Qualitative analysis of quail meat of various genotypes

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Abstract. Quail breeding expands the range of poultry products through the production of highly nutritious dietary semi-finished and canned products. Quail meat is superior to other types of poultry. According to its physicochemical and organoleptic characteristics, it refers to a dietary product. The research objects are quail carcasses. In order to identify features of quantitative indicators of quail meat, carcasses of three genotypes were analyzed: Japanese quail, Estonian quail and hybrid quail - F1. The paper presents results of studies of the qualitative characteristics of quail meat of these genotypes. The data on the chemical composition, content of essential amino acids, and the nutritional value are presented. The organoleptic evaluation of carcasses, the structure of fresh meat of white and red muscles are described. The results allow us to determine the best genotype for producing meat products with a high biological value, as well as to establish differences and characteristics of the composition of quail meat depending on the genotype.

1. Introduction
Currently, functional quail meat food products are sold on the market, which is the basis for the production of original products with high quality and nutritional value indicators.

The poultry industry is going to increase the range of products. Quailing allows you to expand it through the production of highly nutritious dietary products - quail eggs and meat [1, 2, 3].

It should be noted that quails are resistant to many infectious diseases which ensures the ecological purity of meat [4, 5, 6].

Quail meat has a high protein content which exceeds the average indicator by 4-7%. It is rich in macro- and microelements, such as iron, phosphorus, calcium, sodium. The chemical composition and the nutritional value are not inferior to chicken meat. It is characterized by an optimal set of amino acids, the ratio and amount of which are close to the reference one [7, 8, 9].

The range of quail products includes:
• gutted carcasses of quail and processed products;
• semi-finished natural, salted, pickled, sprinkled products;
• chopped semi-finished products - minced meat, meatballs, croquettes, etc.;
• offal (liver, heart, neck).

In addition, quail meat is used for the production of baby and specialized food products.

Today, the requirements of the world market for the quality and safety of poultry products and the expansion of its range have increased. Domestic enterprises must adapt to changing conditions and expand the product range along with traditional poultry products.
2. Problem statement
Currently, the issues of the dependence of qualitative characteristics of quail meat on their genotype are understudied. There are data on the nutritional value of quail meat without taking into account the dependence of these indicators on the breed.

In the literature, there are data comparing the chemical composition of meat of Japanese male and female birds. Some differences in protein content were identified. In meat of females, content of protein is 1-2% less than in meat of males, while the amount of fat is higher by 0.5-1%. There are differences in energy values depending on age and gender traits [10, 11].

The aim of the study was to analyze and identify the characteristics of the chemical and amino acid compositions of quail meat of various genotypes, and evaluate carcasses. Based on the data obtained, the best genotype was determined; it made it possible to produce products with a high nutritional quality.

3. Materials and methods
The studies were conducted using the methods of variation statistics. The results were biometrically processed. The reliability of sample indicators was determined by the ratio of the sample indicator to its average error.

The meat samples belonged to three genotypes:
- Group I – carcasses of males of the Japanese breed,
- Group II – carcasses of males of the Estonian breed,
- Group III – carcasses of hybrid males.

To study the characteristics of hybrid quail meat, hens of the Japanese breed were crossed with males of the Estonian breed. In order to exclude the influence of phenotypic factors on the meat quality, the conditions of feeding were identical for all birds.

By the age of 8 weeks, the quail reaches its greatest live weight; then, their growth slows down. By the age of 56 days, the males were slaughtered.

The slaughter yield, the yield of edible part were determined when cutting carcasses. All carcasses were evaluated in terms of the muscular system and the presence of body fat. The nutritional value, amino acid composition of meat, and chemical indicators were studied for three quail populations. Meat sampling and preparation for testing were carried out in accordance with current regulatory documents [12, 13].

4. Discussion
Quail meat had high organoleptic characteristics: juiciness, aroma, taste, delicate consistence.

When determining the state of the skeletal system of carcasses for the presence of fractures, deformations and deviations were not detected. No other bone defects were detected during the studies.

The characteristics of the organoleptic characteristics of quail meat are presented in Table 1.

As a result of organoleptic studies of carcasses, it was established that the surface of all samples is dry, subcutaneous and internal fat is pale yellow. The serous membrane of the abdominal cavity is moist, shiny; the muscles in the section are slightly moist, pink, elastic; the odor is specific to fresh poultry meat. During the cooking test, it was found that broth was transparent and aromatic. No odor was detected.

It can be seen that for all indicators, carcasses of different groups do not differ.

In the muscle tissue of quail, white meat (pectoral muscles), red meat (drumsticks, thighs) and intermediate muscles of the dorso-scalpular part and wings are distinguished. The color depends on the content of pigments in the muscles. White meat and red meat differ in color and in the chemical composition. White muscles contain more protein and less fat [14, 15, 16, 17]. The structure of fresh meat of white and red muscles is presented in Figures 1-2.
### Table 1. Organoleptic evaluation of quail meat

| Parameter                                               | Feature                                      |
|---------------------------------------------------------|----------------------------------------------|
| Appearance and color:                                   |                                              |
| carcass surfaces                                        | yellowish gray                               |
| with a reddish tint                                     | whitish yellow with a pink tint              |
| subcutaneous and internal adipose tissue                | whitish yellow with a pink tint              |
| serous membrane of the abdominal cavity                 | moist, shiny, without mucus and mold         |
| Sectional muscles                                       | slightly moist, do not leave a wet spot on the filter paper; pale pink |
| Consistence                                             | muscles are dense, elastic, when pressed with a finger, the resulting fossa is quickly leveled |
| Odor                                                    | specific to fresh poultry                    |
| Transparency and aroma of the broth                     | transparent, aromatic                        |

**Figure 1.** Fresh quail meat of white pectoral muscles

**Figure 2.** Fresh quail meat of red pectoral muscles
When evaluating quail carcasses, the following data were obtained. The breast bones of the carcasses are covered with muscles. In all the carcasses, the muscular system is well developed, there was subcutaneous fat on the chest and abdomen. The mass of carcasses exceeded the minimum requirements of GOST R 54673-2011, therefore, all the carcasses for all Groups can be attributed to grade I [18, 19]. The evaluation is presented in Table 2.

**Table 2. Edible portion yield**

| Parameter              | Content, mg / g |
|------------------------|-----------------|
|                        | Group I         | Group II        | Group III        |
| Pre-slaughter mass, g  | 141.25±5.93     | 198.44±5.00     | 180.00±4.70      |
| Carcass weight, g      | 90.94±3.31      | 137.32±3.01     | 119.00±2.55      |
| Slaughter yield, %     | 64.38±1.32      | 69.20±0.81      | 66.11±1.05       |
| Edible portion yield, %| 82.54±0.61      | 82.9±0.42       | 84.34±1.01       |

The maximum mass of carcasses was observed in quails of group II. Hybrid quails also had a high pre-slaughter mass and a high carcass weight (p <0.001). All three groups have a high yield of edible parts (p <0.001), which makes it possible to use them for the production of semi-finished and canned products.

The muscle tissue of poultry compared to that of cattle contains more easily digestible protein. In terms of the chemical composition, quail meat differs from other poultry meat in lower fat and high protein content.

By the nutritional value, quail meat is superior to chicken meat. By the energy value, it is almost 5 times more caloric than chicken [20].

When studying the mineral composition, special attention must be paid to the exchange of calcium and phosphorus, since these elements are involved in various physiological processes.

Sodium transports nutrients through cell membranes, regulates the water-salt balance, and creates osmotic pressure.

Iron is part of some proteins, cytochromes; it is involved in the gas exchange. With aging, iron content in quail meat increases.

The results of studies of the nutritional value and the mineral composition of quail meat of various genotypes are presented in Table 3.

**Table 3. Nutritional value and mineral composition of quail meat of various genotypes**

| Parameter      | Content, mg / g |
|----------------|-----------------|
|                | Group I         | Group II        | Group III        |
| Moisture, %    | 74.13±0.03      | 74.17±0.03      | 74.20±0.01       |
| Protein, %     | 21.67±0.10      | 22.10±0.02      | 22.10±0.03       |
| Fat, %         | 3.93±0.02       | 4.15±0.05       | 4.03±0.07        |
| Ash, %         | 1.01±0.01       | 1.23±0.02       | 1.24±0.04        |
| P, mg/100g     | 187.12±0.45     | 188.11±0.41     | 188.51±0.17      |
| Ca, mg/100g    | 23.18±0.14      | 23.14±0.11      | 23.24±0.14       |
| Na mg/100g     | 43.87±0.15      | 45.12±0.17      | 44.18±0.12       |
| Fe, mg/100g    | 3.12±0.01       | 3.50±0.02       | 3.51±0.01        |
| Vitamin A, mg / 100 g | 0.07 | 0.07 | 0.07 |
All meat samples had an optimal ratio of protein to fat. In carcasses of group I, the protein content was 21.67%; in carcasses of groups II and III, it was at the same level. The difference in fat content is negligible (p < 0.001).

Quail meat is rich in minerals and vitamins. Vitamins are participants and biological catalysts of chemical reactions in living cells. The total protein content in meat does not adequately characterize the nutritional value, since along with complete proteins in meat, there are defective proteins (collagen, elastin). For a complete qualitative analysis of quail meat of various genotypes, the amino acid composition was determined (Table 4).

| Amino acid          | Group I        | Group II       | Group III  |
|---------------------|----------------|----------------|------------|
| Histidine           | 53.85 ± 0.011  | 55.81 ± 0.012  | 56.12 ± 0.014 |
| Isoleucine          | 53.86 ± 0.012  | 57.61 ± 0.016  | 57.54 ± 0.012 |
| Leucine             | 97.51 ± 0.010  | 101.85 ± 0.011 | 109.73 ± 0.015 |
| Valine              | 77.84 ± 0.013  | 77.44 ± 0.013  | 79.15 ± 0.011 |
| Threonine           | 58.37 ± 0.017  | 61.11 ± 0.017  | 64.23 ± 0.014 |
| Lysine              | 91.57 ± 0.012  | 92.57 ± 0.011  | 93.58 ± 0.010 |
| Methionine + cystine| 30.69 ± 0.014  | 31.88 ± 0.012  | 33.4 ± 0.017 |
| Phenylalanine + tyrosine | 65.51 ± 0.013 | 66.75 ± 0.014 | 68.49 ± 0.012 |
| Amount of Essential Amino Acids | 529.20 ± 0.102 | 545.02 ± 0.106 | 562.24 ± 0.105 |

Quail meat contains a large amount of essential amino acids. The best composition were observed in the samples of group III. The sum of essential amino acids exceeded the similar indicator for other groups - 562.24 ± 0.105 (p < 0.001).

5. Conclusion

The studies have shown that the qualitative characteristics of quail meat have a number of features due to the genotype.

Reliable data on the difference in the nutritional and biological values of quail meat of three genotypes were obtained. The data allowed us to conclude that it is possible to produce meat with the best quality indicators and a high content of amino acids. Each genotype must be analyzed.

Hybrid quail carcasses obtained by crossing Japanese and Estonian breeds contain the maximum amount of amino acids. The nutritional value of quail is close to similar indicators of the paternal form (Estonian quail). The organoleptic characteristics were high.

For the production of semi-finished products, one can use quail meat after deboning, as well as whole carcasses.

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