
Ash, %	1.17±0.01	1.12±0.01	1.17±0.01	1.12±0.02
Energy,	633.89±30.57	592.04±78.23	661.17±9.19	662.76±1.63

kJ				
Red meat				
Protein, %	18.38±1.01	17.39±3.63	19.17±2.35	22.85±0.82
Moisture, %	62.01±2.13	66.77±2.17	65.14±1.54	63.568±0.863
Fat,%	2.44±0.04	2.09±0.07	2.76±0.11	2.17±0.10
Ash, %	1.08±0.03	1.19±0.11	1.04±0.01	1.07±0.06
Energy, kJ	682.60±35.89	591.72±38.54	636.31±25.54	650.3 5±14.71

Turkey meat proteins have a high level of essential amino acids. Nutritional and biological value is determined by the significant content of essential amino acids, their optimal ratio. The consumer properties of meat are due to the content of biologically complete proteins in it, which are a source of essential amino acids. In this regard, we determined the quantitative content of amino acids in the studied meat samples. The ratio of amino acids in white and red meat of the domestic system is lower than in industrial meat due to the low content of essential amino acids in the meat of the domestic system (in white meat of females and males, respectively, by 5.2% and 4.9%; in red - by 3.3% and 9.2%), which directly affects the structure of meat, and therefore, it affects the quality of meat.

The greatest amount in meat of all growing systems of such essential amino acids as lysine, histidine, leucine, arginine. Moreover, the indicators are higher in females of both cultivation systems. In white and red meat of the domestic type, the content of interchangeable amino acids is higher than in industrial (in white meat of females - by 1.1%; in red meat of females and males, respectively, by 4.4% and 5.1%). The greatest amount in the meat of both growing systems of such interchangeable amino acids as aspartic acid and glutamic acid. Moreover, the indicators are higher in females of both systems.

According to the total composition of interchangeable and essential amino acids, white and red meat of home-grown type is inferior to industrial. This is especially noticeable in the red meat of home-grown males - by 14.3% ($p>0.99$). It is explained by high energy processes in connection with a mobile free-range lifestyle and an unbalanced diet in the conditions of the Siberian climate. An important feature is a higher body temperature, which is associated with a more intensive metabolism in the body, since in the conditions of the Siberian climate, essential amino acids are used in the energy processes of the body.

Vitamin and mineral nutrition is important for the normal growth and development of broiler turkeys. Excess or lack of minerals and vitamins cause diseases and reduce growth rates.

Muscle tissue is rich in minerals - iron, phosphorus, potassium, sodium, calcium, magnesium, zinc, which increases the biological and nutritional value of meat, so we decided to consider the main indicators of the mineral composition of turkey meat — calcium, magnesium, phosphorus and iron.

White meat of domestic-type females and males exceeds industrial meat in terms of calcium and iron content, respectively: in terms of calcium content - by 0.3% and 0.04%, in terms of iron content - by 14.15% (0.133 mg/kg) $p>0.99$ and 37.82% (0.374 mg/kg) $p>0.99$. In terms of the content of magnesium in white meat, compared with the manufactured type of cultivation, the differences are insignificant.

Indicators of red meat of females and males of domestic types of cultivation are higher than industrial in terms of the content of calcium and iron in it, respectively: in terms of calcium content - by 0.10% and 0.31%, in terms of iron content - by 35.42% (1.622 mg/kg) $p>0.95$ and 3.04% (0.059 mg/kg) $p>0.99$. In terms of the content of magnesium in the red meat of the home-grown type, compared with the industrial type of cultivation, the discrepancies are insignificant.

According to the phosphorus content in the red meat of the home-grown type, in contrast to the industrial type, the data vary. Thus, the red meat of domestic-type females contains

phosphorus more than industrial, by 8.82%, and the red meat of domestic-type males contains phosphorus less than industrial, by 30.61%. At the same time, the content of phosphorus and calcium in all growing systems is higher in females than in males. The content of iron, lead and copper in turkey meat varies within the normal range; red meat accumulates more of them than white meat in both cultivation systems. At the same time, the copper content in the white and red meat of the domestic system is higher than that of the industrial system: in the white meat of females and males, respectively, by 1.7% and 1.2%; in the red meat of males - by 0.2%. The red meat of the domestic system in terms of cadmium content fluctuates within normal values, but closer to the upper limits of the MDU. Thus, it can be concluded that the conditions of different content systems affect the mineral composition of turkey meat.

In red meat, the CMAFAnM exceeds the permissible value in the meat of female and male turkeys of the domestic cultivation system on the fifth day of storage (120 hours) at t +4 °C. In the industrial system of keeping turkeys, changes in the CMAFAnM index in meat above acceptable values were observed in females from the seventh day of storage, and in males only after the seventh day of storage. The KMAFAnM index increases during storage, while the amount of protein in meat decreases in direct proportion as a result of protein breakdown under the action of microorganisms.

Pathogenic microorganisms, including salmonella, were not detected in white and red meat of industrial and domestic methods of cultivation. The conditions of detention affect the microbiological indicators of the freshness of turkey meat. Thus, the white and red meat of the domestic content system is less stable during storage at t +2 +4 ° C (especially females). The study of the storage conditions of turkey meat at t +2 +4 ° C ensures the preservation of the meat of the home growing system for 72, and industrial for 96 hours. At the same time, red meat from both growing systems is less stable than white meat in both domestic and industrial growing systems.

The indicators of fat in the white meat of females and males of domestic and industrial types of cultivation fluctuate within normal values and do not change during storage. The acidity of white meat of females and males of domestic and industrial types of cultivation increases disproportionately due to the accumulation of lactic, orthophosphoric and other acids during storage, which is the norm during storage.

Amino-ammonia nitrogen during storage increases in the white meat of males and the meat of females of domestic and industrial types of cultivation, which is a normal phenomenon during storage as a result of the accumulation of amino acids and ammonia in meat. During storage, the peroxide number of fat in white meat of domestic and industrial types of cultivation increased as a result of fat oxidation with an increase in the formation of peroxides, but the indicators fluctuated within normal values (0.01-0.1% iodine).

The most resistant to storage at t +2 +4 ° C was the meat of the industrial type of cultivation. According to such indicators as the amount of protein, moisture, hydrogen ion concentration, acidity, oxidizability, acidity / oxidizability coefficient, amino-ammonia nitrogen, fat peroxide number, in aggregate, white meat of females and males of industrial type of cultivation can be stored for up to 96 hours, unlike white meat of domestic type, which is not stored more than 72 hours, as prescribed in the regulatory documentation. This fact is most likely explained by the introduction of biologically active and inhibitory substances into the diet of turkeys of industrial production, due to which there is no growth and reproduction, and perhaps even the suppression of microorganisms.

4 Conclusions

- Productivity indicators are higher in the home maintenance system. The slaughter yield of the domestic type of cultivation is higher than that of the industrial type: in females by 8.8%, in males by 0.1%. The ratio of edible parts to inedible parts is higher in the home type of

cultivation: in females by 0.33%, in males by 0.49%. The ratio of total muscle mass to bones in the home type of cultivation is higher in females by 0.54% (p>0.99), in males by 0.39%.

- The chemical indicators of white and red turkey meat of the domestic content system are higher than those of the industrial one. In the white meat of domestic females and males, the amount of protein is higher, respectively, by 3.47% and 2.22%, fat - by 0.42% and 0.29% (at p> 0.95), energy - by 4.31% and 11.95%. In red meat, the amount of protein is higher, respectively - by 0.79% and 5.45%, fat - by 0.32% (at p > 0.95) and 0.08%, energy - by 5.735% and 11.946%.

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