

Grown characteristics and effectiveness of common quail (*Coturnix coturnix*, Linnaeus 1758) raising for game restocking

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Abstract

This study aimed to evaluate the growth characteristics and rearing effectiveness of cage-raised common quails for game restocking. Based on the origin of the quails, three groups of one-day-old birds were formed. Up to the age of 21 days, the quails were reared together, and subsequently, they were separated by sex. The test period lasted 56 days. The rearing conditions and feeding of the quails were analogous to those of domesticated quails. The following traits were monitored: mortality (%), live body weight (g), weight gain (g), feed intake (g), and feed conversion ratio. At 56-day-old, the average male live body weight was 110.68 g, while for the females, it was 127.24 g ($P<0.001$). The cumulative feed intake was 826.9 g for males and 970.4 g for females. Quails raised until 35-day-old consumed half the amount of feed compared to those raised until 56-day-old, with feed conversion ratios of 4.39 for males and 4.58 for females, respectively. By 35-day-old, the males had reached approximately 87 % and the females about 80 % of the live weight of mature individuals. The results of the study provide grounds to recommend common quails raising intended for game restocking up to a maximum age of 35 days. This would increase the efficiency of their production, enable more production cycles, and optimise the utilisation of available facilities and equipment.

Key words: effectiveness, feed conversion ratio, game birds, restocking.

Introduction

In recent decades, poultry farming has become the fastest-developing subsector of animal husbandry worldwide (Mottet and Tempio 2017). In addition to the production from traditional poultry species

such as domestic chicken, domestic turkey, domestic duck, and domestic goose, less commonly farmed species, including game-type birds as quails, are also gaining significance. Beyond their role in poultry farming, some of these birds are also in focus of game farming. For hunting

purposes, common quail (*Coturnix coturnix*, Linnaeus 1758) or hybrid birds (*C. coturnix* × *C. japonica domestica*) are bred in game farms in some countries. These birds are used for game restocking, dog training, or other hunting-related activities (Caravaca et al. 2022). Game farms specialising in the breeding, sale, and game restocking of common quails were established as early as the 1960s and 1970s, primarily in some countries from Southern Europe like Spain, Italy, and Greece (Lukanov 2020, Caravaca et al. 2022). Similar efforts have also been made in countries like Bulgaria, where the species is a popular hunting object (Donchev and Angelov 1971).

The common quail belongs to the genus *Coturnix* within the subfamily *Perdiciinae*. The genus comprises six living and two extinct species (Lukanov 2020). According to some taxonomic classifications, the number of extinct species is higher, with some, such as the brown quail, being classified in a separate genus (del Hoyo et al. 2014). Until a few decades ago, the Japanese quail (*Coturnix japonica*, Temminck and Schlegel 1848–1850) was considered as a subspecies of the common quail. Today, however, the two species are taxonomically distinguished.

A distinctive characteristic of the common quail is its migratory behaviour, making it the only long-distance migratory bird in the family *Phasianidae* (Kosicki et al. 2014). A significant portion of the population migrates from North Africa and the Middle East to Southern and Eastern Europe for breeding. Vertical migration in the species has also been described, associated with agro-ameliorative measures in the lowlands or drought (Boev 1949, Michailov 1995a). It is estimated that between 5 % and 24 % of the global population breeds in Europe (EC 2009). The

common quail is classified as a species of Least Concern (BirdLife International 2025) with global population between 15–35 million mature individuals and extent of occurrence about 87,900,000 km². Estimates suggest that the European population, including European Russia and Turkey, is approximately 2.8–4.7 million pairs (WBRU 2016). Despite this status, a population decline has been observed since the late 20th century (Sanderson et al. 2009, Puigcerver et al. 2012). Similar trend has been established for the Bulgarian population of the species. It is placed among the top three most rapidly declining species in the country according to Hristov et al. (2023). Key factors contributing to the global population decline include habitat loss, uncontrolled pesticide use, climate changes (especially droughts), wind turbine installation, nets trapping, and other threats (Lukanov 2020). Detailed study of the biology and ecology of common quail in Bulgaria was presented by Michailov (1995b).

The domestic quail (*Coturnix japonica domestica*), which originates from the Japanese quail, is widely used in agriculture for egg and meat production, and as a laboratory animal (Lukanov 2019). Domestic quails are used to enhance the productive characteristics of captive common quail populations by crossing (Caravaca et al. 2022, González-Redondo et al. 2023). Some researchers suggest that a significant portion of quails released into the wild are such hybrids (Sánchez-Donoso et al. 2012). Despite the presence of hybrids, no substantial genetic impact on the wild population has been observed (Puigcerver et al. 2007).

Raising wild quails and their hybrids in controlled conditions can improve knowledge about these birds. From the perspective of quail production for restock-

ing, it is important what the growth rate of young birds is and at what stage of their rearing is most appropriate to be realised. To date, there is lack of available literature on the growth characteristics of the common quail or its hybrids from a poultry science perspective. Data on the suitability of these birds for cage-based rearing, which offers several advantages over traditional methods of raising game birds, are also absent. This context defined the aim of the present study: to evaluate the growth characteristics and rearing effectiveness of cage-raised common quails (*C. coturnix*) for game restocking.

Materials and Methods

Experimental design

The study was conducted from August to October 2023 at the Poultry Section Experimental Base at the Faculty of Agriculture, Trakia University, Stara Zagora, Bulgaria. Common quails (*Coturnix coturnix*), raised for game restocking in Greece and Italy, were used. Hatching eggs were received from parental flocks of the same age, originating from captive-bred quails, raised in the Poultry Section Experimental Base. The origin of the common quails used was Greece (two different flocks) and Italy (one flock).

Based on the origin, three groups were established and labelled as follows: I (GR first flock), II (GR second flock), and III (IT). Each group consisted of 60-day-old quails. Up to 21-day-old, the quails were reared in mixed-sex groups (due to low sexing accuracy before that age). At 21-day-old, sexing was performed based on sexual dimorphism in breast plumage colouration: appearance of rusty coloura-

tion on the chest in males and its absence in females, as described by Lyon (1962). Following sexing, the birds were reared in separate male and female groups (I_m , I_f , II_m , II_f , III_m , and III_f) until the end of the study at 56-day-old. Each newly formed group (21-day-old) consisted of 20 males or 20 females with body weights close to the average for the respective population.

Experimental bird management

The quails were housed in wire-mesh floor cages measuring 80×100×80 cm (W/L/H), providing about 130 cm² floor area per bird until 21-day-old and 400 cm² after that age. Hand-fillable trough feeders, protected from feed spillage were used. Watering was provided with hand-fillable vacuum drinkers of 2 L capacity with a low water level until 14-day-old, and 3 L universal hand-fillable vacuum drinkers were used thereafter. Temperature and lighting programs in the bird area were maintained on the detailed recommendations for domestic quails as presented by Genchev (2014). During the brooding period (up to 21-day-old), combined heating was applied: local and general. After that, the birds were kept at a temperature of 20–23 °C. The relative humidity was in the range of 60–75 %. Quails were reared for the first three days under continuous high-intensity lighting (80–100 lx) to facilitate feed and water finding. After which, by 4 weeks of age, the light phase was gradually reduced to 14 h, remaining until the end of the test period. The lighting intensity was about 20–25 lx.

Feeding was conducted *ad libitum*, in three-phase manner (starter, grower, and finisher) according to the birds' age (Table 1), following feeding recommendations for domestic quails (Genchev 2014).

Table 1. Component and nutritional characteristics of the feed used.

Components	Starter <14 days	Grower 14-21 day	Finisher >21 days
Corn, %	29.2	35.5	38.8
Wheat, %	21	23.8	27
Soybean meal 44 CP, %	34.6	25.8	20
Sunflower meal 34 CP, %	8	8.5	9
Fish meal 72 CP, %	2	1	0
Sunflower oil, %	0.615	0.905	1
CaHPO ₄ ·2H ₂ O, %	1.92	1.82	1.71
CaCO ₃ , %	1.52	1.48	1.43
Vitamin-mineral pre-mix, %	0.6	0.6	0.5
NaCl, %	0.2	0.2	0.2
NaHCO ₃ , %	0.1	0.1	0.1
L-Lysine, %	0.11	0.175	0.15
DL-Methionine, %	0.135	0.12	0.11
Nutritional characteristic			
Energy-protein ratio	110.27	134.28	156.31
Metabolizable energy, MJ·kg ⁻¹	11.06	11.51	11.79
Crude protein, %	24.00	20.51	18.04
Crude fiber, %	5.28	5.02	4.90
Ca, %	1.20	1.10	1.00
Av. P, %	0.50	0.45	0.40
Lysine, %	1.30	1.10	0.91
Methionine, %	0.52	0.45	0.40
Methionine + Cysteine, %	0.92	0.81	0.73
Linoleic acid, %	1.30	1.62	1.75

Note: CP is crude protein.

Data collection

During the study, the following parameters were monitored: live body weight (g), weight gain (g), feed consumption (g), and feed conversion ratio (FCR). Live body

weight was measured weekly by using a CB 2000 scale, with an accuracy of 0.1 g for measurements at 1–7-day-old, and 0.2 g at 14-, 21-, 28-, 35-, 42-, 49-, and 56-day-old. The amount of feed supplied and the remaining feed from the previous day were determined daily with an accuracy of 0.1 g. Based on the consumed feed and achieved weight gain, the FCR, and the cumulative feed consumption was calculated. From the point of view of practical application, generalisations of the studied parameters have been made, with group data being summarised.

Statistical analysis

Statistical processing of the obtained results was performed using the IBM® SPSS® Statistics software package (V26) and applying One Way ANOVA. For statistical analysis and result interpretation, the following parameters were used: mean value ($\bar{x}$), standard deviation (SD), and standard error of the mean (SEM). The text indicates the mean $\pm$ SD values. Inter-group and inter-sex differences were considered statistically sig-

nificant at $P < 0.05$, using LSD *Post Hoc* Test, if the data were normally distributed (Shapiro–Wilk test, $n < 50$) and in significant model (F-test) ($P < 0.05$). A Microsoft Excel 16.0 (2018, for Windows) software

product was used for graphic layout purposes.

Results

The average weight of the quail from the three groups at 1 day of age was 6.16 ± 0.74 g (group I – 6.15 ± 0.66 g; group II – 5.97 ± 0.76 g; group III – 6.48 ± 0.75 g). The live weight of quails at 7-day-old ranged from 20.89 ± 3.36 g (group I) to 22.49 ± 3.38 g (group II). At 14-day-old, was the last weighing conducted without accounting for sex differences. The quails from all three groups showed relatively close average weights, ranging from 45.30 ± 5.29 g in group I to 42.71 ± 4.05 g in group III ($P < 0.05$) (Table 2).

After sexing, during the first weighing (on 21-day-old), female quails exhibited a trend of higher live weight compared to males, which persisted until the end of the study. Statistically significant sex differences in live weight were observed

Table 2. Live weight of common quails from the different studied populations before sexing ($\bar{x} \pm \text{SD}$).

Age, days	Group		
	I	II	III
7	20.89 ± 3.36	22.49 ± 3.38	21.81 ± 2.84
14	$45.30 \pm 5.29a$	45.23 ± 6.15	$42.71 \pm 4.05a$

Note: With the same letters (a-a, b-b) are marked statistically significant between-group differences for each sex at $P < 0.05$.

after 42-day-old ($P < 0.01$). By the time of sexual maturity at the end of the experiment (56-day-old) the average weight of males from the three groups was 110.68 ± 7.1 g (Fig. 1), with intergroup variations from 109.43 ± 7.9 g (group III_m) to 111.35 ± 5.4 g (group I_m) ($P > 0.05$). The live weight of females at 56-day-old averaged 127.24 ± 11.3 g across the three groups, with intergroup variations from 120.67 ± 11.4 g (group I_f) to 131.78 ± 11.2 g (group III_f).

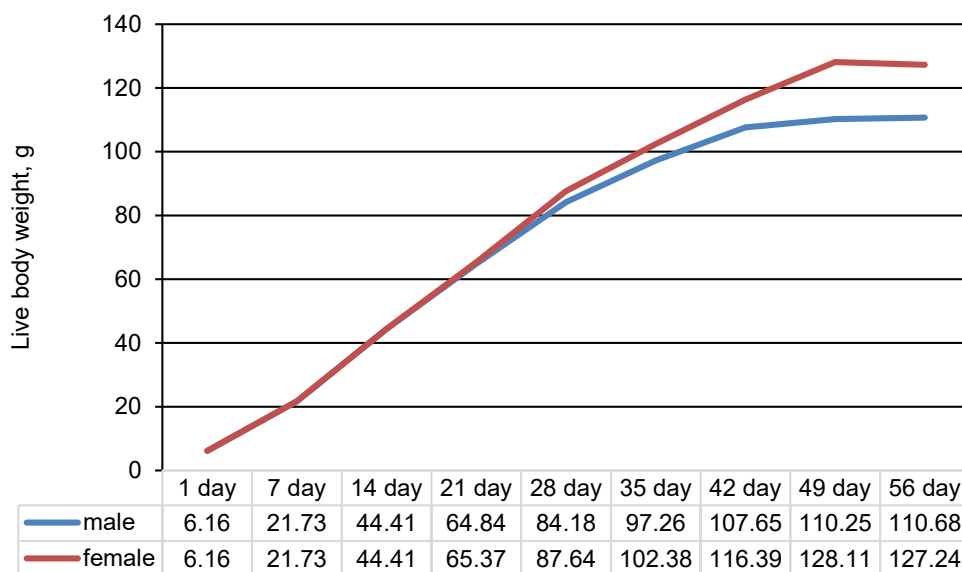


Fig. 1. Live body weight of male and female common quails.

Unlike males at 56-day-old, where no statistically significant differences were observed in live weight, females from group I_f showed statistically significant differences compared to those from groups II_f and

III_f ($P < 0.05$) (Table 3).

The results for cumulative feed consumption in male and female common quails during the period of the study are presented in Figure 2. After the sex-mixed

Table 3. Live weight of common quails from the different studied populations after sexing ($\bar{x} \pm \text{SD}$).

Age, days	Sex					
	Male			Female		
Group	I _m	II _m	III _m	I _f	II _f	III _f
21	66.96 $\pm$ 5.5	64.17 $\pm$ 8.8	63.39 $\pm$ 7.3	64.86 $\pm$ 9.2	68.47 $\pm$ 8.2	62.78 $\pm$ 7.5
28	85.38 $\pm$ 6.5	85.14 $\pm$ 10.7	82.02 $\pm$ 8.5	88.26 $\pm$ 9.7	89.76 $\pm$ 7.9	84.89 $\pm$ 7.6
35	95.06 $\pm$ 5.4*	99.51 $\pm$ 8.7	97.2 $\pm$ 7.9	105.04 $\pm$ 12.8*	104.41 $\pm$ 9.8	97.69 $\pm$ 8.6
42	105.16 $\pm$ 6.5a*	110.52 $\pm$ 7.5a*	107.28 $\pm$ 6.8	118.32 $\pm$ 9.0*	119.88 $\pm$ 10.3a*	110.95 $\pm$ 11.4a
49	109.53 $\pm$ 4.6*	111.79 $\pm$ 7.7*	109.44 $\pm$ 7.2*	127.24 $\pm$ 14.0*	131.29 $\pm$ 13.7*	125.79 $\pm$ 13.2*
56	111.35 $\pm$ 5.4*	111.24 $\pm$ 7.8*	109.43 $\pm$ 7.9*	120.67 $\pm$ 11.4ab*	129.26 $\pm$ 8.9a*	131.78 $\pm$ 11.2b*

Note: With the same letters (a-a, b-b) are marked statistically significant between-group differences for each sex at $P < 0.05$. With * are marked the within-group intersexual differences at $P < 0.01$.

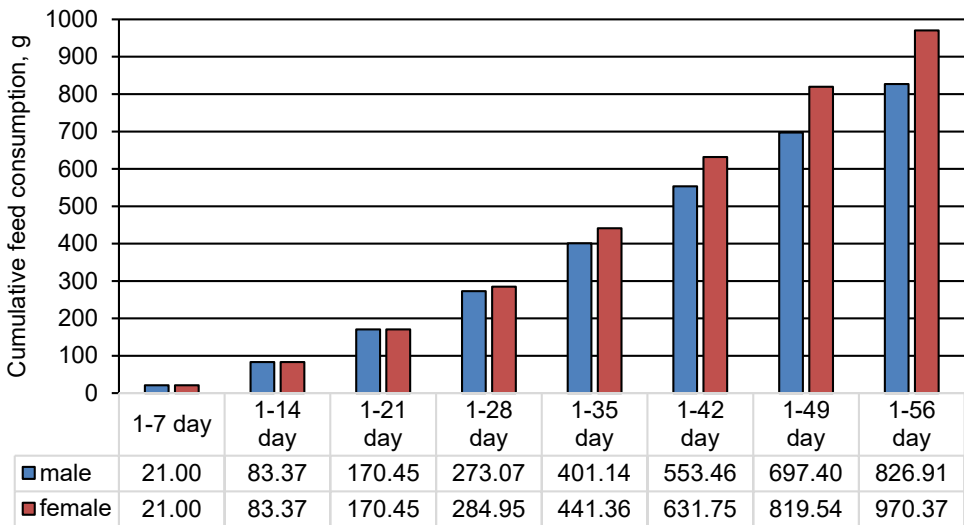


Fig. 2. Cumulative feed consumption in male and female common quails.

raising period (21-day-old), differences between the sex feed consumption became apparent, deepening with age and reaching approximately 143.5 g (14.8 %) by the end of the study. The cumulative feed consumption of male quails up to 56-day-old in our study was 826.9 g, while for females, it was 970.4 g. The observed intersexual differences are directly connected to the sex-related distinctions in live body weight (Fig. 1). Male maturation was associated with a constant and even a decline in feed consumption, reaching an average daily consumption of 18.5 g during the final week. Despite the growth of the reproductive system in females and their preparation for egg-laying, a similar trend was observed, characterised by a slight decline in average daily consumption, reaching 21.5 g in the last week of the experiment. Figure 2 illustrates the age-related changes in cumulative feed consumption in the all tested quails, separated by sex.

The data for FCR showed relatively

close values for feed conversion between the two sexes, raised until 35-day-old, with 4.39 kg for males and 4.58 kg for females (average 4.48 kg for both sexes) (Fig. 3). As expected, with the increase in the quails rearing period, feed utilisation efficiency worsens, reaching an average FCR value of 7.95 for both sexes at the end of the test period (56-day-old).

Discussion

Mihaylov (2006) reported a similar weight for 1-day-old common quail (*C. coturnix*) – 5.99 g as in this study. Lower values, ranging between 5.0–5.5 g, were presented by Botev (1985). It should be noted that the weight of 1-day-old quail is influenced by various factors, with the most significant being the size of the hatching egg and the duration of the chicks' stay in the incubator (Genchev and Lukanov 2023). The growth of the studied populations of common quails up to 14-day-old

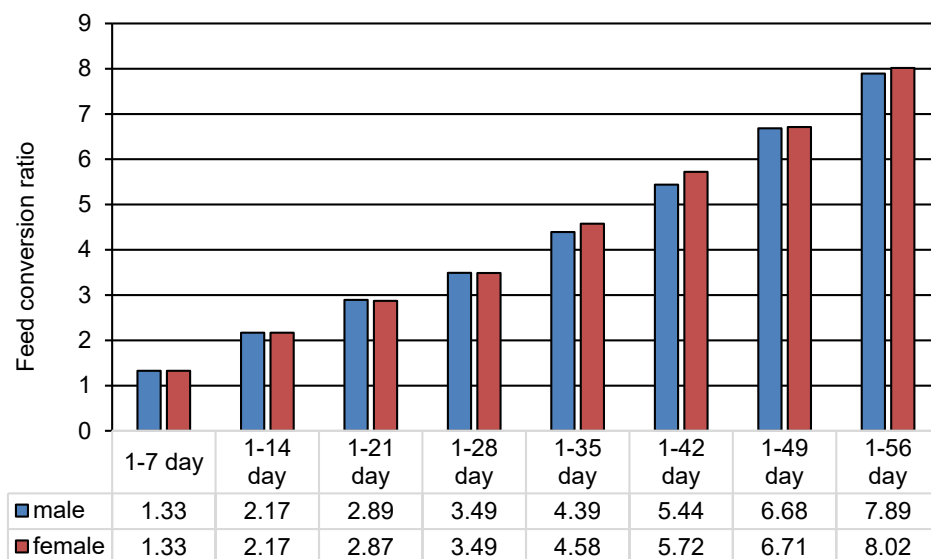


Fig. 3. FCR in male and female common quails.

is comparable to that of light (egg-laying) domestic quails (Anang et al. 2017, Grieser et al. 2018). At this age, in addition to rapid changes in the live weight of the birds, changes in their plumage were also observed. From day 14th, quails enter the phase of intensive feathering, initiating a complete replacement of embryonic down with juvenile feathers (Genchev et al. 2008). Consequently, sex determination based on breast colouration in common quails can be performed as early as 13-day-old, but it is most reliably done about and after day 21st – at the beginning of second juvenal plumage development (Lyon 1962).

Analysing the data on average weekly growth, it can be concluded that quails exhibit the most active growth during the period up to 7-day-old. Relatively close growth values were observed during the control weighing on days 14th and 21st. Up to 21-day-old, the growth of common quails accounts for approximately 60% of the total growth in males and about 54.5 % in females. After this age, the average growth values gradually decrease, even reaching negative levels in some subgroups during the final week of the test period. This decline may be associated with the birds reaching maturity. Similar results regarding growth intensity in common quails were reported by Mihaylov (2006). In contrast, domestic quails of the light egg-laying type demonstrate higher growth rates (Saatci et al. 2002, Sezer et al. 2006, Nankinov 2016, Grieser et al. 2018), indicating a more intensive growth pattern. Regarding the weight differences of sexually mature male and female individuals, our findings align with those presented by several authors studying common quails (*C. coturnix*) in field investigations (Michailov 1995b, Derégnacourt et al. 2002, Tsachalidis et al. 2007,

Qureshi et al. 2016, Bagarić and Dumić 2019). Compared to the cited sources, the live weight of the mature quails used in the present study shows higher values. This can be explained by the better raising conditions and feeding of the birds in captivity or by hybridisation. When comparing wild common and wild Japanese quail (*C. japonica*), no significant differences in live weight were observed (Lyon 1962, McGowan and Kirwan 2020). It can be stated that selection has resulted in higher live weights in domestic quails (*C. japonica domestica*) comparing with their ancestor (Japanese quail) and common quail. In domestic quails, live weight is one of the traits most strongly influenced by selection, with differences from their wild ancestors up to three times (Lukanov and Pavlova 2020a).

The available scientific literature does not provide information regarding feed consumption quantity in the different common quail age periods. In this context, the present study can serve as a foundation for the economic evaluation of the efficiency of their captive raising, as feed costs constitute a major component in determining the production cost of a single quail (Lukanov and Pavlova 2020b). By analysing the feed consumption data, averaged for male and female quails, it is possible to quantify the feed requirements across the different feeding phases (starter, grower, and finisher) for rearing a quail until their restocking. Based on this study, a single quail consumes an average of about 80 g of starter feed (up to 14-day-old), 90 g of grower feed (up to 21-day-old), and 730 g of finisher feed (21–56-day-old). This allows for accurate planning of the feed needed for raising quails in game farms. The primary rearing method for common quails intended for game restocking involves floor rearing during the brooding

period (brooder houses), followed by aviary housing (open-air flight pens) (Caravaca et al. 2022). Typically, higher feed consumption is observed raising birds under non-caged systems due to the increased activity levels of the birds (Ahmed et al. 2014). Therefore, for the purposes of game farming practice and planning, we recommend that feed calculations for game farms be increased by about 10 % during the brooding period and by about 20 % thereafter, compared to the values presented in this study where cage-rearing system was used.

Analysing the results regarding common quails' live body weight, their physical development, and feed consumption, it can be recommended that most effective restocking age is about 35 days. This corresponds to the average age of transfer to open-air flight pens (Caravaca et al. 2022). By this point, the quails have achieved live body weights (approximately 87 % in males and 80 % in females) and physical development levels comparable to those of adult birds. Keeping them on the farm beyond this age would increase their production cost, reduce the number of batches processed, and necessitate additional rearing facilities. Quails reared up to 35-day-old consume half the amount of feed (on average 421.2 g) compared to those raised to sexual maturity. This would lead to a threefold reduction in the finisher phase (approximately 250 g of finisher feed per bird). In game farms, common quails and their hybrids with Japanese quails are typically marketed for purposes such as game restocking, training hunting dogs, or shooting practice at an age range from 45 to 85 days (Caravaca et al. 2022).

In contrast to common quail, feed utilisation in domestic quails is generally more efficient. FCR values for domestic quails raised up to 35-day-old typically

range from 3.0 to 3.9 (Ray et al. 2014, Razee et al. 2016, Pavlova et al. 2018, Lukanov 2022, Arunrao et al. 2023, Taleb et al. 2024). The results provided by the feed conversion ratio are significant when any form of production is achieved, in this case, growth. This information could be of importance when tracking the efficiency of converting feed into 'meat' i.e., when quails are fattened for slaughter. Typically, game farms raise common quails for game restocking or for breeding purposes. Fattening common/hybrid quails and producing game type meat falls into a market niche primarily occupied by domestic quails. The possibility of marketing meat from captive-raised common quails is an opportunity that, with an appropriate marketing strategy, could offer new prospects and economic advantages compared to their classic use for restocking.

Conclusions

The present study provides a basis to conclude that the origin of the population of common quails does not significantly influence their growth characteristics. By 35-day-old, common quails reach approximately 87 % of the body weight of adult males and 80 % of adult females, consuming an average of 421.2 g of compound feed. This gives reason to recommend raising common quail until about 35-day-old for restocking purpose as the most effective.

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References

- AHAMMED M., CHAE B., LOHAKARE J., KEOHAVONG B., LEE M.H., LEE S.J., KIM D.M., LEE J.Y., OHH S.J. 2014. Comparison of aviary, barn and conventional cage raising of chickens on laying performance and egg quality. *Asian-Australasian Journal of Animal Sciences (AJAS)* 27(8): 1196–1203. <https://doi.org/10.5713/ajas.2013.13394>
- ANANG A., INDRIJANI H., SUJANA E. 2017. Mathematical model of growth of two pure lines of Padjadjaran female quail aged 0 to 6 weeks. *Journal of the Indonesian Tropical Animal Agriculture* 42(2): 66–71. <https://doi.org/10.14710/jitaa.42.2.66-71>
- ARUNRAO K., KANNAN D., AMUTHA R., THIRUVENKADAN A., YAKUBU A. 2023. Production performance of four lines of Japanese quail reared under tropical climatic conditions of Tamil Nadu, India. *Frontiers in Genetics* 14, 1128944. 13 p. <https://doi.org/10.3389/fgene.2023.1128944>
- BAGARIĆ M.Z., DUMIĆ T. 2019. Morphometric characteristics of the common quail (*Coturnix coturnix* L.) on Duvno field. *Book of Abstracts 54th Croatian & 14th International Symposium on Agriculture*: 143–144 (in Croatian). <https://www.croris.hr/crosbi/publikacija/prilog-skup/673187>
- BIRDLIFE INTERNATIONAL 2025. Species fact-sheet: Common Quail *Coturnix coturnix*. <https://datazone.birdlife.org/species/fact-sheet/common-quail-coturnix-coturnix> (Accessed on 31 January 2025).
- BOEV N. 1949. Quail. *Hunting and Fishing* 7: 8–9 (in Bulgarian).
- BOTEV N. 1985. *Game Farming*. Zemizdat, Sofia. 270 p. (in Bulgarian).
- CARAVACA F., CAMACHO-PINTO T., GONZÁLEZ-REDONDO P. 2022. The Quail Game Farming Sector in Spain. *Animals* 12(22), 3118. 14 p. <https://doi.org/10.3390/ani12223118>
- DEL HOYO J., COLLAR N.J., CHRISTIE D.A., EL-LIOTT A., FISHPOOL L.D.C., BOESMAN P., KIRWAN G.M. 2014. *HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume 1: Non-passerines*. Lynx Edicions BirdLife International, Barcelona, Spain and Cambridge, UK. 94 p.
- DERÉGNAUCOURT S., GUYOMARC'H J.-C., AEBISCHER N.J. 2002. Hybridization between European Quail (*Coturnix c. coturnix*) and Japanese Quail (*Coturnix c. japonica*). *Ardea* 90(1): 15–21. <https://hal.science/hal-01327133>
- DONCHEV R., ANGELOV I. 1971. Industrial farming of Japanese quail in our country. *Poultry farming* 7: 49 (in Bulgarian).
- EC (EUROPEAN COMMISSION) 2009. Common quail *Coturnix coturnix*. European Union Management Plan 2009–2011. Natura 2000, Luxembourg: Office for Official Publications of the European Communities. 71 p. <https://op.europa.eu/en/publication-detail/-/publication/8b39bddb-c3f3-41e1-9ac7-3653da2af1ad>
- GENCHEV A. 2014. Japanese quails. In: Kabakchiev M., Gerzilov V. (Eds.). *Poultry farming*. Academic Publishing – Agricultural University, Plovdiv: 308–318 (in Bulgarian).
- GENCHEV A., LUKANOV H. 2023. *Poultry Incubation with Biological Control Basis*. Academic Press, Trakia University, Stara Zagora: 139–142 (in Bulgarian).
- GENCHEV A., MIHAYLOVA G., RIBARSKI S., PAVLOV A., KABAKCHIEV M. 2008. Meat quality and composition in Japanese quails. *Trakia Journal of Sciences* 6(4): 72–82.
- GONZÁLEZ-REDONDO P., ROBUSTILLO P., CARAVACA F.P. 2023. Effects of Long-Term Storage on Hatchability and Incubation Length of Game Farmed Quail Eggs. *Animals* 13(13), 2184. 13 p. <https://doi.org/10.3390/ani13132184>
- GRIESER D., MARCATO S., FURLAN A., ZANCANELA V., PAULA A., BATISTA A., TON A., PERINE T. 2018. Estimation of growth parameters of body weight and body nutrient deposition in males and females of meat- and laying-type quail using the

- Gompertz model. Brazilian Journal of Animal Science 47, e20170083. 8 p. <https://doi.org/10.1590/rbz4720170083>
- HRISTOV J., POPGEORGIEV G., SPASOV S., PETKOV N., PLACHIJSKI D., STOYCHEV S. 2023. Status of common bird species in Bulgaria 2023. BSPB. Conservation series 39. Sofia. 30 p. (in Bulgarian).
- KOSICKI J.Z., CHYLARECKI P., ZDUNIAK P. 2014. Factors affecting Common Quail's *Coturnix coturnix* occurrence in farmland of Poland: is agriculture intensity important? Ecological Research 29(1): 21–32. <https://doi.org/10.1007/s11284-013-1093-2>
- LUKANOV H. 2019. Domestic quail (*Coturnix japonica domestica*), is there such farm animal? World's Poultry Science Journal 75(4): 547–558. <https://doi.org/10.1017/S0043933919000631>
- LUKANOV H. 2020. Quails from genus *Coturnix* in Nature and Agriculture. Alfa Visia, Stara Zagora, Bulgaria. 154 p. (in Bulgarian).
- LUKANOV H. 2022. Growth performance and carcass characteristics of dual-purpose and heavy Japanese quails. Trakia Journal of Sciences 1: 18–30. <https://doi.org/10.15547/tjs.2022.01.003>
- LUKANOV H., PAVLOVA I. 2020a. Domestication changes in Japanese quail (*Coturnix japonica*): a review. World's Poultry Science Journal 76(4): 787–801. <https://doi.org/10.1080/00439339.2020.1823303>
- LUKANOV H., PAVLOVA I. 2020b. Economic analysis of meat production from two types of Domestic quails. Agricultural Science and Technology 12(2): 148–152. <https://doi.org/10.15547/ast.2020.02.025>
- LYON D.L. 1962. Comparative growth and plumage development in Coturnix and Bobwhite. Wilson Bulletin 74: 5–27. <https://sora.unm.edu/sites/default/files/journals/wilson/v074n01/p0005-p0027.pdf> (Accessed on 31 January 2025).
- McGOWAN P.J.K., KIRWAN G.M. 2020. Japanese Quail (*Coturnix japonica*), version 1.0. In: del Hoyo J., Elliott A., Sargatal J., Christie D.A., de Juana E. (Eds), Birds of the World. Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.2173/bow.japqua.01>
- MICHAÏLOV CH. 1995a. Seasonal changes in the population of the quail (*Coturnix coturnix* L.1758) in the southwest of Bulgaria. In: Botev N., Golovatch S., Penev L. (Eds), Proceedings of the Congress of the International Union of Game Biologists XXII Congress 'The Game and the Man', 4–8 September, 1995, Sofia, Bulgaria: 14–19.
- MICHAÏLOV CH. 1995b. A study on the Ecology and Biology of Quail (*Coturnix coturnix* L.) in the higher fields of western Bulgaria. PhD thesis, Higher Institute of Forestry and Wood Technology, Sofia. 131 p. (in Bulgarian).
- MIHAYLOV R. 2006. Comparative morphological studies of the alimentary canal between Japanese (*Coturnix coturnix japonica*) and Wild Quail (*Coturnix coturnix coturnix*). PhD Thesis, Trakia university, Stara Zagora (in Bulgarian).
- MOTTET A., TEMPIO G. 2017. Global poultry production: current state and future outlook and challenges. World's Poultry Science Journal 73(2): 245–256. <https://doi.org/10.1017/S0043933917000071>
- NANKINOV D. 2016. The Quail (*Coturnix coturnix*) – a unique bird and a popular hunting object. Sofia. 52 p. (in Bulgarian).
- PAVLOVA I., LUKANOV H., IVANOV V., PETROVA Y., GENCHEV A. 2018. Simultaneous administration of Silymarin and Doxycycline in Japanese quails suggests probable herb-drug interaction. Bulgarian Journal of Agricultural Science 24(1): 126–131.
- PUIGCERVER M., SARDA-PALOMERA F., RODRIGUEZ-TEIJEIRO J.D. 2012. Determining population trends and conservation status of the common quail (*Coturnix coturnix*) in Western Europe. Animal Biodiversity and Conservation 35(2): 343–352. <https://doi.org/10.32800/abc.2012.35.0343>
- PUIGCERVER M., VINYOLE D., RODRIGUEZ-TEIJEIRO J.D. 2007. Does restocking with Japanese quail or hybrids affect native populations of common quail *Coturnix coturnix*? Biological Conservation 136(4): 628–635. <https://doi.org/10.1016/j.biocon.2007.01.007>
- QURESHI N.A., ALI S., ABBASI A., RAKHA B.A. 2016. Morphometrics of Common Quail

- (*Coturnix coturnix*) in Pothohar, Pakistan. *Pakistan Journal of Wildlife* 7(2): 37–40.
- RAY S., DAS S., MISHRA S., SWAIN R., MAITY A., SWAIN P., DAS A. 2014. Performance of Japanese quail on organically complexed minerals by replacing inorganic sources. *The Indian Journal of Animal Sciences* 84(1): 60–67. <https://doi.org/10.56093/ijans.v84i1.37312>
- RAZEE A., MAHBUB A., MIAH M., HASNATH M., HASAN M., UDDIN M., BEAL S. 2016. Performance of Japanese Quails (*Coturnix coturnix japonica*) on Floor and Cage Rearing System in Sylhet, Bangladesh: Comparative Study. *Iranian Journal of Applied Animal Science* 6(4): 931–936.
- SAATCI M., AP DEWI I., AKSOY A.R., KIRMIZIBAYRAK T., ULUTAS Z. 2002. Estimation of genetic parameters for weekly live-weights in one to one sire and dam pedigree recorded Japanese quail. *Proceedings of the 7th World Congress on Genetics Applied to Livestock Production*, August 19–23, 2002, Montpellier, France. 4 p.
- SÁNCHEZ-DONOSO I., VILÀ C., PUIGSERVER M., BUTKAUSKAS D., CABALLERO DE LA CALLE J.R., MORALES-RODRÍGUEZ P., RODRÍGUEZ-TEIJEIRO J.D. 2012. Are farm-reared quails for game restocking really common quails (*Coturnix coturnix*)? A Genetic Approach. *PLoS ONE* 7(6), e39031. 8 p. <https://doi.org/10.1371/journal.pone.0039031>
- SANDERSON F.J., KLOCH A., SACHANOWICZ K., DONALD P.F. 2009. Predicting the effect of agriculture change on farmland bird population in Poland. *Agriculture, Ecosystems & Environment* 129(1–3): 37–42. <https://doi.org/10.1016/j.agee.2008.07.001>
- SEZER M., BERBEROGLU E., ULUTAS Z. 2006. Genetic association between sexual maturity and weekly live-weights in laying-type Japanese quail. *South African Journal of Animal Science* 36(2): 142–148. <https://doi.org/10.4314/sajas.v36i2.3997>
- TALEB H.M., ABDEL-HALIM A.A., RAMADAN G.S., SHAZLY S.A., KAMAL M., ALWAILI M.A., RUDAYNI H.A., ALLAM A.A., TAHA A.E., AL-SAYED H.M.A., MOUSTAFA M., ALSHAHARNI M.O., MAHROSE K., FOUAD A.M. 2024. Does the marketing age impact growth performance, carcass traits, economic feasibility and hemato-biochemical properties of genetically-modified quails? *Poultry Science* 103(7), 103793. 9 p. <https://doi.org/10.1016/j.psj.2024.103793>
- TEMMINCK C.J., SCHLEGEL H. 1844–1850. Description des oiseaux, observes au Japon par les voyageurs Hollandais. In: Siebold Ph.Fr. von (Ed.), *Fauna Japonica sive description animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava imperium tenent, suscepto, annis 1823–1830. Collegit, notis, observationibus et adumbrationibus illustravit*. 4. Aves: 1–142. *Lugduni Batavorum, Apud Auctorem*. <https://www.biodiversitylibrary.org/item/223586#page/27/mode/1up> (Accessed on 31 January 2025).
- TSACHALIDIS E.P., PARALIKIDIS N., TSIOMPA-NOUDIS A., TRIKILAS K. 2007. Morphometry, body mass and autumn diet of European quail (*Coturnix coturnix coturnix*) in Evros and Chios, Greece. *Wildlife Biology in Practice* 3(1): 9–17. doi:10.2461/wbp.2007.3.2
- WBRU 2016. Report on the Conversation Status of the Common Quail (*Coturnix coturnix*). Wild Birds Regulation Unit. Parliamentary Secretariat for Agriculture, Fisheries and Animal Rights Ministry for Sustainable Development, the Environment and Climate Change. 34 p. <https://wbru.gov.mt/wp-content/uploads/2024/08/consStaJan-16TurQua.pdf> (Accessed on 31 January 2025).