

Requirements for Quail Productivity for Determining their Valuation Class

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Abstract— To the present day, quail breeding was carried out at pedigree level. However, there are no regulatory requirements for assessment of poultry. In order to develop the minimal requirements for assessing the productivity of egg and meat quail breeds for determining their valuation class, the productive qualities of quail breeds were assessed: egg breeds – Japanese and English white; meat breeds – Pharaoh and Radonezh. Additionally, in order to accumulate information, two meat-and-egg breeds were also evaluated – Omsk and Estonian ones. Based on the patterns of growth and development of quails of egg and meat breeds at the final stage of rearing (5 and 6 weeks), on the results of previous studies, as well as on the analysis of source materials for previous years, it was found that bird growth ends at 6 weeks. At the age of 7 weeks, the start of egg laying was observed in the studied breeds. Based on the data of egg production by months and calculations of economic safety of production, minimal requirements for the productivity of egg, meat-and-egg and meat quail breeds were developed.

Keywords—quail, breed, egg production, egg weight, live weight.

I. INTRODUCTION

Poultry farming has recently achieved outstanding biological and economic results, combining the achievements of science and business in the interest of providing consumers with cheap, affordable, high-quality food products and thereby improving people's living standards. However, at present, domestic poultry farming fully satisfies the need of Russians for poultry meat and eggs. Further development of the industry is associated with increasing range of products; this means two directions. The first one is the in-depth processing of meat and eggs of chickens, turkeys, ducks, geese. The second one is breeding of such bird species as guinea fowl and quail [1-3].

Quail is a kind of innovation for the domestic market. And this is one of the problems that hinder its confident presence in the product range of agricultural sector.

Rapid growth, early maturity, short term incubation of quail – all this allows using them as an object for breeding work. A short period of production of quail products ensures a quick turnover of funds and increased profitability of enterprises. Quail puberty occurs at 6-7 weeks of age. Based on a unit of live weight, a quail produces dietary protein per year about

twice as much as a laying hen of highly productive industrial cross. There is a significant interest in quails of meat breeds with the slaughter age of 6 weeks [4, 5, 6, 7].

Up to the present time, there was almost no focused effort on pedigree work with quail breeds in our country. Insignificant quail flocks mainly of Japanese egg breed were a part of some industrial factories. A small flock of quails of different breeds was kept at private farms. However, actually only two breeds were used: Pharaoh meat breed, and Japanese egg breed. In fact, there are no normative parameters for live weight, egg production, and egg mass for quail breeds [8].

In the course of breeding quails, only elements of mass selection methods were used: selection by live weight and exterior. It should be noted that all this taken together led to significant variance in terms of productivity and exterior of separate groups of birds within the same breed. A slight increase in live weight with a decrease in egg production was observed; the viability of birds and their reproductive qualities also changed for the worse.

At the present stage of poultry farming development, leading breeding firms apply breeding criteria in order to improve over 30 traits. In-depth breeding work with the gene pool of quail breeds is necessary due to the narrowing of the genotypic and phenotypic diversity of important for productivity traits [9-11].

Over the past three decades, European and American producers have focused most on meat production what required using special meat breeds.

The main reason for the preference for heavier breeds for egg production is the consumer demand for larger eggs (12-13 g). The size of eggs in Japanese quail depends on the body weight of the breed. Another reason to give preference to heavier breeds is cost-effective feeding of unnecessary males that is more beneficial for the universal breeds than for egg-laying ones. The second circumstance is important in connection with the relatively late age (17-20 days) when the gender of bird could be precisely determined. About 30% of costs associated with the rearing of quail falls on this period, so culling unwanted males is not economically justified.

Using only two special quail breeds – Japanese and Pharaoh – results in two negative factors. So, Japanese breed

is used for getting eggs. At the same time, slaughter for meat of males aged 42-56 days is required with the carcass weight barely exceeding 100 g. Production of quail meat is, however, based on using Pharaoh breed. But their egg production is low compared to the Japanese and also drops sharply at the end of productive period.

In chicken farming, for the production of meat and eggs specialized crosses of chickens are used. To obtain broiler chickens, Cornish white meat breed is bred with Plymouth Rock white meat-and-egg breed. Plymouth Rock white breeding is carried out in two directions: some lines are improved for using in meat crosses, others – in egg ones. The characteristic of meat-and-egg breeds depends accordingly on which crosses they are used in. There are no similar domestic quail breeds. Therefore, we believe that there is a long-felt need for the creation of such breeds in our country.

An increase in quail meat production will develop by analogy with that of broiler chickens. Meat-and-egg quail breed is supposed to be used as a female parent for creating meat crosses. In addition, meat-and-egg quail breed is most suitable for keeping in collective and private subsidiary farms. It is noted that a significant proportion of the production of quail eggs and meat is concentrated precisely in the farms of this form of ownership. This ensures the employment of rural population what is a socially significant phenomenon.

The lack of an objective assessment of poultry is due to the fact that until recently there were no breeding enterprises in the country engaged in the creation of new and improvement of existing quail breeds. To the present day, quail breeding is carried out at pedigree level. At the same time, there are no regulatory requirements for the assessment of poultry (valuation) of egg, meat-and-egg, or meat breeds.

Based on the abovementioned, the aim of this work was to develop minimal requirements for assessment the productivity of egg, meat-and-egg, meat quail breeds to determine their valuation class.

To achieve this goal, the following tasks were set:

- 1) To determine age and standards for assessing young quail on live weight and viability;
- 2) To study egg production, live weight and incubation quality of quail eggs;
- 3) To develop minimal requirements for assessment of the productivity of egg, meat-and-egg and meat quail breeds.

II. MATERIALS AND METHODS

The work on determining minimal requirements for assessment of the productivity of egg, meat-and-egg and meat quail breeds was carried out at OOO Genofond of the Moscow Region and Siberian Research Institute of Poultry Farming – the branch of Omsk Agrarian Research Center Federal State Budgetary Scientific Institution.

Two common quail breeds were selected for the experiments: egg breeds – Japanese and English white; meat ones – Pharaoh and Radonezh. For each breed, 100 young animals and 50 adult birds were evaluated. Poultry was raised in specially equipped battery cages.

Additionally, in order to accumulate information on the basis of Siberian Research Institute of Poultry Farming – the branch of Omsk Agrarian Research Center Federal State Budgetary Scientific Institution, two meat-and-egg breeds

Omsk and Estonian were evaluated. Control variant for the test included 280 day-old and 70 adult animals.

The standards of rearing, keeping (amount of floor space per bird, feeding and watering) and feeding corresponded to the standards accepted at the farm.

In the course of rearing and keeping quails, the following parameters were taken into account:

- 1) live weight – at 5 and 6 weeks of age, accurate within 1 g;
- 2) viability of livestock during growing period;
- 3) egg production during keeping period – up to 44 weeks of life;
- 4) egg weight – monthly, 3 straight days, accurate within 0.1 g;
- 5) hatching qualities of eggs (fertilization of eggs and hatching) – at the start, in the middle and at the end of the breeding period.

Statistical processing of experimental data was performed on a personal computer using Microsoft Excel (2003). Mean trait value (M) and standard error of the mean (m) were found. Statistical significance was evaluated using Student's criterion.

To define the threshold of economic security for egg production, we used the formula proposed by Prof. A. Kavtarashvili. (1) [12]:

$$P_e = \frac{I_f \times C_k}{S_f \times P_s} \quad (1)$$

where P_e – economic production threshold for egg production, %;

$I_f I_k$ – feed intake per 1,000 heads per day, kg;

$C_k C_k$ – the cost of 1 kg of feed, RUR;

S_f – the share of feed in the structure of eggs cost, %;

P_s – selling price for 10 eggs, RUR.

III. RESULTS

Here is a brief description of some quail breeds bred at OOO Genofond and Siberian Research Institute of Poultry Farming – the branch of Omsk Agrarian Research Center Federal State Budgetary Scientific Institution.

Japanese quails were bred in Japan from wild quails. Breeding was aimed at increasing egg productivity.

English white breed was bred in the UK. It has white plumage, dark feathers on head or trunk are allowed, eyes are dark. It is egg breed.

Estonian quail breed was bred on the basis of Japanese, Pharaoh and English white. It is meat-and-egg breed.

Omsk quail breed (meat-and-egg) was created by crossing Pharaoh (meat) and Japanese (egg) breeds. At the initial stage, females of Japanese breed were crossed with males of Pharaoh breed. Resulting hybrids were estimated by live weight at 28 and 42 days of life, by egg production for 126 and 308 days of life. Based on this assessment, a group was selected with high egg production and optimal live weight and egg mass. The next step was the backcross of females (σ Pharaoh \times ϕ Japanese) with males of Pharaoh breed with live weight of 28 days at least 200 g. Resulting hybrids had $\frac{3}{4}$ blood percentage

of Pharaoh breed. Further, in the course of breeding, the resulting genetic material was bred “inter se”.

Pharaoh breed was bred in the USA as a result of long breeding work with Japanese quails. This breed was selected for high meat productivity.

Radonezh quail meat breed (patent holder is OOO Genofond, Federal Scientific Center “All-Russian Research and Technological Institute of Poultry Farming” of RAS) was bred by the method of composite cross breeding of Pharaoh and Texas white breeds, followed by breeding “inter se”, with

strict selection according to productive and reproductive characteristics. Starting from the fourth generation, poultry breeding was carried out differentially in two directions of productivity: male parent form (meat) and female parent form (egg). According to the originator, it is a bird with predominantly white plumage. The created breed differs from the original forms by its adaptability to be kept in cage. It was found that in quail, an intensive increase in live weight continues up to 6 weeks of age (Table 1).

TABLE I. LIVE WEIGHT AND VIABILITY OF QUAILS FOR 5 AND 6 WEEKS OF LIFE, (M ± M)

Group	Breed	Age			
		5 weeks		6 weeks	
		Live weight, g	Viability, %	Live weight, g	Viability, %
1	Japanese	118.1±10.0	95.0	144.2±11.0	95.0
2	English white	121.3±9.0	97.0	149.1±14.0	96.0
3	Pharaoh	227.0±10.0	96.0	235.4±24.0	95.0
4	Radonezh	246.0±12.0	97.0	299.2±18.0 ^a	96.0

^a P < 0.05

It should be noted that live weight of Radonezh domestic meat breed at the age of 6 weeks was 27.1% (P < 0.05) higher than that of Pharaoh meat breed. Average daily gain in live weight of quails of Radonezh breed during the period from the 5th to the 6th week amounted to 7.6 g. At the age of 7 weeks, separate quails started egg laying, so, for this reason the age of 6 weeks was considered the age of stopping intensive increase in live weight. From the age of 7 weeks, quails of four

evaluated breeds started laying first eggs. At the age of 10 weeks, egg production was the following: Japanese breed – 34.54%; English white – 32.60%; Pharaoh – 26.70%; Radonezh – 28.90%.

Results of the assessment of productivity and reproductive qualities of egg and meat quail breeds are shown in Tables 2 and 3.

TABLE II. PRODUCTIVITY AND REPRODUCTIVE QUALITIES OF EGG BREEDS

Productivity month (week)	Breed							
	Japanese				English white			
	egg production, pcs	average egg weight, g	egg fertilization, %	hatching, %	egg production, pcs	average egg weight, g	egg fertilization, %	hatching, %
1 (8-12)	18.7	9.5±0.08			16.9	8.9±0.09		
2 (13-16)	27.9	10.2±0.09	89.5	72.9	26.7	10.1±0.10	87.7	72.3
3 (17-20)	29.7	11.3±0.10			29.4	11.4±0.11		
4 (21-24)	29.4	11.5±0.09			29.1	11.5±0.09		
5 (25-28)	27.6	12.3±0.10	92.3	80.3	27.8	12.0±0.11	91.5	79.2
6 (29-32)	25.9	11.7±0.09			25.1	11.4±0.09		
7 (33-36)	24.8	12.3±0.09			23.5	11.2±0.10		
8 (37-40)	18.6	12.5±0.11	81.3	69.4	14.3	12.3±0.09	80.5	66.4
9 (41-44)	11.5	11.9±0.11			10.8	11.7±0.10		
Total	214.1				203.6			

TABLE III. PRODUCTIVITY AND REPRODUCTIVE QUALITIES OF MEAT BREEDS

Productivity month (week)	Breed							
	Pharaoh				Radonezh			
	egg production, pcs	average egg weight, g	egg fertilization, %	hatching, %	egg production, pcs	average egg weight, g	egg fertilization, %	hatching, %
1 (8-12)	15.3	11.6±0.09			16.3	11.8±0.08		
2 (13-16)	26.4	12.7±0.10	87.5	70.4	25.7	12.7±0.09	86.4	69.3
3 (17-20)	29.2	13.3±0.09			28.3	13.4±0.08		
4 (21-24)	28.7	13.7±0.09			29.1	14.0±0.09		
5 (25-28)	25.9	14.2±0.10	90.2	71.7	25.4	14.1±0.10	90.4	71.6
6 (29-32)	24.5	14.3±0.11			25.0	14.2±0.10		
7 (33-36)	14.7	14.0±0.09			17.6	14.3±0.11		
8 (37-40)	8.9	14.2±0.10	81.5	68.9	9.7	14.4±0.10	79.7	65.3
9 (41-44)	6.5	14.3±0.11			7.8	14.4±0.09		
Total	180.1				184.9			

In 2019, Omsk quail breed which was created at the Siberian Research Institute of Poultry Farming was included in the State Register of Selection Achievements Allowed for Use. This breed is a meat-and-egg one. Previously, the only

breed of this direction of productivity was Estonian breed created in the last century in Estonia. Comparative characteristics of breeds are shown in Table 4.

TABLE IV. PRODUCTIVITY AND REPRODUCTIVE QUALITIES OF MEAT-AND-EGG BREEDS

Parameter	Breed	
	Estonian	Omsk
Live weight at 6 weeks, g:		
male	189±5.2	207±3.4
female	240±6.7	271±8.1
Egg production per year of life, pcs.	263	281
Egg weight at 10 weeks of life, g	13.20±0.10	13.25±0.11
Viability at 6 weeks, %	97.5	97.0
Hatching, %	81.1	79.1

Quails of Omsk breed are superior to Estonian quails: in live weight at 6 weeks of life, males by 18 g, or 9.52% ($P < 0.01$), females by 31 g, or 12.90% ($P < 0.01$); in egg production per year of life – by 18 eggs, or 6.84%.

Comparative tests of Omsk meat-and-egg breed and Japanese egg breed showed that egg production for 44 weeks of life was 217 and 226 eggs, respectively, with an average egg weight of 14.1 and 13.2 g. Thus, the yield of egg weight in Omsk breed was 3.06 kg from one laying bird, what is 0.64 kg more than from one laying bird of Japanese breed. Therefore, quails of the Omsk breed can be used to obtain both eggs and hybrid quail-broilers in crossbreeding with meat breeds.

Calculations showed that the threshold of economic security for quail eggs production for egg breeds is 55%, for meat breeds – 42%, for meat-and-egg breeds – 49%. Economic security threshold for egg production shows the level of egg production below which the enterprise starts to incur losses.

For obtaining objective data on the assessment of poultry, source materials of OOO Genofond of the Moscow Region and AO Uglich Poultry Factory of the Yaroslavl Region over the past 3 years were additionally analyzed. Based on the results of a comprehensive assessment of poultry, the following conclusion can be made.

IV. CONCLUSION

Based on the patterns of growth and development of quails of egg, meat-and-egg and meat breeds at the final stage of rearing (5 and 6 weeks), on the results of previous studies, as well as on the analysis of source materials for previous years, it was found that poultry growth ends at 6 weeks. At the age of 7 weeks, the start of egg laying was observed in studied breeds.

For determining the duration of minimal productivity level of mature poultry, we have taken egg production data for months and calculations of economic production safety. Minimal requirements for productivity of egg, meat-and-egg and meat quail breeds are shown in Tables 5, 6, 7.

TABLE V. MINIMAL REQUIREMENTS FOR PRODUCTIVITY OF EGG BREEDS^a

Parameter	Elite record	Elite	Class I	Class II
<i>Basic</i>				
Live weight at 6 weeks, g	150	145	140	135
Egg productivity per laying bird for 40 weeks of life, pcs	215	210	205	200
Egg weight at 10 weeks, g	11.5	11.0	10.5	10.0
<i>Additional</i>				
Hatching, %	70.0	68.0	67.0	66.0
Viability before 6 weeks, %	96.0	95.8	95.6	95.4

^a. egg breeds – Japanese, English white, English black, Tuxedo.

TABLE VI. MINIMAL REQUIREMENTS FOR PRODUCTIVITY OF MEAT-AND-EGG BREEDS^a

Parameter	Elite record	Elite	Class I	Class II
<i>Basic</i>				
Live weight at 6 weeks, g	190	185	180	175
Egg productivity per laying bird for 40 weeks of life, pcs	195	190	185	180
Egg weight at 10 weeks, g	12.5	12.0	11.5	11.0
<i>Additional</i>				
Hatching, %	70.0	68.0	67.0	66.0
Viability before 6 weeks, %	96.0	95.0	95.0	95.0

^a. meat-and-egg breeds – Estonian, Omsk.

TABLE VII. MINIMAL REQUIREMENTS FOR PRODUCTIVITY OF MEAT BREEDS^a

Parameter	Elite record	Elite	Class I	Class II
<i>Basic</i>				
Live weight at 6 weeks, g	225	220	215	210
Egg productivity per laying bird for 40 weeks of life, pcs	170	165	160	155
Egg weight at 10 weeks, g	13.0	12.5	12.3	12.1
<i>Additional</i>				
Hatching, %	70.0	68.0	66.0	64.0
Viability before 6 weeks, %	96.0	95.0	94.5	94.0

^a. meat breeds – Texas white, Pharaoh, Radonezh.

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