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Egg production potential of Manchurian Golden quail breeders

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Abstract. *According to its weight traits, the population of Manchurian Golden quails bred at the Department of Poultry Science at Trakia University can be referred to the heavy all-purpose type of Japanese quails with an average live weight of 259.7–273.1 g of females and 214.3–230.3 g of males. Under optimal temperature conditions, the females of the examined population ate, on average, 42–45.2 g of feed per day, which comprised 16.9–17.3% of their live weight during the most active period of laying. The average intensity of egg-laying during the control period was 80.95%, with 78.96% of all laid eggs being fit for incubation. In absolute terms, this accounted for 168.55 breeding eggs per layer hen. The percentage of culled eggs, excluding the first production month, varied between 0.98–2.2% with a noticeable tendency towards a slight increase after the third production month. The mean egg mass varied between 12.37–13.45 g, with the average egg mass per layer hen for the 7-month control period being 1986.69 g, equal to 7.65 times the average weight of layers. The feed conversion ratio per kg egg mass for the different generations ranged within 3.45–5.05 kg per kg of egg mass, with the highest values observed during the phase of the flock's peak egg production – 3.626±0.111. The hatchability of the incubation eggs was high, relatively stable, at levels of 78–80.87%. The percentage of vital quail hatchlings comprised 95.6–98.2% of all hatched birds. Of all culled incubation eggs, the highest share was that of dead embryos during the final incubation stage (15th–18th day) with higher percentages during the beginning of egg production (16.3%).*

Keywords: Japanese quails, egg production, incubation traits

Introduction

Currently, various breeds, lines, and colour variations of quails are being used for production purposes around the world. One of the breeds that can be very attractive for industrial-scale production of Japanese quail eggs and meat is the Manchurian Golden. The breed was created as a result of a colour mutation in the farms of Albert Marsh and is one of the six breeds registered in the early 1970's in the International registry of poultry genetic stocks – a directory of specialized lines and strains, mutations, breeds and varieties of chickens, Japanese quail and turkeys. In Central, Southern and Western Europe this breed is known as the Golden Italian (Thear, 2005). According to the author, the breed's American population is a light egg-laying type weighing 140–160 g and with an average annual egg production capacity of 290 eggs, whereas European populations are of a heavier type.

Japanese quails are the fastest maturing species among all avian species reared for production purposes. They lay their first egg between the 5th and 6th week of age (Shanaway, 1994). The fast onset of maturity and egg laying capacity of the domestic Japanese quails are, to a major extent, the result of the intensive selection performed on this species (Kumar et al., 2000). The laying intensity is among the most important traits of egg production. The trait is influenced by many factors, the most important among which are the temperature conditions of poultry rearing (Gerzilov, 2011), clutch length as well as the duration of the intersequence pauses (Kumar et al., 2000). To a high extent, clutch length is determined by the time of the egg's formation, which is between 24 and 25 hours for Japanese quails (Panda and Singh, 1990; Shanaway, 1994).

Stress is one of the most powerful factors affecting not only egg production but also the physiological and health status of birds. Most susceptible to stress are birds that are genetically predisposed to increased adrenal responsiveness and release high corticosterone concentrations in blood under stress (Schmidt et al., 2009). Among the most important factors with regard to aggressiveness among birds, hence egg production, are the rearing density, group size, and sex ratios of birds. Higher population density slows down sexual maturity (Bhanja et al., 2006). Waheda et al. (1999) found out that laying capacity in smaller groups (up to 6 birds per cage) was statistically significantly higher compared to that in larger groups (9 birds per cage). Asasi and Jaafar (2000) discovered that sex ratios of 1:1 to 1:4 did not have any effect on the reproductive traits of the breeder flock, yet narrow ratios significantly increased the tension among birds in the group. Broader sex ratios (1:3 to 1:5) significantly relieved stress and thus had a positive effect on egg-laying intensity, although it posed a potential risk of deteriorating fertility (Tandron et al., 1999; Asasi and Jaafar, 2000).

The goal of this study is to evaluate the production potential of the Manchurian Golden Japanese quail population, reared at Trakia University.

Material and methods

The productivity of nine Japanese quail generations of the Manchurian Golden breed, reared at the Department of Poultry Science at Trakia University was followed. Birds were used as breeders. They were kept in cages with dimensions of 1000x400x200, each cage divided into two sections. Each section housed a nest, consisting of 8 female and 3 male birds, at a sex ratio of 2.67:1. Each bird in the nest had 180 cm^2 of the cage's total area. The components and nutritive value of the used compound feeds were the same for all nine generations. The birds were provided with 16 hours of light in a ventilated yet not air- conditioned premise. The

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room was heated during the winter in order to maintain the temperature regimen. During the summer it was difficult to maintain an optimal temperature regime within the values.

The control period for the studied generations included 7 months of the productive cycle. This duration was grounded on the flock's use for breeder egg production and the higher level of stress related to the narrower sex ratio of the birds. Egg production control was carried out by daily registration of the number of laid eggs from each nest and their differentiation into standard (eggs with normal size, shape, appearance, shell intactness and colour for the respective age) and culled. The culled eggs category included double-yolk eggs, eggs with soft or no shells, as well as those with various deviations from the standard size, shape, appearance, shell intactness, or eggs without pigmentation or major colour anomalies. The daily yield from all nests was individually weighed twice within a production month using Chirana 02 scales with a precision of 0.1 g.

To evaluate the reproduction potential of the breeder flock, in the various phases of the production cycle, control incubation was done for each generation. Breeding eggs were gathered over 3 days, and were kept at 20°C and 70% relative air humidity. Incubation was carried out in a Victoria-560 incubator observing the conditions and the protocol described in detail by Genchev (2010). The results were statistically processed using the classical methods of statistical analysis by MS Excel 2003 software.

Results

The mean live body weight of the adult sexually mature birds of the Manchurian Golden quails population reared at the Trakia University of was 259.7–273.1 g for females and 214.3–230.3 g for males (Table 1). Under optimal temperature regimen female birds from the studied population consumed, on average, 42–45.2 g of feed per day, which comprised 16.9–17.3% of their live weight during the most active period of lay (Table 2). When ambient temperature was higher during the summer period, the average feed consumption was 36–37.5 g (13.9–14.5% of the live body weight), which is 6–7.7 g less compared to previous seasons when temperatures were within 20–25 °C. In optimal conditions towards the end of the control period (7th production month), feed consumption was between 42,1–43.2 g, which made up 16–16.2% of the layers' live body weight.

Over the controlled period, the mean intensity of laying for the studied population of Japanese quails was 80.95%, with 78.96% of all laid eggs having normal appearance, standard size and shape, no deviations from the quality traits, and fit for incubation. In absolute terms, this accounted for 168.55 breeding eggs per layer. The time course of the laying intensity (Figure 1) showed that the birds from the studied population reached peak egg production during the second production month that varied between 81.7–92.3%. The

Table 1. Live body weight of Japanese quails, g

Production cycle stage	Body weight, g					
	Mean for all generations		IV generation		VIII generation	
	female	male	female	male	female	male
Flock formation – 35 days of age	197.20-228.40 214.10±3.03	192.10-217.78 195.10±1.86	24.06.2006 197.20±1.49	192.10±2.14	3.10.2009 228.44±2.81	205.22±2.04
Beginning to mid egg production	247.85-267.40 255.39±2.13	207.0-217.14 211.05±1.94	3-9.07.2006 247.85±1.40	207.05±2.10	6-12.10.2009 267.40±3.50	215.26±2.20
Peak egg production	252.85-266.48 259.66±1.80	214.27-227,31 225.53±2.91	21-27.08.2006 265.00±2.49	225.5±3.94	16-29.11.2009 266.48±1.96	227.31±2.18
End of experimental period	262.26-284,00 273.10±3.56	220.18-230.32 226.39±2.39	1-4.02.2007 263.6±3.92	227.30±2.41	3-9.05.2010 262.26±2.54	230.32±2.93

Table 2. Daily feed consumption, g

Production cycle stage	Daily feed consumption, g				
	Mean for all generations	IV generation		VIII generation	
		Consumption	% of live body weight	Consumption	% of live body weight
Flock formation – 35 days of age	29,13-41,87 34,599±1,047	27.61-32.80 29.131±0.618	14.77	40.18-43.16 41.867±2.313	18.32
Beginning to mid egg production	36,04-42,67 38,988±0,487	35.04-37.25 36.038±0.502	14.54	42.08-43.13 42.667±0.533	16.91
Peak egg production	36,95-45,23 43,549±0,757	36.0-38.8 36.954±0.805	13.94	42.97-45.23 45.00±0.667	17.33
End of experimental period	40,18-43,33 41,959±0,672	42.24-43.33 43.214±1.311	16.20	41.6-43.47 42.080±1.028	16.05

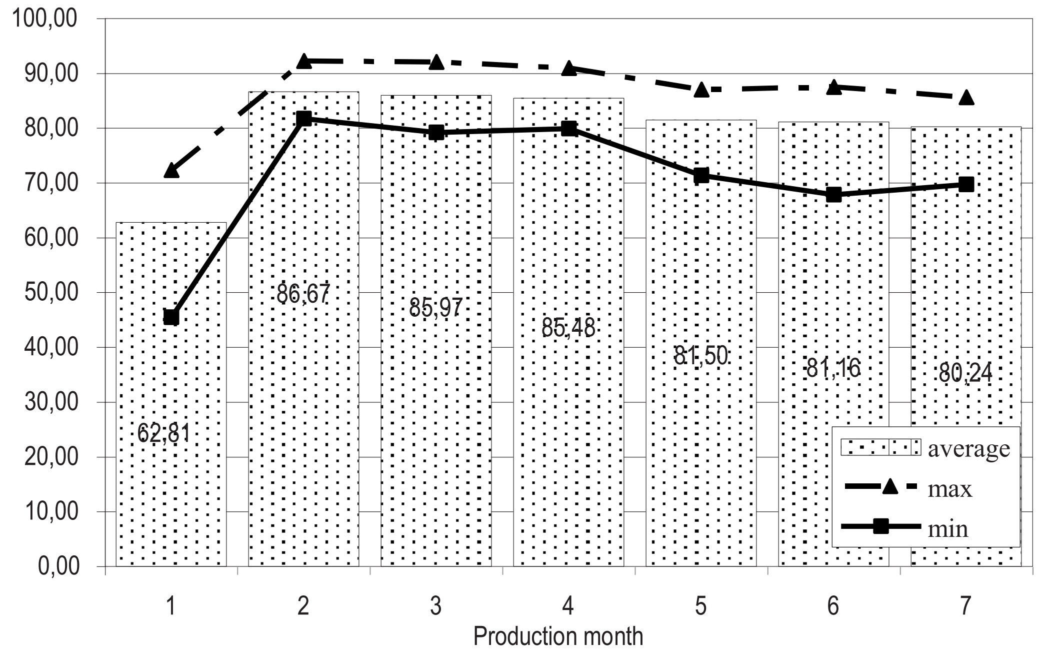

Figure 1. Mean (minimum-maximum) egg production intensity for each production month

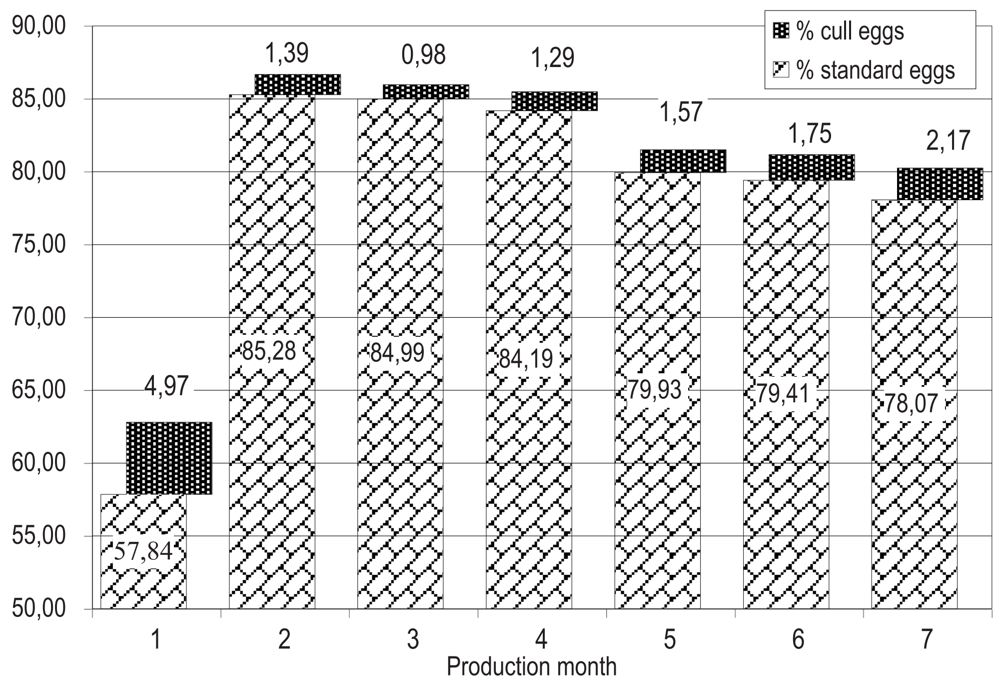

Figure 2. Egg production intensity, % (mean for all generations)

high laying intensity was preserved during the next two production months, with variations between the different generations between 79.2 and 92.1%. During the entire control period, with the exception of the first production month, deviations above and below the mean laying intensity values ranged from +6.4÷7.9% to –5.7÷16.4%.

For all generations studied, culled egg percentages (with the exception of the first production month) varied between 0.98–2.2% with a marked tendency towards an increase after the third production month (Figure 2). The culled egg type analysis showed that the share of double-yolk eggs was the highest (Figure 3). During the other months, eggs with various deviations in size, shape, shell intactness or appearance were predominating. The relative share of this category increased from 39.5% during the first production month up to 81,7% by the end of the control period. The percentage of eggs without shells varied within a relatively narrow range: between 15,4 and 18,8% of culled eggs between the 2nd and 7th production months.

The most dynamic changes in egg production occurred during the first months after onset of lay (Figure 4). During this period, only within 3 weeks, laying intensity reached and exceeded 70%. During the first two weeks after lay onset, double-yolk eggs comprised more than half of all culled eggs (Figure 5). Gradually, by the end of the first production month, their proportion was reduced to 29,1%, with the total percentage of culled eggs also decreasing over the same period (Figure 4).

The mean egg mass of the examined population of Japanese quails varied between 12.37–13.45% (Figure 6), which made up 4.7–4.9% of the layers' weight. The summarised results for the nine generations showed that, for the 7-month control period, the average yield per layer hen was 1986.69 g of egg mass. This result compared to the average weight of female birds during the peak laying phase, when the physiological growth was completed, made up 7.65 times the layer's weight. Examining the time course of egg mass during the control period, the highest values of this trait were observed between 3rd and 5th production months, when egg mass varied between 13.16 and 13.23 g (Figure 7).

The relative stability of the laying intensity, combined with the relatively low variation of the egg mass within the control period, are prerequisites for an economically efficient egg production. The feed conversion ratio per kg egg mass, with the exception of the period between onset of lay to mid egg production, varied among the different generations within 3.45–5.05 kg feed per 1 kg egg mass (Figure 8). Logically, feed conversion was the most efficient during the flock's peak egg production stage, with mean ratio for all generations of 3.626±0.111 per 1 kg egg mass. During this stage, the lowest variation among generations, with the maximum and minimum deviation from the mean value of 4.7 and 4.9%, respectively, has been observed.

The data presented so far have revealed the high egg production potential of the Manchurian Golden quail breed. The high relative production of hatching eggs predetermined the high reproduction capacity of the studied population of Japanese quails. Our studies in this direction have shown that, after the onset of lay, the hatchability of eggs set for hatching was high, relatively stable, at levels of 78–80.87% (Figure 9). The percentage of viable, suitable for further breeding birds was 95.6%–98.2% of all hatchlings. The highest proportion among culled eggs was that of embryos that died during the final stage of incubation (15th – 18th day) with values at lay onset being higher (16.3%).

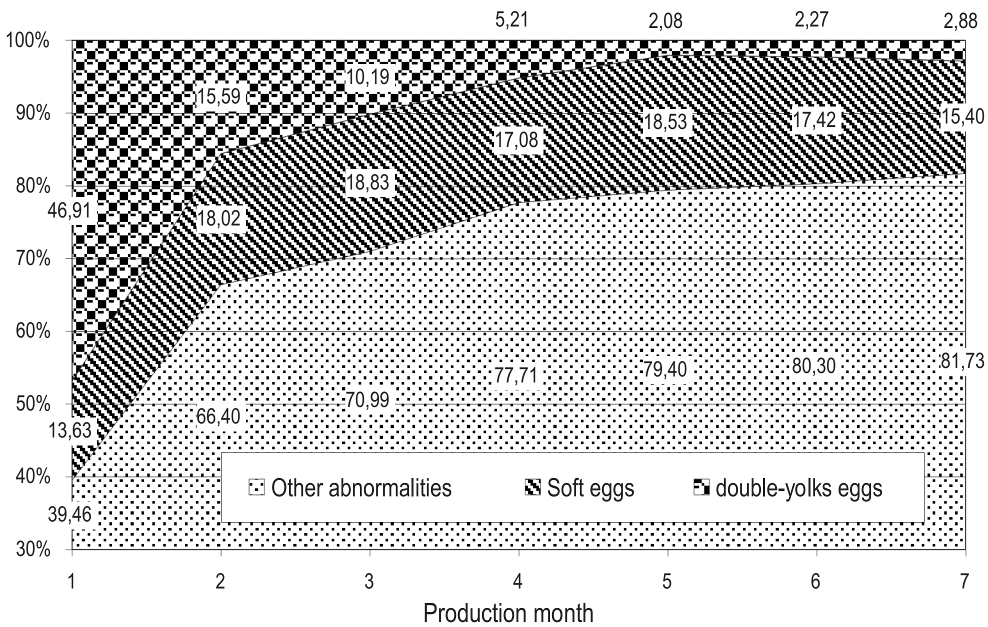

Figure 3. Cull eggs type, % (mean for all generations)

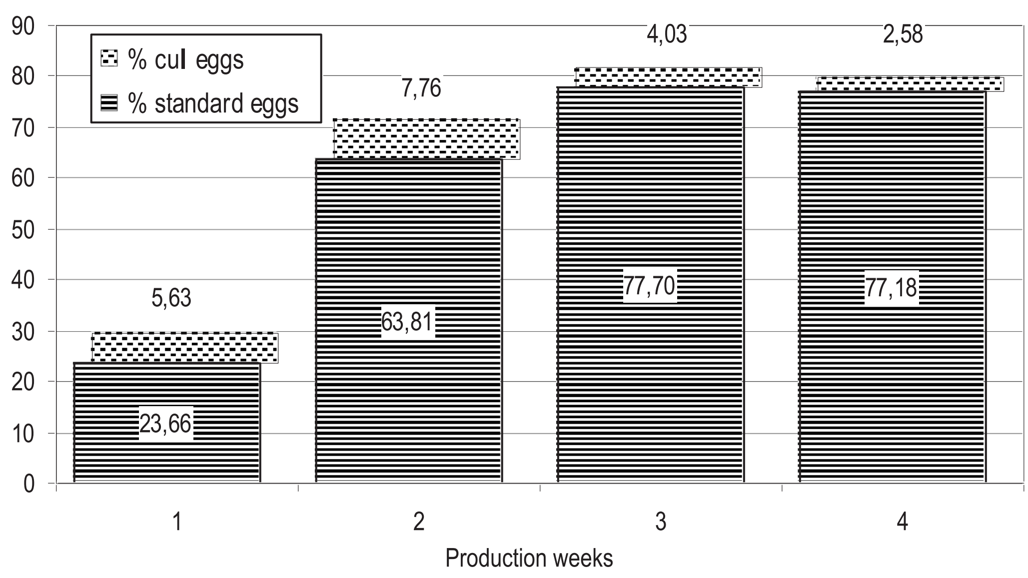

Figure 4. Time course of egg production during the first production month, %

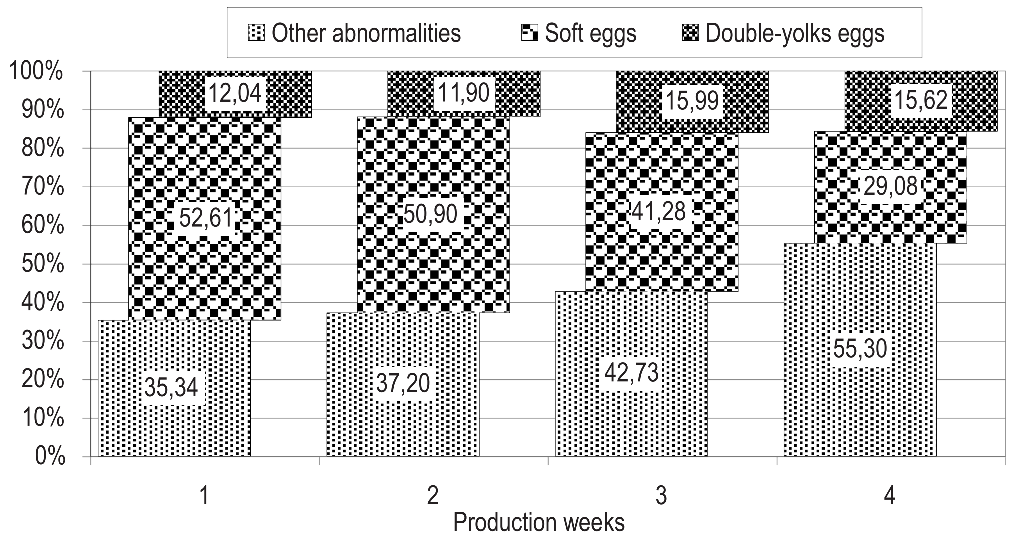

Figure 5. Cull eggs type during the first production month, %

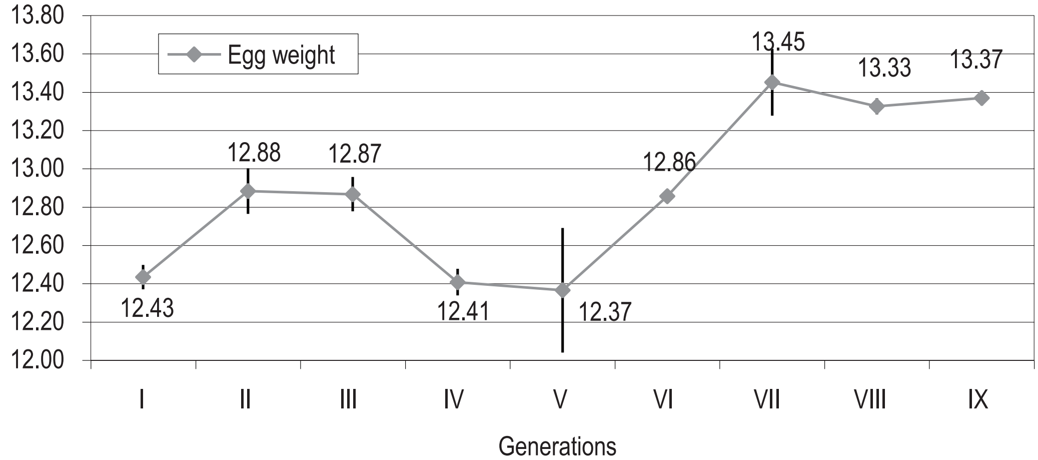

Figure 6. Mean mass of eggs from the different generations

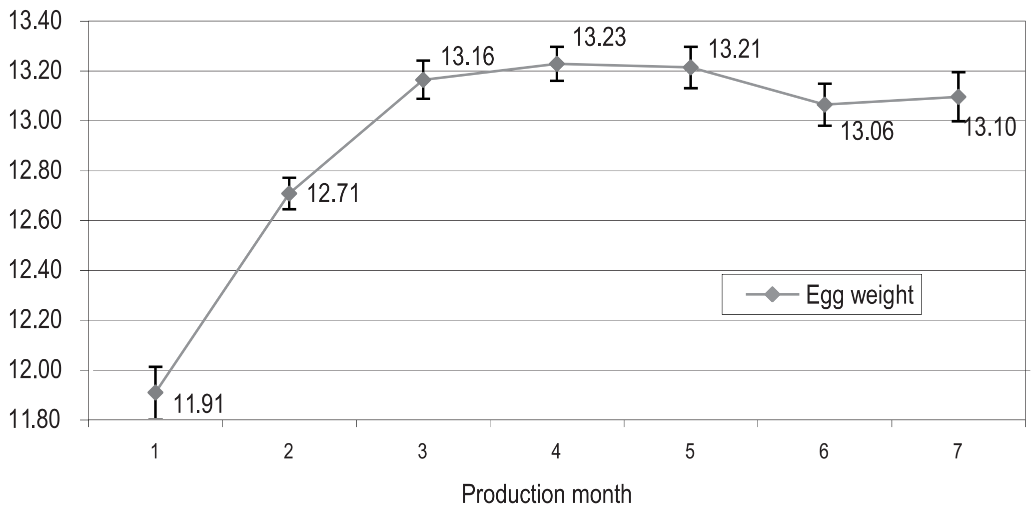

Figure 7. Mass of eggs, g (mean for all generations)

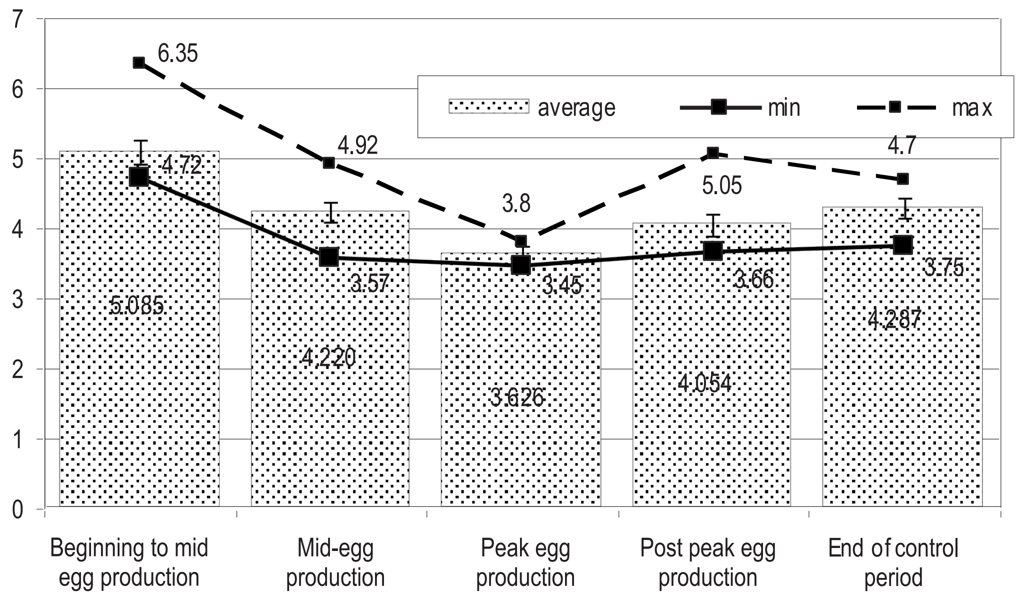

Figure 8. Feed conversion ratio, kg/kg egg mass

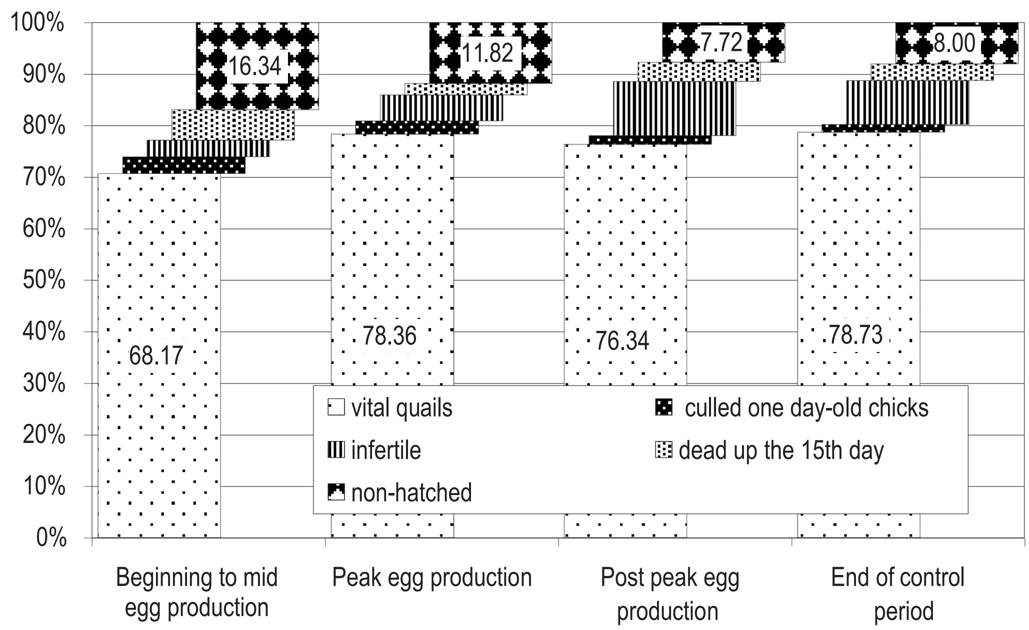

Figure 9. Egg incubation traits

Discussion

The weight parameters of the Manchurian Golden quails population reared at the Department of Poultry Science at Trakia University correspond to the heavy all-purpose type of Japanese quails. The live body weight was by about 70–85% higher, compared to the data reported by Thear (2005) for the American variant of the breed and the populations of Manchurian Golden quails reared at the territory of the former Soviet Union (Pigareva and Afanasiev, 1989; Bondarenko, 2002).

In Japanese quails, the major part of the nutrients ingested with feed is used by layer hens for the formation of the egg. Depending on the flock's laying intensity and the individual traits, whether or not there is an already formed egg within the layer's reproductive tract, the average daily consumption could vary within a wide range (Pigareva and Afanasiev, 1989). The birds' average daily consumption of the examined population of Manchurian Golden quails was adequate to the higher live body weight. The ratio of average daily consumption to layers' live body weight corresponded to the data reported by other authors regarding birds of the egg-laying type – 20–30 g for the lighter breeds weighing 140–150 g (Anonymous, 2008) and 21.7–35 g for the heavy breeds, such as the Estonian, weighing 190–200 g (Pigareva and Afanasiev, 1989). The cited data made up, respectively, 16.5–20% of the live weight for the lighter and 15–18% for the heavier breeds.

Under summer heat stress conditions, the observed average daily feed consumption was by 13.2-14.2% lower as compared to seasons with ambient temperatures between 20–25oC. In similar conditions, Djouvinov and Mihailov (2005) have demonstrated a various response of birds with regard to feed consumption depending on the dietary crude protein level. At a crude protein level of 20.4%, the consumption of feed by layers was by 16% lower during the summer period while a dietary level of 17.4% protein resulted in reduction by 7.4% only. This difference was attributed to the impaired thermoregulation in birds that received more proteins with feed, as the metabolism of nitrogen compounds is exothermic and is characterized with greater amount of released heat as compared to carbohydrate and fat metabolism (Musharaf and Latshaf, 1999).

The genetic potential of Japanese quails for egg production was very high, and mean laying intensity was usually around and above 80% after the first production month. These levels of egg production were maintained over the next 5–6 production months (Pigareva and Afanasiev, 1989). Depending on the productive type, and also on the flock's purpose, a layer could produce 150–170 breeder eggs for a 6- to 7-month production period (Pigareva et al., 1989) and up to 250–300 eggs in stock layer flocks for one year (Anonymous, 2008). According to literature sources, this makes up an average laying intensity of about 70–80%.

The high egg production intensity of the layers from the studied population and the high egg mass produced by them determine quails' effective egg production not only as breeders, but also as stock layers. The relative proportion of produced eggs in this study compared to layers' body weight was lower than values reported by other authors (Pigareva et al., 1989; Bondarenko, 2002). According to Pigareva et al. (1989) the egg share from layers' weight for the Estonian breed was 6–6.2%, yet these data are relevant for a shorter production cycle (25 weeks) and for a flock of stock layers, in which the level of stress is usually lower than in breeders. The higher relative proportion of the egg vs the layers' body weight (7.5%) reported by Bondarenko (2002) did not provide information on the breed and population on which the author's statement was based.

The lower mean egg mass in our research for the I, IV, and V generations were due to the fact that three of the controlled production months were during the summer season (June – September), with average daily temperatures above 30 oC. The studies of Onderci et al. (2006) and Sahin et al. (2007) showed that daily 8-hour exposure at ambient temperature of 34oC lowers feed consumption, thus reducing the supply for the body to form eggs. The data reported by Pigareva and Afanasiev (1989) clearly indicated that 61.5% of nutrients from the average daily feed consumed by a layer are used up as building material for the egg.

Culled egg analysis revealed that the major part was made up of unfertilised eggs and late embryonic mortality. In other avian species, the percentage of unfertilized eggs was reported to increase after the phase of peak egg production, while the percentage of late embryonic mortality was the highest at the beginning of lay (Hristev and Gerzilov, 2009). Studies by Tullett and Noble (1988) related late embryonic mortality to lower eggshell permeability. Another reason explaining this fact during the onset of lay is the lower intensity of lipid transport from the yolk to the embryo (Noble and Tullett, 1988). The increased percentage of unfertilized eggs after peak egg production phase is explained by Pigareva and Afanasiev (1989) with the partially rearranged hierarchical structure of birds due to mortality, which is also supported by the later studies of Asasi and Jaafar (2000). This enhances the tension in the group, promotes competition among the males, which finally lowers their fertilizing potential. This conclusion is shared by other authors as well, with their recommendations being that Japanese quails should not be used as breeders for more than 8 production months (Pigareva and Afanasiev, 1989; Anonymous, 2008).

Conclusion

The mean live body weight of the Manchurian Golden quail population reared at the Department of Poultry Science at Trakia University was 259.7–273.1 g for females and 214.3–230.3 g for males. The average daily feed consumption was 42,1–45.2 g, which, in the phase of intensive laying comprised 16.9–17.3% of their live body weight. The average intensity of egg-laying during the control period was 80.95%, with 78.96% of all laid eggs being fit for incubation. The average egg mass was within 12.37–13.45 g. The feed conversion ratio per kg egg mass for the different generations ranged within 3.45–5.05 kg per kg of egg mass, with the highest values observed during the phase of the flock's peak egg production – 3.626±0.111. The hatchability of the incubation eggs was high, relatively stable, at levels of 78–80.87%. The percentage of vital quail hatchlings comprised 95.6–98.2% of all hatched birds. Of all culled incubation eggs, the highest share was that of dead embryos during the final incubation stage (15th – 18th day) with higher percentages during the beginning of egg production (16.3%).

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows, IX th International Conference on Production Diseases in Farm Animals, Sept.11 – 14, Berlin, Germany, p. 302 (Abstr.).

Thesis:

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