



Original Contribution

COMPARATIVE INVESTIGATION OF THE EGG PRODUCTION IN TWO JAPANESE QUAIL BREEDS – PHARAOH AND MANCHURIAN GOLDEN

A. Genchev*

Department of Poultry Science, Faculty of Agriculture, Trakia University, Stara Zagora, Bulgaria

ABSTRACT

Modern Bulgarian quail stockbreeding uses mainly the Pharaoh (PH) and Manchurian Golden (MG) quail breeds. The purpose of this study was to perform a comparative investigation of egg production in these two breeds on the basis of egg production data obtained from nine generations of birds, reared in batteries in groups of 8 female and 3 male birds (sex ratio 2.67:1) and individual floor area 180 cm².

The sexual maturity of MG and PH quails was attained within 37-49 days, when females started laying eggs and a 50% egg production was reached. The genetic potential for egg production was very high in both breeds with mean egg production intensity 80.5% and 75.8% in MG and PH breeds, respectively ($P < 0.001$). Out of all produced eggs, 78.5% (MG) and 73.1% (PH) were appropriate for further use ($P < 0.001$). In absolute terms, the produced standard eggs per hen were 166.7 ± 2.75 and 158.42 ± 2.36 respectively. The highest share of cull eggs was observed in the beginning of the production cycle, with predominance of double-yolk eggs. The average egg mass varied between 12.37 and 13.45 g in MG and 12.87-13.96 g (PH) ($P < 0.001$). In both breeds, it was the highest between the 3rd and 5th production months when it varied within 13.16-13.23 g (MG) and 13.78-13.89 g (PH). The death rate and cull eggs proportion during the 7 months was 25.2% and 26.5% for MG and PH quails, respectively. Almost two thirds (MG) and three quarters (PH) of technological losses occurred during the first and after the 4th production months.

Key words: Japanese quails, egg production, egg weight, death rate, culled eggs.

The fast onset of maturity and the high egg production rate of domesticated Japanese quails make them attractive for industrial egg and meat production. Being gourmet food products in the middle of the 1980s, today they are rather a traditional food in many countries in Asia, Europe and America. During the last three decades European and American producers focused their attention most on meat production, necessitating the utilization of specialized breeds for meat production as the Pharaoh and the Big French. These production development trends influenced not only the selection of breeds for stock egg production, but also the selection work. A typical example is the change in body weight of the Estonian

quail breed, which by the end of the 1980s was 195-200 g (females) and 170-180 g (males) (1), and today, 240 and 212 g, respectively (2). The main reason for the preference towards heavier breeds for egg production is the consumers' demand for larger eggs (12-13 g). The size of eggs in Japanese quails depends on the breed's body weight (3). Another reason to prefer heavier breeds is the economically profitable fattening of unneeded male birds, which is more rewarding for the all-purpose type of birds than for the egg-laying type. The second circumstance is important with regard to the relatively late age (17-20 days, when bird's sex could be precisely determined. About 30% of expenses related to quail rearing are made during that period; therefore the culling of unwanted males is not economically justified (4).

The egg laying intensity and egg weight are major egg production traits. Laying rate is

*Correspondence to: A. Genchev, Department of Poultry Science, Faculty of Agriculture, Trakia University, Stara Zagora 6000, Bulgaria; E-mail: agenchev@abv.bg

influenced by numerous factors, most important among which are rearing conditions and the laying rhythm of hens (5). The series size depends on the duration of egg formation that takes 24 to 25 hours in Japanese quails (6, 7).

Among the all-purpose type quail breeds reared in Bulgaria, the Manchurian Golden is compliant with aforementioned requirements. The breed is characterized with high egg production and large eggs (8), clear sexual dimorphism allowing for the exact sexing of birds at the age of 15-17 days (9), good fattening properties (10) with high quality and excellent meat content (11).

The Pharaoh and the Manchurian Golden quail breeds are the most popular for modern Bulgarian industrial breeding. Therefore the purpose of this study was to perform a comparative investigation of egg production in these two breeds.

MATERIAL AND METHODS

The productivity of nine Japanese quail generations of the Pharaoh (PH) and Manchurian Golden (MG) breeds, reared at the Department of Poultry Science, Trakia University was followed out. Each breed was maintained with 20 selection nests housed in cages with dimensions of 1000x400x200. Each cage was divided into two sections, housing 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 cm² of the cage's total area.

The birds were provided with 16 hours of light in a ventilated not air-conditioned premise. The 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 components and nutritive value of the used compound feeds was the same for all nine generations.

The control period for the studied generations included 7 months of the productive cycle. This duration was determined by the flock's use for breeder eggs 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 (normal size, shape, appearance, shell intactness and colour for the respective age) and cull eggs. The cull 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 CB 2000 scales with a precision of 0.01 g.

Control of the physiological and health status of the birds was performed through daily inspections when the number of laid eggs was registered. During the inspection, dead, emaciated, quails with pecking wounds, injuries, bone fractures, uterine prolapse were registered, removed from the cages and formed the category of dead and culled quails.

The results were statistically processed using the classical methods of statistical analysis by MS Excel 2003 software.

RESULTS

The data obtained from nine generations of the Manchurian Golden (MG) and Pharaoh (PH) breeds showed that the average age of the first egg laid varied between 37 and 42 days without statistically significant interbreed differences (**Fig. 1**). Variations in the 50% egg production age were within a narrow range: 42-49 days for MG and 44-49 days for PH quails. Having followed the variation of the trait in the different generations, MG matured faster as they reached 50% egg production by 2.5 days on average as compared to PH hens (44.3 and 46.8 days, respectively).

Over the controlled period, the mean laying intensity in MG quails was 80.5%, whereas for PH quails – 75.8%. The difference of 6.2% was statistically significant ($P < 0.001$). The egg laying curve (**Fig. 2**) showed that MG hens reached peak egg production during the 2nd production month with average peak egg laying rate 86.67% (from 80.15 to 91.33%). In PH quails, the peak egg production occurred during the 3rd production month with variations within 68.41–90.06%. The most significant difference in egg laying intensity between the breeds was observed by the end of the period (7th production month): 11.4%.

Within the 212-day production period, the share of produced standard eggs (% of all eggs laid) was 78.49% (MG) and 73.09% (PH). The interbreed difference of 6.9% was statistically significant ($P < 0.001$). The shape of standard eggs curve (**Fig. 3**) was similar to the tendency of egg laying intensity but the difference between the breeds by the end of the lay cycle was higher (12.8%).

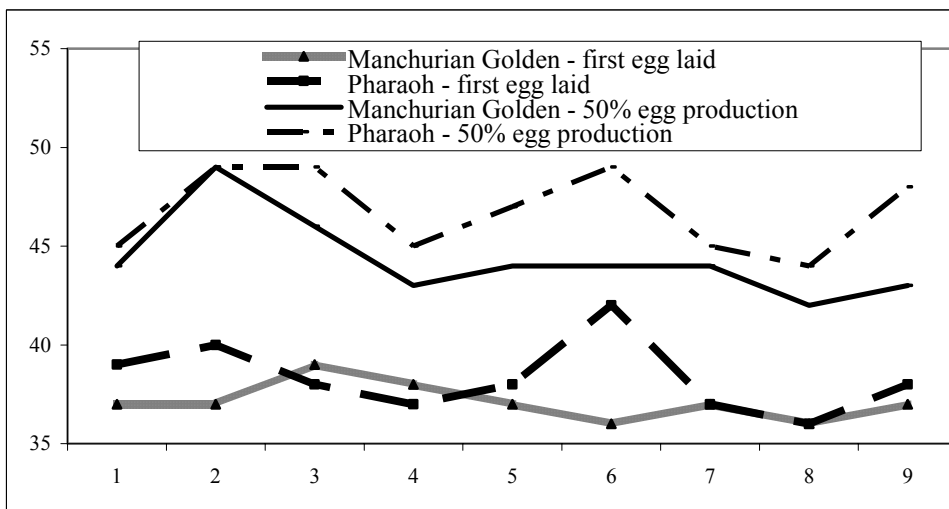


Fig. 1. Age of first egg laid and age of 50% egg production, days

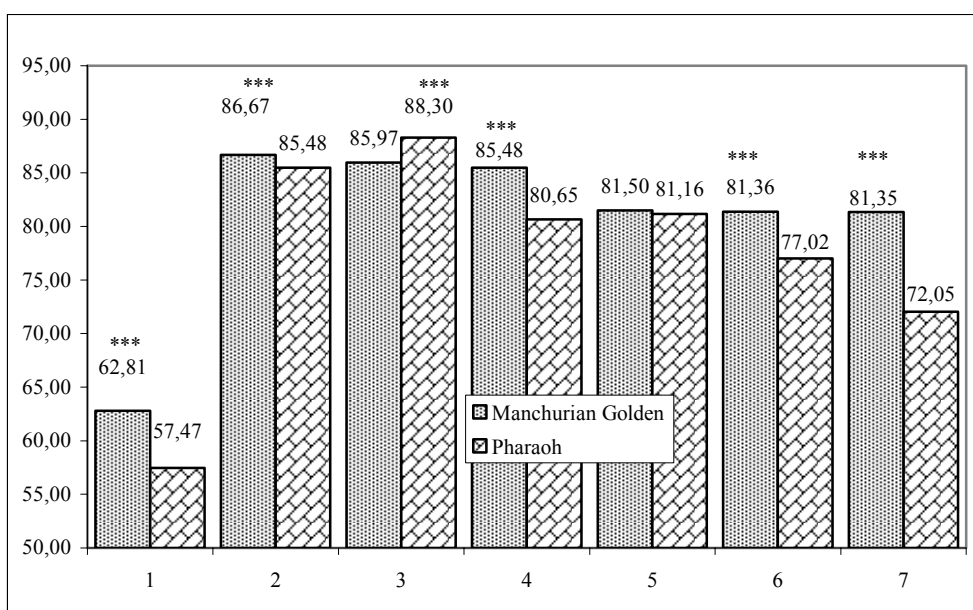


Fig. 2. Mean egg laying intensity, %

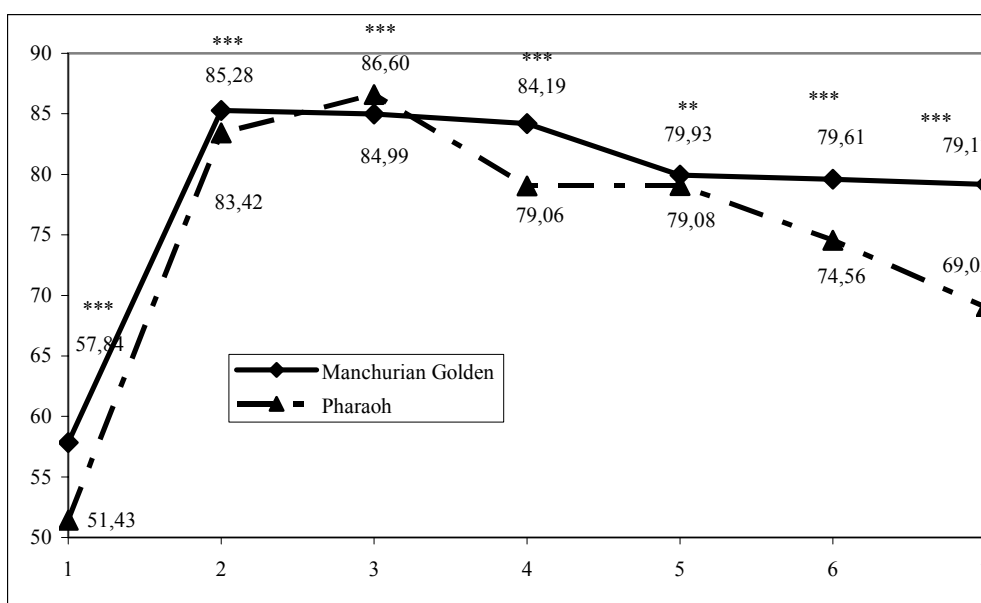


Fig. 3. Standard egg share, % of eggs laid

The highest share of cull eggs was observed at the beginning of the production cycle (Fig. 4). Until the end of the first month, the percentage of non-standard eggs fell to 1.4-2.1%. The lowest cull egg percentages were detected during the second and the third production months. In the beginning of the lay cycle, double-yolks made up the major part of cull eggs (Fig. 5). In both breeds, their relative proportion varied within similar ranges during the 1st production month (27.1-57% in MG and 34.6-62.6% in PH quails). After the second

production month, eggs with various deviations in the size, shape, integrity or shell appearance predominated. Their relative share increased from 35.7-39.5 % during the 1st month to 81-81.7% of all cull eggs by the end of the controlled period. Eggs without shells varied within relatively narrow ranges during the individual production months. In MG quails, this range was 13.6-18.8% (16.28% on average), whereas in PH quails – 13.5-22.5% (19.67% on average).

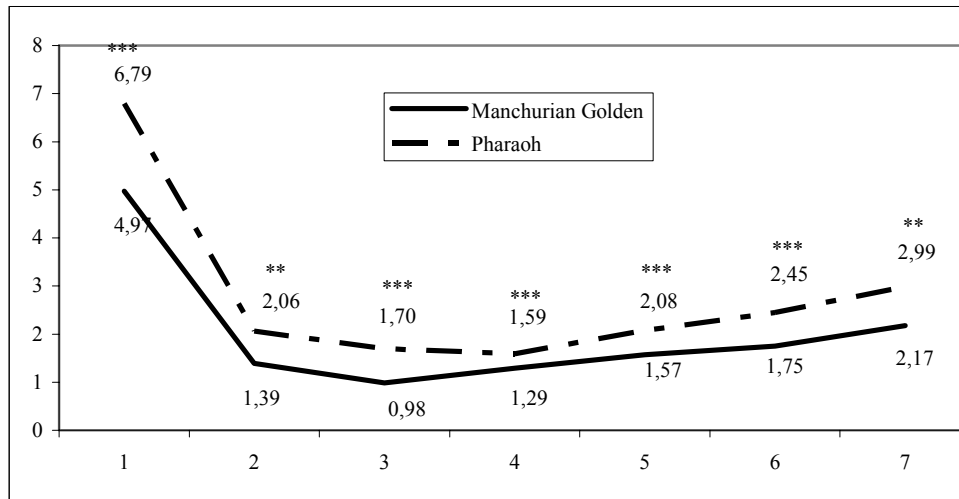


Fig. 4. Cull eggs, % of eggs laid

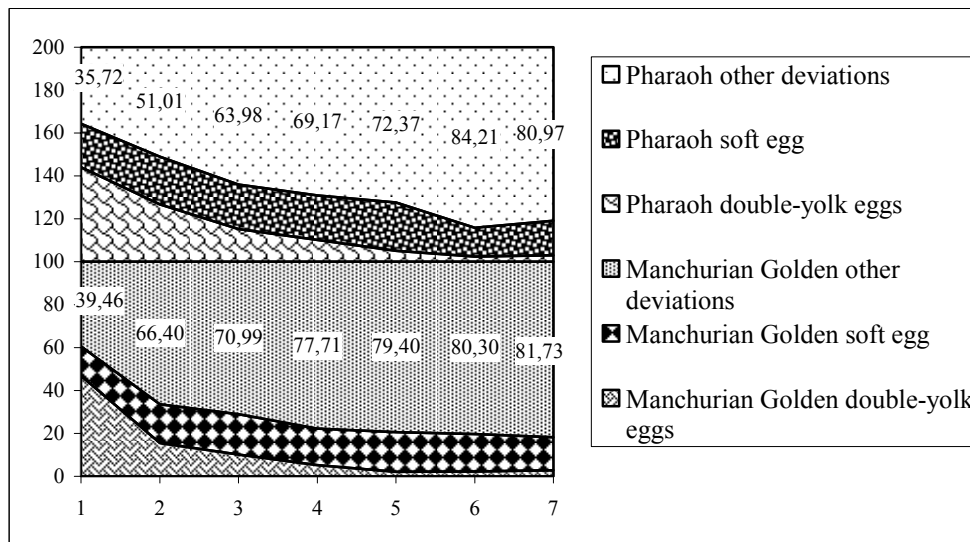


Fig. 5. Cull eggs structure, %

The most consistent changes in the dynamics of egg laying occurred during the first 3-weeks after lay started (Fig. 6). By that time, the egg laying intensity attained and exceeded 70%, accompanied with more dynamic changes in the MG breed. During the first two weeks of the production cycle, the relative share of cull

eggs was the highest. Double-yolk eggs were 50.9-52.6% of all cull eggs in MG quails and 45.4-48.5% in PH quails. Gradually, their share in MG breed decreased to reach 29.1% at the end of the first month, while remaining at a relatively high level in Pharaoh quails (40.3%).

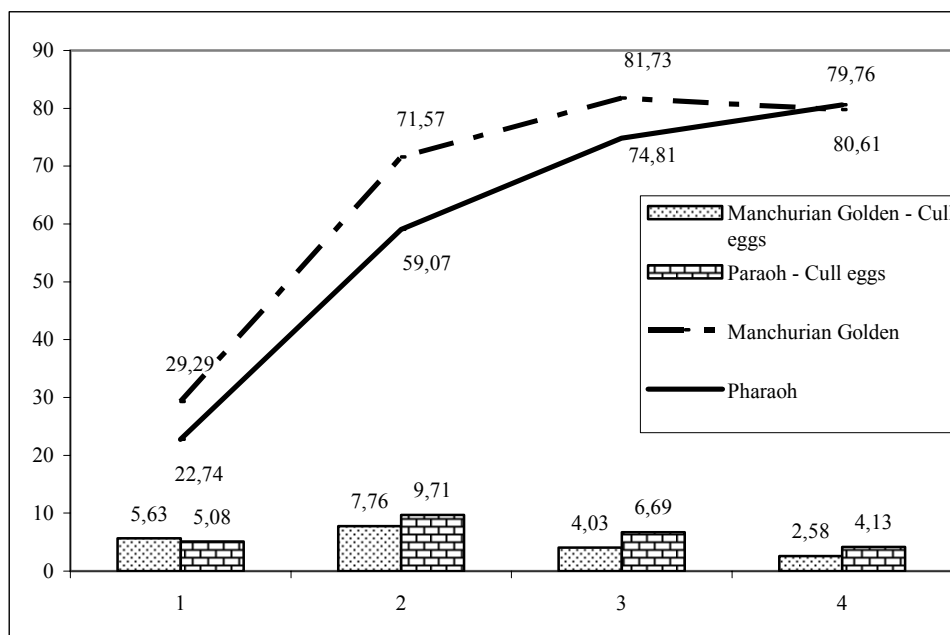


Fig. 6. Dynamics of egg laying and cull eggs during the first production month

The average egg mass of studied Japanese quail breeds varied within 12.37-13.45 g in MG quails (12.88 ± 0.11) and 12.87-13.96 g (13.57 ± 0.12) in PH quails, with statistically significant difference of 5.3% ($P < 0.001$). The egg mass pattern of change during the studied period showed that the highest values of the trait in both breeds were observed between the 3rd and the 5th production month's – 13.16-13.23 g in MG quails and 13.78-13.89 in PH quails (Fig. 7). Within the studied period, values were higher in eggs produced by PH quails and the differences (between 3.6 and 6.6%) were statistically significant. On the basis of the average eggs laid per hen and the

average egg mass, the total egg mass obtained for the control 212-day period was 2167.48 ± 33.23 g and 2153.95 ± 26.26 g for MG and PH hens, respectively. Compared to the average body weight of breeders (260-270 g for MG and 307-326 g for PH), the resulting egg mass was equal to 8.2 times the body weight of MG and 6.7 times the body weight of PH hens. In absolute terms, the egg mass corresponded to, on average, 166.7 ± 2.75 (from 157 to 182 for the different generations) standard eggs laid by a MG hen and 158.42 ± 2.36 (153-171) eggs laid by a PH hen (Fig. 8). The difference between the breeds (5.3%), was statistically significant at $P < 0.05$.

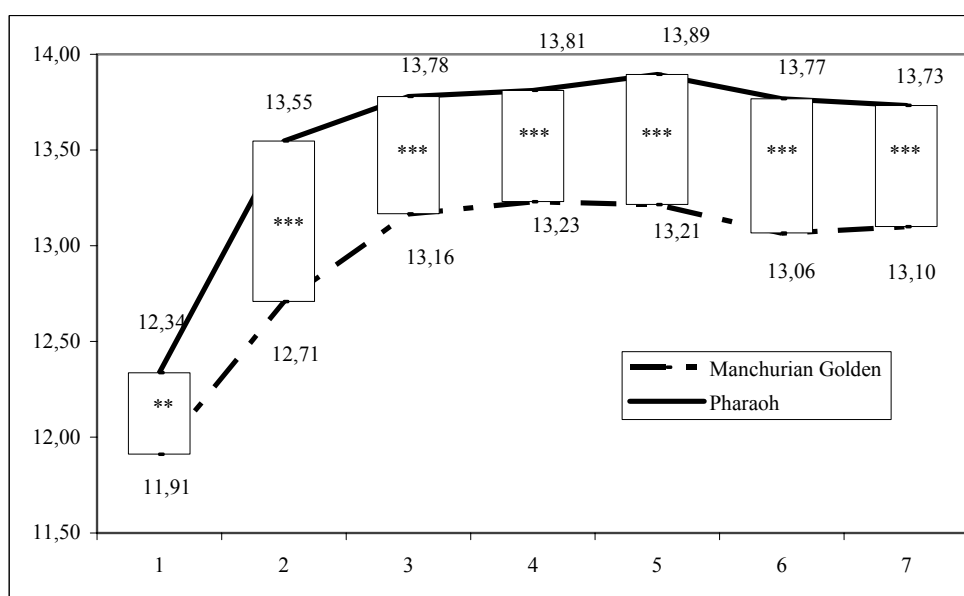


Fig. 7. Average egg mass, g

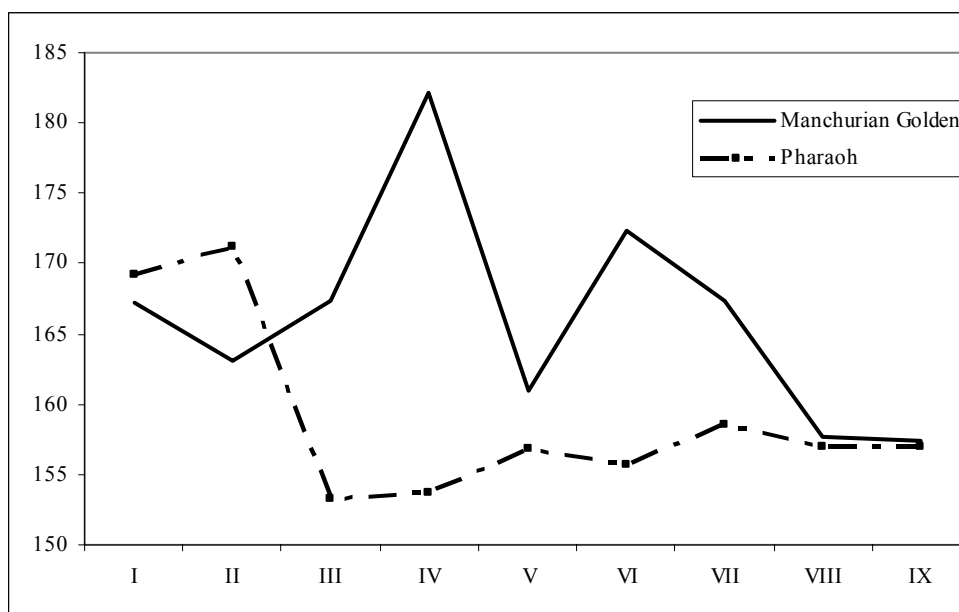


Fig. 8. Average egg production, number of breeder eggs per hen

The average death rate and technological losses (Fig. 9) in both breeds were similar. Higher percentage of culled birds was observed during the first and after the 4th production months. For all 7 months, the dead and culled birds consisted 25.2% for MG and

26.5% for PH quails. The relative proportion of culled birds during the first and after the fourth month was equal to two-thirds of the total number of culled birds for the MG breed and about three-quarters – for the PH breed.

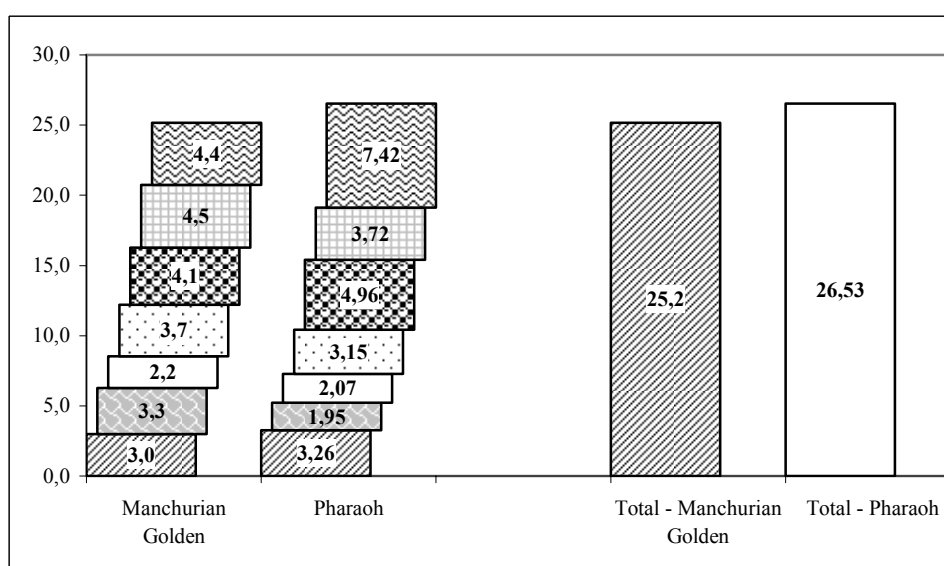


Fig. 9. Average monthly death rate and culled birds, %

DISCUSSION

The sexual maturity of Japanese quail populations reared at the Trakia University was attained average at 44.3 days (MG) and 46.8 days (PH hens), i.e. by about 5 days less than data reported in the literature - 48 days for all-purpose type quails (12) and 52 days for meat-type quails (13).

The genetic egg production potential of Bulgarian Japanese quail breeds is very high, and after the first production month the average egg laying intensity for MG quails was in general about and over 80%, whereas in PH hens these values were preserved until the end of the 5th month and afterwards, decreased to 77-72%. Taking into consideration the

differences in the production type of both studied breeds, our data are corresponding to what was reported for a similar production period: 70-80% (1, 14).

The egg production curve revealed that the difference between both investigated breeds was more pronounced until the 2nd week, ranging within 28.8-21.2%. This difference is expected on the background of the different production type of breeds, hence the age of sexual maturity. The higher lay intensity of MG quails, by 11.4% on average, is logical provided the production type of the breed.

The structure of cull eggs during the first production month showed that double-yolk eggs predominated. The higher relative proportion of this category was preserved over the next two production months with slower rate of decrease in PH quails. Earlier studies of ours, based on the egg production of one of generations showed that after the 6th week (MG) and after the 7th week (PH), the functions of the ovary and the oviduct were synchronized and as a result, the share of double-yolk eggs decreased to less than 10% (15). The present data on 9 generations, ignoring the seasonal variations of individual generations allow us to conclude that the share of double-yolks fell below 10% after the third production month. At that age, birds completed their growth and maintained a lay intensity rate over 80%. This rate was preserved until the end of the study period, which evidenced a genetic potential allowing a more prolonged production life of birds – something very important for industrial egg production. In PH breed, the higher laying intensity (>80%) was preserved until the end of the 5th month, then slowly decreased but remained over 70%. Considering the fact that PH was selected as a heavy meat-type breed, its egg production potential is assessed as very high. This is one of the most important selection traits in contemporary meat-oriented poultry breeding, making the breed valuable for Bulgarian quail rearing industry.

For the 212-day period of the study, a MG hen produced 5.3% more eggs on average than a PH hen. The summarized production results however showed that the total egg mass per hen was almost equal in both breeds. The statistically significant difference in breeder eggs produced by MG was compensated by the considerably higher mass of PH quail eggs.

The number of breeder eggs produced per hen was in agreement with results reported in the literature (1).

The mean egg mass for the MG breed was higher than average values reported by other investigators for the all-purpose type (3, 12, 16), while the mean egg mass for PH was by 7.2-9.5% lower than data provided by Milviele for the Big French quail breed (13). The high egg laying intensity of MG hens combined with the high egg mass produced suggested that the breed could be successful and competitive in an industrial egg production setting.

Lower mean egg mass values in some of generations included in this study were due to the fact that three or more of their production months were during the summer (June – September) when the mean daily temperatures were over 30 °C. According to several reports, the daily 8-hour exposure of birds to ambient temperatures of 34 °C has decreased feed consumption and thus limited the supply of nutrients necessary for formation of eggs (17, 18). The occurrence of 2-3 hot summer months within the 7-month production period was able not only to reduce the average production of a generation, but also influenced the results from the entire research. Heavier-type birds are more sensitive to high temperatures, which Khan (19) has attributed to high plasma corticosteroid concentrations, essential for avian susceptibility to stress (20).

The dynamics of death rate and culled birds in this study was similar to detailed technological chart presented by Pigareva and Afanasiev (21) for changes in Estonian quail breed population during industrial egg production. The higher level of stress resulting from the restricted space in the cage and the narrower sex ratio, specific for Japanese quails, could be among the reasons for the relatively high number of dead and culled birds. The traumatism, emaciation and death during the first 3-4 production months, the hierarchy in some nests was disturbed with even narrower sex ratio (until 2:1), resulting in more problems. In such nests, the aggression of males is enhanced, contributing to higher anxiety and stress and often, to cannibalism. The daily inspection of quails' status, performed by the time of eggs collection, and the thorough culling by the 5th production month when death rate began to increase, had a positive effect with

substantially reduction of the level of stress in the groups, slightly slowing down of death and culling rates during the 6th and the 7th production months.

CONCLUSION

The sexual maturity of MG and PH quails was attained within 37-49 days, when females started laying eggs and a 50% egg production was reached. The genetic potential for egg production was very high in both breeds with mean egg production intensity 80.5% and 75.8% in MG and PH breeds, respectively ($P < 0.001$). Out of all produced eggs, 78.5% (MG) and 73.1% (PH) were appropriate for further use ($P < 0.001$). In absolute terms, the produced standard eggs per hen were 166.7 ± 2.75 and 158.42 ± 2.36 respectively. The highest share of cull eggs was observed in the beginning of the production cycle, with predominance of double-yolk eggs. Their proportion decreased gradually to attain a level $< 10\%$ after the 3rd production month. The average egg mass varied between 12.37 and 13.45 g in MG and 12.87-13.96 g (PH) ($P < 0.001$). In both breeds, it was the highest between the 3rd and 5th production months when it varied within 13.16-13.23 g (MG) and 13.78-13.89 g (PH). The death rate and cull eggs proportion during the 7 months was 25.2% and 26.5% for MG and PH quails, respectively. Almost two-thirds (MG) and three-quarters (PH) of technological losses occurred during the first and after the 4th production months.

REFERENCES

1. Pigareva M.D., G.D. Afanasiev and V.P Neps., Quail breeding, M., Agropromizdat, 1989.
2. Tikk H., A. Lemberg, M. Piirsalu and V. Tikk, The chemical composition and mineral content of the Estonian quail meat. Proceedings of the 10th Ukrainian Poultry Breeding Conference with International Participation, Alushta, 15-18 September 2009, Ukraine, 2009.
3. Afanasiev G.D., Breeds and versions in Japanese quails. *Pticevodstvo*, 3:12-15, 1991.
4. Kajtasov G. and A. Genchev, The nutrition as a basic factor, determining the effectiveness of meat and eggs producing from Japanese quail. *J. of Animal Science*, XL, 5:50-53, 2003.
5. Kumar A., S.M.H. Akhtar, S.B Verma., K.G. Mandal, Mani Mohan, A. Kumar and

- M. Mohan, Influence of age, body weight, egg weight, clutch size and pause on egg production in Japanese quails. *Indian Journal of Animal Health*, 39, 2:82-84, 2000.
6. Panda B. and R.P. Singh, Developments in processing quail meat and eggs. *World's Poultry Sci. J.*, 46, 3:219-234, 1990.
7. Shanaway M.M., Quail production systems: a review. *Rome, Food and Agriculture Organisation of the United Nations*, 1994.
8. Genchev A., Egg Production Potential of Manchurian Golden Quail Breeders. *Agricultural Science and Technology*, Vol. 3, 2:73-80, 2011.
9. Genchev A., M. Kabakchiev, R. Mihailov, Potential of using sexual dimorphism in plumage colour for sexing Manchurian Golden quails. *Trakia Journal of Sciences*, v.6, 2:10-15, 2008.
10. Genchev A., S. Ribarski, G. Zhelyazkov, Physicochemical and technological properties of japanese quail meat. *Trakia Journal of Sciences*, 8, 4:86-94, 2010.
11. Genchev A., Effect of slaughter age of male Japanese quails on the production, quality and composition of meat. *Poultry*, 4:26-28, 2010.
12. Yalmaz Dikmen B. and A. Ipek, The effects of shank length on egg production and egg quality traits of Japanese quails (*Coturnix coturnix japonica*). In CD-Rom Abstracts and Proceedings of XII European Poultry Conference, Sept. 10-14, Verona, Italy, N 10100, 2006.
13. Milvielle F., Genetics and breeding results for quail production. In CD-Rom Abstracts and Proceedings of 11th European Poultry Conference, Aug. 6-10, Bremen, Germany, 2002.
14. Anonymous, Handbook of quail rearing. http://www.ptahi.com/articls_025.html. 19.04.2010 date last accessed, 2008.
15. Genchev A. and M. Kabakchiev, Egg productivity and egg quality estimation and evaluation of two breeds Japanese quail (*Coturnix japonica*). *Agricultural Science and Technology*, Vol. 1, 1:8-12. 2009.
16. Aggoor F.A.M., Y.A. Attia, F.S.A. Ismail, E.M.A. Qota and E.A. Shakmak, Effect of level and source of dietary energy and/or enzyme additions fn productive performance and egg quality of Japanese quail hens. In CD-Rom Abstracts and Proceedings of XII European Poultry

- Conference, Sept., 10-14, Verona, Italy, N 10210, 2006.
17. Onderci M., N. Sahin, K. Sahin, T.A. Balci, M.F. Gursu, V. Juturu and O. Kucuk, 2006. Dietary arginine silicate inositol complex during the late laying period of quail at different environmental temperatures. *Br. Poultry Sci.*, 47, 2:209-215, 2006.
18. Sahin N., M. Onderci, T.A. Balci, G. Cikim, K. Sahin and O. Kucuk, The effect of soy isoflavones on egg quality and bone mineralisation during the late laying period of quail. *Br. Poultry Sci.*, 48, 3:363-369, 2007.
19. Khan A.G., Status of sex linked dwarfing gene in poultry production. *Poultry Guide*, 27, 1:45-57, 1990.
20. Schmidt J.B., D.G. Satterlee and S.M. Treese, Maternal corticosterone reduces egg fertility and hatchability and increases the numbers of early dead embryos in eggs laid by quail hens selected for exaggerated adrenocortical stress responsiveness. *Poultry Sci.*, 88, 7:1352-1357, 2009.
21. Pigareva M.D. and G.D. Afanasiev, Quail breeding, First edition, M., Rosagropromizdat, pp 84-87, 1989.

GENCHEVA.