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RESEARCH ARTICLE

The effect of housing system and strain on growth performance and carcass trait of quails

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Abstract

Aim of study: This study investigated the effect of housing system and strain on growth performance and carcass trait of quails.

Area of study: The study was carried out at the Poultry Unit and Research Centre of Çukurova University in the Republic of Türkiye.

Material and methods: A total of 900 eggs (450 eggs per strain) of two quail strains (brown and golden quails) were incubated. At hatch, 720 quail chicks (360 chicks per strain) were reared in 3 different housing systems (cage, litter system or slatted floors) with a total of 3 replicates per housing system.

Main results: Brown quails had significantly higher body weight between 1week (wk) and 4 wk of age however, feed intake at 4 wk of age was significantly higher in golden quails ($P \leq 0.05$). The feed conversion ratio was significantly better in brown quails than in golden quails at 5 wk of age ($P \leq 0.05$). Quails reared in cages had higher body weight between 1 and 5 wk of age than quails housed in other production systems ($P \leq 0.05$). While the body weight gain was significantly higher in quails housed in cages at 3 wk and 5 wk of age, the quails housed in slatted floors had the highest body weight gain at 4 wk of age ($P \leq 0.05$). Feed intake was significantly higher in quails reared in cages between 3 wk and 5 wk of age however, quails reared in the litter system had the highest feed intake between 1 wk and 2 wk of age ($P \leq 0.05$). The feed conversion ratio at 3 wk of age was better in quails reared in slatted floors however, quails reared in the litter system had the best feed conversion ratio at 4 wk of age ($P \leq 0.05$). The dressing percentage and carcass weight were significantly higher in golden quails and quails housed in cages, respectively ($P \leq 0.05$).

Research highlights: It was concluded that the performance of brown and golden quail strains is better in cages and litter housing systems however, the selection of brown quails coupled with the use of cages for production may yield better results.

Keywords: performance, production systems, quail, strain.

Efecto del sistema de alojamiento y de la cepa sobre el crecimiento y las características de la canal de las codornices

Resumen

Objetivo del estudio: Este trabajo se realizó para determinar el efecto del sistema de producción y de la cepa sobre el rendimiento en crecimiento y el rasgo de la canal de las codornices.

Área de estudio: Este estudio se llevó a cabo en la Unidad Avícola y Centro de Investigación de la Universidad de Çukurova en la República de Turquía.

Material y métodos: En este estudio se utilizaron un total de 900 huevos de codorniz (450 huevos por cepa) de dos cepas (codorniz parda y dorada). Una vez eclosionados, se criaron un total de 720 pollitos de codorniz (360 pollitos por cepa) en 3 sistemas de producción diferentes (jaula, sistema de yacija o suelos de rejilla) con un total de 3 réplicas por sistema de producción.

Resultados principales: Las codornices marrones tuvieron un peso corporal significativamente mayor entre la 1ª y la 4ª semana de edad, sin embargo, el consumo de pienso a las 4 semanas de edad fue significativamente mayor en las codornices doradas (P≤0.05). El índice de conversión alimenticia fue significativamente (P≤0.05) mejor en las codornices marrones que en las doradas en la 5ª semana. Las codornices criadas en jaulas tenían un peso corporal superior entre 1 y 5 semanas de edad que las codornices alojadas en otros sistemas de producción (P≤0.05). Mientras que la ganancia de peso corporal fue significativamente mayor (P≤0.05) en las codornices criadas en jaulas a las 3 y 5 semanas de edad, las criadas en suelos de rejilla tuvieron la ganancia de peso corporal más alta (P≤0.05) a las 4 semanas de edad. El consumo de alimento fue significativamente mayor (P≤0.05) en las codornices criadas en jaulas a las 3, 4 y 5 semanas de edad; sin embargo, a las 1 y 2 semanas de edad, las codornices criadas en el sistema de yacija tuvieron el mayor consumo de alimento (P≤0.05). El índice de conversión alimenticia a las 3 semanas de edad fue mejor en las codornices criadas en suelos de rejilla; sin embargo, las codornices criadas en el sistema de yacija tuvieron el mejor índice de conversión alimenticia a las 4 semanas de edad (P≤0.05). Mientras que el peso de la canal fue significativamente mayor en las codornices alojadas en jaulas, el porcentaje de faenado fue significativamente mayor en las codornices doradas (P≤0.05).

Conclusiones: Se llegó a la conclusión de que el rendimiento de las cepas de codorniz parda y dorada es mejor en jaulas y sistemas de alojamiento en yacija, sin embargo, la selección de codornices pardas unida al uso de jaulas para la producción puede dar mejores resultados.

Palabras clave: rendimiento, sistemas de producción, codorniz, cepa.

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Introduction

The rapidly growing population of the world has increased the demand for cheap and affordable chicken meat, eggs, and poultry products. Pomaah et al. (2023) reported that the demand for poultry products have increased tremendously due to increasing levels of income and standard of living. This has increased the search for the production of other alternative poultry species such as quails (Ozkan et al., 2024). Quails are one of the fastest-growing alternative poultry species and there are various genotypes or strains of quails worldwide. These birds are normally characterized by their feather color or country of origin. By plumage color, the most common are brown, black, grey, and golden quails, and by country of origin, they are classified as Japanese quails, European quails, Pharaoh quails, and Manchurian Golden breeds. However, the most widely known and most commonly used for experimental research is the Japanese quail (*Coturnix japonica*).

The commercial production of Japanese quails (Coturnix japonica) as an alternative poultry specie is gaining a significant interest compared to the production of other alternative poultry species (Abdallah et al., 2024). Japanese quails have attracted attention as an important species due to the unique flavour of their meat and eggs (Kayang et al., 2004). The small body size, low maintenance cost, high egg production, short generation interval, and disease resistance of the Japanese quails make these birds excellent laboratory animals (Baumgartner, 1994; Yalcin et al., 1995). Quail production is relatively easy and their housing requirements are less complex compared to the housing requirements of chickens (Capitan, 2003; Lambio, 2010). Indeed, Bagh et al. (2016) reported that in India, the Japanese quail is a promising poultry species for rural farmers due to its minimal capital and management requirements.

In terms of size, Japanese quails are the smallest farmed poultry species (Panda & Singh, 1990) and have become highly important for their eggs and meat (Baumgartner, 1994; Dahouda et al., 2013). Quails are characterised by faster growth, and rapid reproduction, coupled with a higher efficiency in converting feed into eggs and meat (Randall & Bolla, 2008).

Eggs are an important source of nutrients (Kurşun et al. 2024a) and it has been reported that eggs of Japanese quails are rich in minerals, vitamins, and antioxidants with a nutritional value 3-4 times higher than chicken eggs (Lalwani, 2011; Tunsaringkarn et al., 2013). Additionally, a comparative analysis by Ioniţă et al. (2008) revealed that the meat of quails has the highest amount of protein and the lowest amount of calories compared to duck and broiler meat. According to Vali (2008), quail meat is lean and its low cholesterol content makes it a superior economic source of animal protein.

Similar to broiler chickens and layer hens, the housing system (Roshdy et al., 2010) and the strain of the quail are some of the most important factors affecting growth and welfare performance as well as carcass and meat quality trait of quails. For instance, Islam et al. (2014) identified the effect of quail genotype on body weight at hatch, highest and lowest in Japanese quail genotype and black quail genotype, respectively. Uçar et al. (2024) also identified lower body weight in quails housed in litter systems compared to those housed in either conventional or enriched cages. In addition, better feed conversion efficiency in brown quails at 2 wk of age and in white quails at 6 wk of age were identified (Tawfeq, 2024).

Therefore, this research investigated the effect of housing system and strain on growth performance and carcass trait of quails.

Material and methods

Animal material and experimental area

The experiment was carried out at the Research Unit of the Çukurova University. The animal material consisted of 720-day-old quails (360 brown and 360 golden quail strains).

Experimental groups

The experimental groups consisted of brown and golden quails raised in a litter system, slatted floors, or cages. The quails reared in cages were reared in chick cages for the first 2 wk of age and then transferred to grower cages from the 3 wk of age until slaughter age. The dimensions of the chick cage were 28 cm x 92 cm x 44 cm (height, length, and width, respectively). In the litter system, 1 m^2 plywood enclosures were used with 6-8 cm sawdust as the litter material. Additionally, in the slatted floor system, 8 cm height slatted floor was used. The dimensions of the litter system and the slatted floor housing systems were 200 cm x 200 cm x 200 cm for height, length, and width, respectively. There were three replicates per housing system and the number of quails in each replicate pen is given in Table 1.

Table 1. Number of quails per replicate used in the study.

Quail Strain	HS	Number of replicates			
		1	2	3	Total
		Number of quails per replicate			
Brown	C	40	40	40	120
	LS	40	40	40	120
	ST	40	40	40	120
Golden	C	40	40	40	120
	LS	40	40	40	120
	ST	40	40	40	120
Total					720

HS (Housing system), C (Cage), LS (Litter system), ST (Slatted floor).

Feed material

The experimental quails were fed a broiler diet containing 22% crude protein and 300 kcal/kg metabolic energy during the experimental period. Feed and water were provided *ad libitum*.

Measurement of growth parameters

The body weight and feed intake were identified weekly using a sensitive electronic scale (SCALTEC SBA 41, Germany) with a precision of 0.1 g. The body weight gain was calculated by subtracting the initial body weight from the subsequent body weight. The feed intake was calculated by subtracting the initial feed provided at the beginning of a particular week from the remaining feed at the end of that week. The weekly feed conversion ratio was calculated by dividing the feed intake of a given week by the average body weight gain of that week. The formula below was used to evaluate the respective parameters.

Body weight gain (g) = Final body weight - Initial body weight

Feed consumption (g) = Total feed given - Feed left

$$Feed\ conversion\ efficiency = \frac{Feed\ intake}{Body\ weight\ gain}$$

Evaluation of carcass traits

Ten quails per replicate summing up to 30 and 90 quails per housing system and strain were slaughtered, respectively. The weight of the carcass, heart, liver, gizzard, and non-edible organs were measured with an electronic scale (SCALTEC SBA 41, Germany) with a precision of 0.1 g. The dressing percentage was identified using the formula below.

$$Dressing\ percentage\ (\%) = \frac{Carcass\ weight}{Slaughter\ weight} \times 100$$

Statistical analysis

Statistical analysis to evaluate the mean difference between the strain effects was performed by t-test analysis. The main effect of rearing systems was evaluated by a one-way ANOVA test. The interaction effect of the of strain and the housing system was determined by the Tukey multiple comparison test. The significant level was considered at P≤0.05. SPSS version 22 was used for the statistical analyses.

The following linear model was used in the analysis.

$$Yijk = \mu + \alpha i + ßj + (\alpha ß)ij + eijk$$

Where;
Yijk= Observation value of the examined feature
μ= Population mean
ai= Genotype effect
ßj= Impact of the housing system
(αß)ij= Effect of the interaction of strain and housing system
eijk= Error variable

Results

The effect of the strain on hatching weight and post-hatch performance trait is given in Table 2. While the strain had no significant effect on body weight at hatch and at 5 wk of age (P>0.05), the brown quails had superior body weight than the golden quails between 1 wk and 4 wk of age (P≤0.05). However, the body weight gain did not statistically differ between the strains throughout the experimental period (P>0.05).

Table 2. The influence of strain on hatching weight (g), and post-hatch growth performance in quails.

BW (g)	Quail Strain	Age of quails (weeks)					
		0*	1	2	3	4	5
	Brown	8.96 ±0.05	36.06 ±0.36	87.64 ±0.66	162.09 ±1.03	229.26 ±1.51	274.49 ±1.76
	Golden	8.93 ±0.05	33.45 ±0.36	83.46 ±0.70	153.82 ±1.06	222.66 ±1.32	270.35 ±1.62
	P value	0.674	<0.001	<0.001	<0.001	0.001	0.086
BWG (g)	Brown	-	26.58 ±1.58	51.67 ±0.40	73.95 ±1.84	67.72 ±1.06	43.62 ±3.70
	Golden	-	24.48 ±0.47	49.50 ±0.62	70.37 ±1.11	68.85 ±1.10	47.60 ±1.28
	P value	-	0.272	0.086	0.115	0.467	0.326
FI (g)	Brown quails	-	6086.17 ±619.76	10533.73 ±1060.63	4492.33 ±515.41	6657.11 ±568.00	8095.78 ±854.27
	Golden	-	5912.33 ±589.28	11262.00 ±1258.20	5518.78 ±305.50	8135.22 ±229.96	9792.89 ±382.84
	P value	-	0.849	0.681	0.106	0.028	0.089
FCR	Brown	-	2.80 ±0.52	2.39 ±0.13	2.08 ±0.06	3.44 ±0.10	3.40 ±0.39
	Golden	-	2.32 ±0.27	1.96 ±0.14	2.10 ±0.09	3.19 ±0.11	3.50 ±0.24
	P value	-	0.465	0.089	0.831	0.099	0.012

*0 (Body weight at hatch); BW (Body weight), BWG (Body weight gain); FI (Feed intake), FCR (Feed conversion ratio).

Additionally, the feed intake at 1 wk, 2 wk, 3 wk and 5 wk of age did not statistically differ between the strains (P>0.05) however, at 4 wk of age, the golden quails had a significantly higher feed intake than the brown quails (P≤0.05). Similarly, between 1 wk and 4 wk of age, the feed conversion ratio did not significantly vary between the strains (P>0.05) however, the feed conversion efficiency of the brown quails was better than that of the golden quails at 5 wk of age (P≤0.05).

The effects of the housing systems on body weight, body weight gain, feed intake, and feed conversion efficiency are given in Table 3. The body weight was significantly higher in quails reared in cages between 1 wk and 5 wk of age (P≤0.05). The least body weight throughout the experimental period was identified in the quails housed in slatted floors. While the body weight gain was statistically higher in quails reared in cages at 3 wk and 5 wk of age (P≤0.05), the quails housed in slatted floors had the highest significant body weight gain at 4 wk of age (P≤0.05). Feed intake was significantly higher in quails reared in the litter system between 1 wk and 2 wk of age (P≤0.05) however, between 3 wk and 5wk of age, the quails housed in cages had the statistically highest feed intake (P≤0.05). Additionally, feed conversion efficiency was significantly better in quails housed in slatted floors and litter system between 3 wk and 4 wk of age, respectively (P≤0.05).

The interaction effect of the strain and the housing system is presented in Table 4. It was identified that the interaction effect of the housing system and the strain had no significant effect on the body weight, body weight gain, feed intake, and feed conversion ratio (P>0.05).

The effect of housing systems and strains on carcass traits and internal organ weights are presented in Table 5. The dressing percentage was significantly higher in golden quails than in brown quails (P≤0.05) however, the heart weight was significantly higher in brown than in golden quails (P≤0.05). Additionally, carcass weight was significantly higher in quails housed in cages than in quails housed in other production systems (P≤0.05).

Table 3. The effect of housing systems on body weight (g), body weight gain (g), feed intake (g), and feed conversion ratio in quails.

BW	HS	Age of quails (weeks)				
		1	2	3	4	5
	C	36.32 ±0.36	86.90 ±0.71	163.34 ±1.14	229.54 ±1.69	283.52 ±1.10
	LS	33.91 ±0.46	85.49 ±0.89	155.22 ±1.30	223.28 ±1.69	266.17 ±1.89
	ST	33.05 ±0.54	82.88 ±0.97	152.34 ±1.43	223.22 ±1.81	264.88 ±2.04
P value		<0.001	0.005	<0.001	0.011	<0.001
BWG	C	27.51 ±2.12	50.59 ±0.51	76.72 ±1.70	66.35 ±1.30	53.89 ±2.35
	LS	24.98 ±0.76	51.74 ±0.70	69.80 ±1.14	67.78 ±0.90	42.53 ±2.84
	ST	24.10 ±0.26	50.18 ±1.29	69.97 ±1.56	70.71 ±1.16	40.41 ±2.14
P value		0.302	0.524	0.008	0.044	0.003
FI	C	5443.75 ±384.75	11803.60 ±103.60	6325.17 ±160.30	8725.50 ±171.43	11036.83 ±435.06
	LS	7154.00 ±111.00	12218.00 ±971.00	5011.17 ±413.67	71643.00 ±464.90	8579.83 ±642.47
	ST	5400.00 ±235.00	8672.00 ±225.00	3680.33 ±351.06	6300.00 ±615.47	7216.33 ±658.59
P value		0.030	0.040	<0.001	0.006	0.001
FCR	C	1.79 ±0.00	2.14 ±0.17	2.27 ±0.03	3.63 ±0.09	3.50 ±0.34
	LS	2.81 ±0.26	2.25 ±0.16	2.10 ±0.99	3.07 ±0.08	3.06 ±0.44
	ST	3.08 ±0.45	2.15 ±0.46	1.91 ±0.06	3.25 ±0.10	3.65 ±1.47
P value		0.109	0.956	0.001	0.002	0.411

Table 4. P-values of the strain x housing system interaction effect on body weight, body weight gain, feed intake, and feed conversion ratio.

Traits	**P values**
Body weight	0.986
Body weight gain	0.891
Feed intake	0.904
Feed conversion ratio	0.678

Table 5. The effect of strain and housing system on carcass traits and viscera organs.

Strain		Carcass weight (g)	Dressing percentage (%)	Heart (g)	Liver (g)	Gizzard (g)	NEO (g)
	Brown	197.28 ±3.46	72.54 ±1.37	3.28 ±0.17	7.41 ±0.26	6.43 ±0.25	15.20 ±0.72
	Golden	202.48 ±3.15	75.44 ±0.40	2.82 ±0.08	7.15 ±0.31	6.69 ±0.20	16.42 ±0.77
	P value	0.271	0.046	0.014	0.524	0.425	0.251
HS	C	208.37 ±3.10	72.56 ±0.76	3.21 ±0.19	7.83 ±0.35	6.63 ±0.23	17.41 ±1.16
	LS	199.51 ±3.59	74.86 ±0.58	2.89 ±0.19	6.82 ±0.36	6.57 ±0.33	15.47 ±0.88
	ST	191.70 ±4.73	72.54 ±1.97	3.05 ±0.10	7.19 ±0.30	6.48 ±0.25	14.55 ±0.54
	P value	0.013	0.375	0.388	0.106	0.932	0.077

*HS (Housing system), C (Cage), LS (Litter system), ST (Slatted floor), BW (Body weight), BWG (Body weight gain), NEO (Non-edible organs).

Discussion

In the current study, the hatching weight did not significantly differ between the quail strains however, the post-hatch body weight during the rearing period was higher in brown quails than in golden quails. In line with the findings of the current study, other authors have also identified no significant effect of genotype on the hatching weight between brown and golden quails or other quail genotypes (white and grey) (Bagh et al., 2016; Nasr et al., 2017; Kursun, 2022) however, Islam et al. (2014) identified the effect of quail genotype on hatching weight, highest in Japanese quail genotype and lowest in black quail genotype. The higher significant body weight observed in the brown quails between 1 wk and 4 wk of age is a direct reflection of their faster growth rate and development. In line with the findings of the present study, different authors (Al-Kafajy et al., 2018; Chatoo & Al-Barzinji, 2022; Kursun, 2022) have also identified higher body weight in brown quails than in golden quails or quails of other strains. However, Nasr et al. (2017) reported that at 2, 4, and 6 wk of age brown quails had lower body weight compared to other quail strains.

In the present study, the body weight gain did not significantly differ between the strains throughout the experimental period. This contradicts the findings of other studies (Hassan and Abd-Alsattar, 2016; Chatoo & Al-Barzinji, 2022; Kirrella et al., 2023) that have reported higher significant body weight gain in brown quails than in other quail strains. The differences in the results could be related to the housing systems used in the various studies, nutrition, and the performance of the other quail strains that were compared to the brown and golden quails.

The present study was conducted in winter and during the entire third week of the study there was an electric problem in the poultry unit where the quails were reared. Due to this reason, there were no heating systems which severely affected the performance, especially the feed intake of the quails on that week. However, the golden quails had better feed intake at 4 wk of age than the brown quails. Poultry birds eat to meet their energy requirements and it may be possible that the golden quails had higher energy requirements for maintenance and growth (compensatory feed intake) after the heating system was restored at 4 wk. Contrary to the findings of the current study, Kursun (2022) identified a significantly higher total (0-5wk) feed intake in brown quails than in golden quails. Chimezie et al. (2018) also reported no significant difference in feed intake between brown and other quail strains, however, Kirrella et al. (2023) reported higher total feed intake in brown quails compared to quails of other strains. The age of quails, housing system, stocking density, and the environmental management may have accounted for the difference between the results reported by the various authors.

Feed conversion efficiency was better in brown quails than in golden quails at 5 wk of age. The brown quails might have been characterised by a better digestive system or gut health, leading to a better conversion efficiency of feed into body mass however, Kursun (2022) identified better feed conversion efficiency in golden than in brown quails.

In the current study, the body weight of the quails housed in cages was significantly higher than that of quails housed in the other production systems between 1 wk and 5 wk of age. This confirms the findings of previous studies (Meneeh and Fouda, 1992; Fouzder et al., 1999; El-Sagheer et al., 2012; Kayastha et al., 2012; Razee et al., 2016; Badawi, 2017; Gözet et al., 2019) that have identified higher body weight in quails housed in cages compared to those housed in other production systems (floor, cage, slatted floor). The higher body weight in the quails housed in the cage system is a direct reflection of the high feed intake among quails in this group. Additionally, it could be possible that the quails housed in the cage system spent less energy due to the limited space for movement which in turn led to the conversion of most of the energy in feed into fat in the adipose tissue. This event could have also contributed to the higher overall body weight identified in the quails housed in the cage system. Furthermore, the quails in the cage system had no advantage of expressing natural behaviours, which might have caused them to spend more time expressing feeding behaviour than the quails in the other housing systems (with some opportunities for expressing other more natural and playful behaviours). However, EL-Sheikh et al. (2016) and Muhammad & Mirza (2019) reported higher body weight in quails housed in litter system than in quails housed in cages. Similarly, Gözet et al. (2019) also identified higher body weight in quails housed in litter system at 1 wk of age than in quails housed in cages. The differences between the results of the various studies may be related to the strain, age, and stocking density.

The body weight gain in the present study was significantly higher in quails housed in cages at 3 wk and 5 wk of age, however, the quails housed in the slatted floor had the highest body weight gain at 4 wk. The higher body weight gain in the quails housed in cages at 3 wk and 5 wk could be attributed to their faster growth rate and development. Additionally, the higher body weight gain observed in the quails housed in the slatted floor system could be attributed to compensatory growth due to the electrical management problems of the previous week. It is therefore speculated that the quails housed in the slatted floors were the most affected by the electrical problem and therefore converted most of the energy in feed into body weight to compensate for the previous loss after normal housing conditions were restored. In line with both the findings of the current study, significantly higher body weight gain in quails housed in non-cage housing systems as well as in cages has been identified by several authors (Kayastha et al., 2012; Badawi, 2017; Alindekon et al., 2019).

Feed intake was significantly higher in quails housed in litter system between 1 wk and 2 wk of age however, the quails reared in cages had the highest feed intake between 3 wk and 5 wk of age. The higher feed intake between 1 and 2 wk in quails reared in the litter system may be attributed to the fact that birds reared on wood shavings and in non-cage rearing systems are stress-free and easily acclimatized to their environment which could lead to a rapid return to the expression of normal behaviour such as feeding or foraging. However, the higher feed consumption in quails housed in cages between 3 wk and 5 wk of age may be related to activation of higher feeding behaviour to compensate for lost feed consumption during the early production cycle. Additionally, birds in cages do not have enough space or enrichment to explore or to express most of their natural behaviours and therefore may spend most of their time feeding or engaging in feeding behaviour. Similar to findings of the current study, different authors have also identified higher feed intake in quails housed in either cages or litter systems throughout the production cycle (Kayastha et al., 2012; Alindekon et al., 2019; Gözet et al., 2019; Muhammad & Mirza, 2019).

In the current study, better feed conversion efficiency between 3 wk and 4 wk of age was identified in quails housed in non-cage production systems (litter system and slatted floors) than in quails housed in cages. Birds in cages are identified with poor welfare due to stress, which has a profound negative effect on their performance (Kursun et al., 2024b). This might account for the poorer feed conversion efficiency observed in the quails housed in cages. El-Sagheer et al. (2012) and EL-Sheikh et al. (2016) also identified a better feed conversion ratio in quails housed in non-cage housing systems than in quails housed in cages.

The similar carcass weight between the strains in the current study confirms the findings of Chatoo & Al-Barzinji (2022) and Kursun (2022), who also reported identical carcass weight between quail strains. In addition, Kursun (2022) identified a higher dressing percentage in golden quails, which is in line with the findings of the present study. The higher dressing percentage in golden quails may be due to their higher carcass weight compared to brown quails. It is possible that the brown quails had a higher percentage of abdominal fat resulting in higher live weight but lower carcass weight. Additionally, it could also be possible that at the slaughter age, growth and development were still continuing in golden quails however, brown quails may have reached their peak growth and developmental stage earlier before the slaughter age.

The heart weight was higher in brown quails than in golden quails in the present study and this may be due to the rapid growth and development of this strain. Although not significantly different, Kursun (2022) also identified a higher heart weight in brown quails than in golden quails.

In line with the findings of the current study, Badawi (2017) also reported no significant effect of the production system on the weight of internal organs (heart, liver, and gizzard). Additionally, the carcass weight was higher in quails housed in cages than in quails housed in other production systems. This observation is a direct reflection of the higher body weight identified in quails housed in cages throughout the experimental period. Our findings contradict the results of Gözet et al. (2019) and Muhammad & Mirza (2019), who reported a higher carcass weight in quails housed in a litter system and free-range than in quails housed in cages.

The overall performance of quails housed in cages in terms of body weight, body weight gain, carcass weight, and feed intake were better than that of quails housed in other production systems. Growth performance was poorest in the quails housed in the slatted floors. Additionally, brown quails had superiority in terms of body weight, body weight gain, and feed conversion ratio than golden quails. It was therefore concluded that brown and golden quails could be reared in cages or litter systems without any negative effect on growth performance and carcass traits. However, because most of the research focused on cages, litter systems, or free-range systems, it is recommended that subsequent research should be conducted to investigate the effect of indoor systems with slatted floors on quail performance.

Ethical approval: This study was conducted with the full consideration of animal welfare and the approval of this study was granted by the ethic committee of Çukurova University in Adana, Türkiye.

Data availability: The data for this research is available with the corresponding author and will be shared upon request.

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