The Impact of Quail Breeding Conditions at Private Farmsteads on Meat Quality

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Abstract. In Russia, different quail breeds are widely grown and bred at specialized poultry farms and private farmsteads. In the Amur Region, only private farmsteads engage in this type of aviculture. The most common breeds are Pharaoh quail, Japanese quail, and Estonian quail. 100 eggs of the Estonian quail have been prepared for hatching in a specialized room at a private enterprise. The incubation has been carried out in the Rcom 20 MAX (RMX-20) machine at a temperature of + 37.2–38°C and 55–60% humidity over 17–18 days. The egg hatchability amounted to 75%. In Russia, the birds receive balanced complete feeds of the following grades: P-K-5, P-K-2-1, P-K-6, Start, Super Start, RusQuail, Multigain and others. These feeds include different percentage mixtures of corn, oats, wheat, barley, meals and various types of flour (soy, fish, rice, etc.), yeast, chalk, phosphates, sodium chloride and other minerals. In the Amur Region, the balanced feed ration for poultry is produced by local companies "Amuragrocenter" and "Grinodir". These products have been used for feeding the chicks. The study of the Estonian quail bred at a private farmstead using the Amur feeds revealed some changes. According to the literary sources, the average weight of the Estonian breed is 180–200 g. The weight of the quails grown under the specified conditions was significantly higher — up to 200–260 g. In many regions, consumers prefer local products that they trust.

1 Introduction

In recent years, meat products in Russia have become very diverse. The poultry processing industry is also gaining momentum in the market. The production of eggs and meat largely depends on the breeding performance and vitality of birds and its efficiency. The product range of the poultry processing industry is wide and diverse (chicken, turkey, quail, goose, ostrich, duck meat, etc.). The most popular of them is the quail. At present, quail meat and eggs are common at markets, on supermarket counters and even on the restaurant menus. In Russia, different quail breeds are grown and bred at specialized poultry farms and private farmsteads.

A quail is a collective name that refers to several small species of fowl belonging to either the partridge subfamily or the tooth-billed partridge subfamily (order Galliformes) [14].

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Historically, quail meat has been a royal meal. To catch a quail during a hunt was extremely lucky. In the past, the quail was considered an endangered species, so many countries engaged in its breeding. In Europe, the active development of this industry began in the 20th century, especially after scientists discovered that quail eggs help remove radioactive substances from the human body. However, Japan and China are the righteous founders of this poultry business branch.

Since quail breeding was a novelty in Russia, in the 1960s, the Department of Fowl Cage Management Technologies of the All-Russian Research Institute for Poultry Processing Industry formed a special group guided by Doctor of Agricultural Sciences, Professor N. V. Pigarev to develop management and feeding technologies for the Japanese quail suitable for the domestic poultry farms [5, 8].

Nutritionists recommend using quail meat in the treatment and prevention of certain diseases, such as gastritis, diabetes, stomach ulcers, kidney and liver diseases, diseases of the cardiovascular and respiratory system. Quail meat is also beneficial to people that have been exposed to radiation. This product is a rich source of essential amino acids for the human body. Quail meat has peculiar taste compared to many other types of meat and is considered dietary. Another feature is that quails rarely get sick and are less susceptible to disease due to their fairly high body temperature. Quails rarely suffer from ornithosis and salmonellosis. Thanks to the elevated body temperature of birds, these pathogens quickly die [1].

2 Materials and Methods

The quail breeding research was carried out at a private farmstead in Blagoveshchensk. The object of the study was the Estonian breed of the quail. The analysis of chemical composition (determination of fat by the Gerber Method per GOST 23042-86, determination of the mass fraction of moisture per GOST 33319-2015) and organoleptic characteristics of meat was performed at the laboratory of the Department of Agricultural Processing Technology of the Far Eastern State Agrarian University. The experimental data were mathematically processed using Microsoft Office Word 7, Excel 7, Statistika 10 programs.

3 Results

At present, there are many natural breeds of quail (Brown, Chinese Painted, ordinary, dumb, etc.) differing in size, color, and habitat. In addition to these, people also cultivated a variety of quail breeds (Pharaoh, Japanese, Manchu, Marble, Estonian quail, a cross between different breeds) with a live weight of 140 to 400 grams. The ancestor of all domestic breeds is the Japanese quail.

In the Amur Region, this type of aviculture is the domain of private farmsteads. The most common breeds are the Pharaoh quail, the Japanese quail, and the Estonian quail. Their comparative indicators are presented in Table 1.

The purpose of this study is the assessment of the impact of management conditions and feeds on the meat quality of quails bred at a private farmstead in the city of Blagoveshchensk, the Amur Region.

Research objectives:

1. Conduct a comparative analysis of the quail breeds raised in the Amur Region.
2. To substantiate the technology of growing Estonian quail in the conditions of private farmsteads, taking into account the fodder base of the region.
3. Conduct a comprehensive assessment of the quality of poultry meat.

Quail management is relatively easier compared to other fowl species because this bird is low-maintenance and adapts to any conditions well. The Estonian quail was cultivated in Estonia in 1988 by crossing three breeds. At present, it is the most common meat-and-egg breed [11].

Table 1. Indicators of quail breeds.

Breed	Yield type	Egg-laying capacity, pcs per year	Carcass weight, g
Pharaoh	meat	250–300	200–220
Japanese	egg	300–320	90–100
Estonian	meat and egg	280–310	180–200

To conduct the study, we purchased 100 eggs of the Estonian quail at a private farmstead in Blagoveshchensk. All eggs had an intact, clean shell and regular shape with the absence of its defects, the color of the eggs was beige, with characteristic spots of dark brown color and a matte surface. The selected eggs had a weight of 8 to 15 g, a shape index of 60-75%. Before incubation, viewed through an ovoscope to detect hidden deficiencies. The chicks were hatched from eggs in a specialized room. The incubation has been carried out in the Rcom 20 MAX (RMX-20) machine at a temperature of + 37.2–38⁰C and 55–60% humidity over 17–18 days. The egg hatchability amounted to 75%.

Fig. 1. RCom 20 MAX (RMX-20) incubator.

The hatched chicks were covered with fluff and could drink water and peck the food, which should always be available to them. The mass of each quail at hatching was about 6–8 g. They were subsequently placed in a brooder (or a box) with optimal conditions (temperature of +35–38⁰C, 50% humidity, 24-hour daylight) so that the chicks could dry off and become stronger. Hatched chicks with defects were removed due to a short life expectancy [1].

The substantiation of the technology for raising quails for meat is associated, first of all, with the substantiation of methods for heating young animals, since for the first time 2-3 weeks of life, quails surpass other types of farm birds in terms of heating requirements. It should also be noted that the body temperature of quails is 2 ° C higher than that of chickens and, accordingly, the highest ambient temperature is recommended for their maintenance. According to the standards, in the first week, the temperature under the heater should be at 35-37 ° C, and then decrease by 3-4 ° C weekly.

After two weeks, young quails were transferred to cages. The mature bird has a size of about 15–18 cm, the female is slightly larger than the male (Fig. 2). The quail can be managed in standard cages for 35–40 heads. The recommended cage height is about 20–30 cm; the floor should be made from a 10×10 mm metal grid with a slight slope allowing the eggs to roll down for convenient picking.

Fig. 2. Management conditions and exterior appearance of grown quails.

On the sides of the cage, it is necessary to place a feeder and a nipple waterer that prevents moisture from splashing. The litter tray is installed at the bottom. For proper fowl management, it is necessary to maintain 50% humidity and the temperature of + 22–20°C in the room. The recommended daylight regime is from 15 to 18 hours [6].

The poultry feed must be complete and include all essential components, such as vitamins, proteins, micro- and macronutrients. For optimal functioning of the bird's body, it is also necessary to provide the quail with clean drinking water. The quail breeders can use both industrial and self-prepared feeds, however, as evidenced in practice, the choice of feed greatly affects the productivity and quality of meat, and changing the feed type leads to a decrease in egg-laying capacity.

In Japan, the fodder base is a mix of rice and fish residue; in Russia — balanced complete feeds of the following grades: P-K-5, P-K-2-1, P-K-6, Start, Super Start, RusQuail, and Multigain. These feeds include different percentage mixtures of corn, oats, wheat, barley, meals and various types of flour (soy, fish, rice, etc.), yeast, chalk, phosphates, sodium chloride and other components [12].

Table 2. Feed mix composition.

Components	Content, %	
	Reference data [1]	Amuragrocenter
Corn	20	3.2
Wheat	19	55.7
Soybean meal	-	10.26
Extruded full-fat soybeans	-	4
Bald-seeded oats	-	5.5
Millet	15.7	-
Sunflower meal	4.9	9.2
Fish meal	12	3.9
Limestone flour	-	4.33
Meat and bone meal	12	-
Dried skimmed milk	4	-
Feed yeast	6	-
Grass meal	3	-
Chalk, shells	2	-
Shell meal	-	2.24
Trace mineral premix MKR2	0.5	-
Premix 1 (P5-1)	0.6	1.5
Sodium chloride	0.3	-
Monocalcium phosphate	-	0.17
Total	100	100

In different cities, the price of feed varies from 15 to 50 rubles per kilo. In the Amur Region, the balanced feed ration for poultry is produced by local companies "Amuragrocenter" and "Grinodir". Such feeds are much cheaper than imported or supplied from other regions. The example of a balanced quail feed composition compared to the reference is presented in Table 2.

The daily feed rate by age group and live weight gain of mature quails are presented in Table 3.

The bird reaches maturity by 1.5–2 months. At this age, the female can already lay eggs. At the private farmstead, female quails receiving proper nutrition per Table 3 laid their first eggs on day 45–50. They produced one egg per day. The live weight gain continued up to 2.5 months (males — 200 ± 0.12 g, females — 260 ± 0.2 g), then it stopped and the body mass remained at the same level.

In addition to valuable taste and nutritional properties, quail meat is also considered a dietary product due to the low fat content and the ratio of protein and carbohydrates that differs from any other type of poultry. The energy value of quail meat is much lower [4]. The comparative chemical composition of poultry meat is presented in Table 4.

Table 3. Daily nutrient requirement and live weight gain in quails.

Bird age	Feed, price per kg	Gram per head per day	Live weight, g
From 0 to 20 days	Complete feed "Start", 40 rubles	From 4 to 13	8–80
From 20 days to 1.5 months	Chicken feed, 24 rubles	From 14 to 16	108–160
From 1.5 months	Specialized complete feed for quails, 26 rubles	From 16 to 17	160–200

Table 4. Chemical composition of the poultry meat.

Name	Mass fraction, %					Caloric value, Kcal/100 g
	water	fat	protein	ash	carbs	
Category 1 chicken meat	63.8	16.1	18.7	0.9	0	183
Quail meat	71.03	4.53	21.76	1.32	0	134

4 Discussion

The possibility of using Estonian quails has contributed to the development of this poultry industry in many countries around the world. The spread of this breed in Russia in recent years has been facilitated by their rapid reproduction, high taste of meat and eggs, healing properties of eggs, quail resistance to a number of diseases, and many other economically useful factors.

The poultry meat quality depends on bird management conditions, the fodder base, age, etc. (Fig. 3). The main quality indicator is the carcass category, which is determined by its fatness, taking into account the degree of development of adipose and muscle tissue, as well as the live weight gain rate and the age of bird after slaughter [2,3]. The most complete description of the meat qualities of poultry is given by the anatomical cutting of carcasses. The carcasses of the Estonian quail breed had a good presentation, were of medium size, round in shape with well-defined muscles of the chest and legs. The color of quail carcasses is pink with a yellow tint. There were slight white fat deposits in the neck, back and abdomen.

Fig. 3. Quail carcasses.

One of the fastest and most objective methods for assessing the quality of poultry meat is organoleptic analysis. The organoleptic assessment is carried out in order to establish the compliance of the organoleptic parameters of the quality of poultry meat with the requirements of regulatory documents. Organoleptic evaluation of poultry meat provides for the determination of the appearance and color of the carcass, the state of the muscles in the section; consistency; smell; transparency and aroma of broth. Currently, five and nine-point scales are used. The nine-point scale recommended by VNIIMP expands the range of organoleptic quality assessment.

To assess the organoleptic characteristics of quail meat, the tasters ranked quality indicators according to their importance and assigned weight factors. The experts' estimates were entered into the tasting sheets, after which they were statistically processed.

Fig. 4. Meat quality assessment profile.

The results of the organoleptic quality assessment showed that all indicators met the requirements of the regulatory document. The cooked meat had a pleasant delicate taste and characteristic aroma. The comparison of organoleptic indicators was carried out according to GOST R 54673-2011 "Quail meat (carcass) Technical specifications" and GOST R 51944-2002 "Poultry meat. Methods for the determination of organoleptic indicators, temperature and mass". Results are presented in Table 5.

Table 5. Organoleptic indicators of meat.

Indicator	Specific feature of the bird's meat (carcass)	
	GOST	Estonian breed meat
Appearance and color: beak	Glossy	Glossy
Carcass surface	Dry. Whitish yellow with a pink tint	Dry. Whitish yellow with a pink tint
Subcutaneous and internal adipose tissue	Whitish yellow or yellow	Whitish yellow
Serous membrane of the thoracoabdominal cavity	Moist, shiny. No mucus or mildew	Moist, shiny. No mucus or mildew
Muscles on the cut section	Slightly moist. Pale pink	Slightly moist. Pale pink
Texture	The muscles are dense, elastic; the fossa formed by pressing with a finger is quickly leveled	The muscles are dense, elastic; the fossa formed by pressing with a finger is quickly leveled
Odor	Characteristic, typical of fresh poultry meat	Characteristic, typical of quail meat
Broth transparency and aroma	Transparent, fragrant	Transparent, fragrant

The nutritional value of poultry meat is determined by the content of proteins, fats, carbohydrates and other components. In addition to fats, proteins, carbohydrates and minerals, poultry meat contains almost all water-soluble vitamins and insignificant amounts of fat-soluble vitamins. Muscle tissue is an important part of the meat composition. The lipid content in muscle tissue varies significantly depending on the age, breed, management and feeding conditions [2].

Extractives determine the gustatory qualities of poultry meat. Meat contains about 1% nitrogen-free extractive substances (glucose, lactic acid, glycogen, etc.) that are involved in its maturation. Free glutamic acid, free purines (hypoxanthine) contribute to the creation of a characteristic taste and aroma of meat [7, 9].

Nutritional value of quail meat is characterized by high protein content, low fat content, high moisture content and low energy value. The chemical composition depends on many factors [3]. The following methods for chemical analysis of were implemented: determination of fat per GOST 23042-86 (Gerber method); determination of the mass fraction of moisture per GOST 33319-2015.

The results of the analysis of the chemical composition of meat from grown Estonian quails in comparison with the reference data of the Japanese breed are presented in Table 6.

Table 6. Chemical composition of the studied quail meat.

Name	Mass fraction, %					Caloric value, Kcal/100 g
	water	fat	protein	ash	carbs	
Studied Estonian breed meat	72.3	4.5	22.0	0.9	0	132
Japanese breed meat (reference data)	69.87–71.0	3.5–4.2	19.97–20.0	6.6–3.1	2	123–130

5 Conclusions

Breeding of the quail, a low-maintenance bird, is convenient and cost-effective. The Amur-produced feeds are sufficiently balanced for proper nutrition of birds and contribute to an increase in live weight and yield of quality raw materials (meat and egg). The fodder base is of great importance. It is strongly recommended to use the same balanced feed during breeding, as any changes in body weight loss and a stop of egg-laying in females. For this

reason, after the chicks are transferred to cages and start receiving proper nutrition, the enterprise should give them one kind of feed until the slaughter. It can only be complemented but not changed. The cost of feeding one female up to 2 months is 26 rubles 63 kopecks. Before it is slaughtered for meat, the quail will lay about 10 eggs with an average price of 4 rubles per piece. Therefore, this type of aviculture is profitable and provides sufficient amounts of meat and eggs for customers.

The study of the Estonian quail bred at a private farmstead using the Amur feeds revealed some changes. According to the literary sources, the average weight of the Estonian breed is 180–200 g. The weight of the quails grown in the course of the study was significantly higher — above 200–260 g [10, 15].

The resulting quail meat is a high-protein product with low fat content and low energy value. These characteristics allow its implementation in dietary nutrition for different population groups [13]. The study in hand has proved that the Estonian quail bred at a private farmstead of the Amur Region using the local fodder base provided by the Amur manufacturers is a source of quality meat with excellent organoleptic, physical and chemical properties. Consequently, this type of meat can be used in local restaurants, to expand the meat product range in grocery stores and improve the nutrition of sick people with specific physiological needs.

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