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The Effect of Adding the Cracked Corn to the Ration at Finishing Period on Fattening and Morphological Traits in Male Quails

ABSTRACT

Objective: This research was conducted to determine the fattening performance of males from egg-type quails (*Coturnix coturnix japonica*) sorted as non-breeding stocks after 35 days using three different finisher rations.

Material and Methods: Three different rations were used as finisher feed: cracked corn (CC), broiler chick feed (BCF), and cracked corn- broiler chick feed (1:1) mixture (CC-BCF) for fattening 270 male quails. Quail fattening started with an average weight of 198 g and was carried out in cage pens with 3 replicates in each group and 30 male quails in each replicate. Quails were weighed individually on the 5th and 10th (40 and 45 days of age) days of the experiment. When the quails reached 45 days of age, some morphological traits were measured in a total of 135 quails, 15 randomly from each pen.

Results: The mean body weights of the CC, BCF, and CC-BCF groups at 40 and 45 days of age were determined 202.00, 227.21, and 222.81 g and 200.55, 231.79, and 229.04 g, respectively. While the CC group had the lowest fattening performance (P<0.01), the difference between the BCF and CC-BCF mixture groups was insignificant (P>0.05). In terms of carcass ratio, the highest value (75.2%) was observed in the BCF group and the lowest value (73.6%) in the CC group (P<0.05). The difference between the groups in terms of beak length, beak width, head length, head width, folding wing length, back length, tail length, body length, shank length, shank width, and middle finger length was insignificant (P>0.05). The lowest mean in terms of breast width (32.9 mm) was observed in the CC group, and the highest mean in terms of breast length (67.3 mm) was observed in the CC-BCF group (P<0.01). In terms of feed conversion ratio, the CC group (9.24) had the lowest average (P<0.01), while the BCF (5.80) and CC-BCF groups (6.00) had higher average (P>0.05). According to the discriminant analysis of morphological traitss, the average reclassification success of quails in different finishing feed groups was 79.1%.

Conclusion: The study results showed that a 5-day fattening period is sufficient for male quails from 35 days of age and that adding cracked corn as cheap grain feed to expensive high-protein feeds during the finishing period can reduce feed costs by approximately 10-20% without causing any loss in fattening.

Keywords: Quail, fattening, corn, chick feed, morphology

Bitirme Döneminde Rasyona Kırık Mısır Ilavesinin Erkek Bıldırcınlarda Besi ve Morfolojik Özellikler Üzerine Etkisi

ÖZ

Amaç: Bu araştırma, 35. günden sonra üç farklı bitirme rasyonu kullanılarak damızlık dışı olarak ayrılan yumurta tipi bıldırcın erkeklerinin (*Coturnix coturnix japonica*) besi performanslarını belirlemek amacıyla yürütülmüştür.

Materyal ve Metot: Bitirme yemi olarak kırık mısır (CC), etlik civciv yemi (BCF) ve kırık mısır-civciv yemi (1:1) karışımı (CC-BCF) 270 erkek bıldırcının besisi için üç farklı rasyon kullanılmıştır. Bıldırcın besisi, ortalama 198 g olarak başlatılmış ve her gruba ait 3 bölme ve her bölmede 30 hayvan tekerrür olacak şekilde yürütülmüştür. Denemenin 5. ve 10. (40 ve 45 günlük yaş) günlerinde bıldırcınlar bireysel olarak tartılmıştır. Bıldırcınlar 45 günlük yaşa eriştiklerinde her bölmeden rastgele 15 olmak üzere toplam 135 hayvanda bazı morfolojik özellikler belirlenmiştir.

Bulgular: CC, BCF ve CC-BCF gruplarında 40 ve 45 günlük yaşta canlı ağırlıklar sırasıyla 202.00, 227.21 ve 222.81 g ve 200.55, 231.79 ve 229.04 g olarak belirlenmiştir. CC grubu en düşük besi performansına sahip olurken (P<0.01), BCF ve CC-BCF grupları arasındaki fark önemsiz bulunmuştur(P>0.05). Karkas oranı bakımından en yüksek değer (%75.2) BCF grubunda ve en düşük değer (%73.6) CC grubunda gözlenmiştir. Gruplar arasında gaga uzunluğu, gaga genişliği, kafa uzunluğu, kafa genişliği, katlanır kanat uzunluğu, sırt uzunluğu, kuyruk uzunluğu, vücut uzunluğu, incik uzunluğu, incik genişliği ve orta parmak uzunluğu özelliklerinde farklar önemsiz bulunmuştur (P>0.05). En düşük göğüs genişliği (32.9 mm) CC grubunda ve en yüksek göğüs uzunluğu (67.3 mm) CC-BCF grubunda gözlenmiştir (P<0.01). Yemden yararlanma oranı bakımından CC grubu (9.24) en düşük oranı alırken (P<0.01), BCF (5.80) ve CC-BCF (6.00) grupları daha yüksek ortalamaya sahip olmuştur (P>0.05). Morfolojik özelliklerin diskriminant analizi sonuçlarına göre bıldırcınların bitirme yemi gruplarına tekrar sınıflandırma başarısı %79.1 olmuştur.

Sonuç: Araştırma sonuçları, 35 günden itibaren erkek bıldırcınlar için 5 günlük besi süresinin yeterli olduğunu ve bitirme döneminde pahalı yüksek protein içerikli yemlere kıyasla ucuz dane yem olarak kırılmış mısır ilavesinin beside bir kayba neden olmaksızın yaklaşık %10-20 kadar yem maliyetini düşürebileceğini göstermiştir.

Anahtar Kelime: Bıldırcın, besi, mısır, civciv yemi, morfoloji

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INTRODUCTION

Since 2016, poultry meat has been the most consumed animal protein source in the world, with about 86% of it coming from chicken alone (Govoni et al. 2021). On the other hand, as the accessibility to food increases, the demand for products obtained from alternative poultry species also increases (Boz et al. 2022). Quail, one of the first alternative poultry species that comes to mind, has great potential for both egg and meat production due to its traits such as requiring less space for rearing, resistance to diseases and adverse environmental conditions, and reaching sexual maturity quickly (Uçar et al. 2020). Japanese quail (*Coturnix coturnix japonica*) has a relatively fast growth rate compared to other alternative poultry species. Therefore, Japanese quails can be used efficiently for meat production. Quail fattening usually takes 5-6 weeks. During this period, it is recommended that quails be fed with high protein rations to promote rapid growth and weight gain (Serge-Olivier et al. 2021).

Japanese quails show rapid body development from hatching and reach sexual maturity within 5-6 weeks. It is critical to regularly monitor body weight and growth development and adjust feeding regimes according to these parameters. The growth in Japanese quail is faster in the early stages of life. As quails approach sexual maturity, their growth rate decreases, but they continue to gain live weight throughout fattening (Baumgartner, 1994; Narinç et al. 2010). The excess males of quails reared for breeding or egg production are fattened and reach slaughter age within 5-6 weeks (Alarslan, 2006). Quails are generally used as breeding stock in a ratio of 3:1 (female-male) and 2/3 of the male quails are separated as non-breeding stock (Erensayın et al. 2002; İpek et al. 2004; Karousa et al. 2015). Fattening these males for meat production has the potential to provide significant benefits in terms of reducing production costs, using resources efficiently, and generating additional income. In quails, sexual dimorphism is unlike other farm poultry, the females have larger body than males. Male quails remain at a lower in terms of live weight gain after the 4th week compared to female quails (Lukanov et al. 2021; Uçar, 2024a). The fact that the differences in growth and development observed in male and female quails may be due to muscle fibers, the structure of muscle bundles, and morphological differences (Kim et al. 2024) also necessitates studies on morphological development in this species. The fact that almost all of the females are reserved for egg production or breeding requires the fattening of the surplus males. Aiming to complete the fattening process with the lowest cost and highest yield in the shortest time is important in terms of economic efficiency. The feed ration used in fattening affects not only the live weight but also the morphology and carcass yield (Van Der Ziel and Visser, 2001; Özcan et al. 2021). On the other hand, the fattening capabilities of egg-type quails are limited. In addition, sex determination based on feather color can be done at the earliest at 3-4 weeks of age, which limits the remaining time for the fattening of male quails that are separated for breeding purposes. The average body weight of egg-type quails at 35-45 days of age is 200-250 g and their feed conversion ratio is 3.5-4 (Lukanov and Genchev, 2018; Vargas-Sánchez et al. 2018; Abou-Kassem et al. 2019; Bayril, 2023). In Türkiye, quails are generally raised for egg production rather than meat production (Uçar et al. 2020). Although it shows relatively lower fattening performance compared to meat quail genotypes in meat production (Tavaniello, 2014), the fact that excess males have to be separated as non-breeding stocks in egg-type quails requires questioning the fattening performance capabilities of this group with cost-effective rations.

This research aims to determine whether there will be a negative effect on fattening by adding cracked corn as a cheap grain feed to the ration at the end of the fattening period of male quail to reduce the costs. In this research compared the fattening performance and some morphological traits of male quails, which were separated as non-breeders after gender determination, at 35-45 days of age using 3 different finisher feeds.

MATERIAL and METHODS

A total of 270 male egg-type Japanese quail (*Coturnix coturnix japonica*) were used in the experiment. All quails obtained from the incubation of eggs from the same batch were reared under the identical diet and environmental conditions until 35 days of age. At the beginning of the experiment, the quails were weighed and numbered individually, and randomly distributed into 3 groups, and fattening was started with similar weights. In the study, 3 finisher feed groups were formed: cracked corn (CC), broiler chick feed (BCF), and a 1:1 mixture of these two feeds (CC-BCF). Each finisher feed group had 3 replications and 30 quails in each replication. Quails were fed with cracked corn (CC; 6% Crude Protein, 3100 ME kcal/kg, cost: 0.19 $/kg), broiler chick feed (BCF; 20% Crude Protein, 2900 ME kcal/kg, cost: 0.34 $/kg), cracked corn broiler chick feed mixture (CC-BCF; 13% Crude Protein, 3000 ME kcal/kg, cost: 0.26 $/kg).

Feed and water were given to the quail's ad-libitum. On the 5th and 10th days of the experiment (40th and 45th days of age), individual live weights of quails were determined, and the remaining feed at the end of the experiment was collected from the pens and weighed, thus calculating the feed conversion rate of each group. The cost per unit live weight gain was calculated by multiplying the feed conversion ratio and the finishing feed kg cost. When the quails reached 45 days of age, some morphological traits were measured in a total of 135 quails, 15 randomly selected from each pen. Within the scope of morphological traits, body length (cm), breast width (mm), breast length (mm), beak length (mm), beak width (mm), head width (mm), head length (mm), back length (mm), tail length (mm), shank length (mm), shank width (mm), middle finger length (mm) and folded wing length (mm) were determined using a digital calliper. Morphological measurements were performed on the right body parts of the quails by the same person, after the measurements were completed, the quails were slaughtered, and carcass weight (g) and carcass ratio (%) were determined (Uçar, 2024b).

IBM-SPSS Statistics 20 package program was used for statistical analyses. One-way analysis of variance (ANOVA) was used to compare live weight, carcass traits, feed conversion ratios, and morphological traits, and the Duncan multiple range test was used to determine statistically significant group means ($P<0.05$). Discriminant analysis was used in multivariate analyse.

RESULTS

Statistically significant differences ($P<0.05$) were found between the average live weights measured on both the 5th day (40 days of age) and the 10th day (45 days of age) of quail fattening according to the finisher feed groups (CC, BCF, and CC-BCF) (Table 1, Figure 1).

Table 1. Changes in live weight (g) of quails fed with different finisher feeds according to age*
*Tablo 1. Farklı bitirme yemleri ile beslenen bıldırcınların yaşa göre canlı ağırlık (g) değişimi**

Groups	Fattening Days (Quail Age Days)		
	0 (35)	5 (40)	10 (45)
Cracked Corn (CC)	$197.31^{aA} \pm 2.79$	$202.00^{bA} \pm 2.61$	$200.55^{bA} \pm 2.54$
Broiler Chick Feed (BCF)	$198.71^{aB} \pm 2.61$	$227.21^{aA} \pm 2.50$	$231.79^{aA} \pm 2.43$
Mixed (CC-BCF)	$197.94^{aB} \pm 2.59$	$222.81^{aA} \pm 2.50$	$229.04^{aA} \pm 2.45$

***: Differences between means, shown with different lowercase letters in each column and different uppercase letters in each row, are statistically significant ($P<0.05$).**

On the 5th and 10th days of feeding, the lowest live weight values were in the CC group (202.00 g and 200.55 g), and the highest values were in the BCF (227.21 g and 231.79 g) and CC-BCF (222.81 g and 229.04 g) groups (Table 1). The difference between the CC-BCF and BCF groups within each age (5 and 10 days) was insignificant ($P>0.05$), however the differences between the CC group and both groups were significant ($P<0.05$).

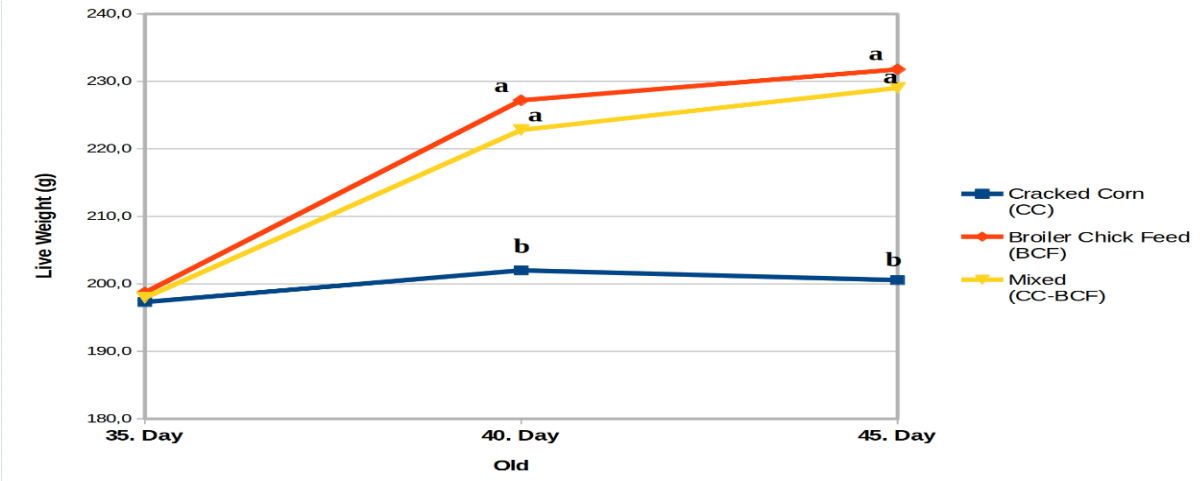

Figure 1. Changes in live weight of quails fed with different finisher feeds
Şekil 1. Farklı bitirme yemleri beslenen bıldırcınlarda canlı ağırlık değişimi

The differences between the average live weights determined on the 5th and 10th days of feeding in each feed groups were insignificant (P>0.05), but significant (P<0.05) between feed groups. The BCF and CC-BCF groups gained significant live weight compared to the initial weight of the study (P<0.05), no significant increase was achieved in the CC group on days 5 and 10 compared to the initial weight (P>0.05, Table 1). In terms of feed conversion ratio, at the end of the 10th day, the CC group (9.24) had the lowest mean, while the BCF (5.80) and CC-BCF (6.00) groups were similar. The values determined in terms of cost-effectiveness in male quail fattening, from best to worst, were observed in the CC-BCF (1.56 $/kg), CC (1.76 $/kg) and BCF (1.97 $/kg) groups, respectively (Table 2).

Table 2. Values related to feed conversion ratio (FCR) and fattening costs*
Tablo 2. Yemden yararlanma oranı (FCR) ve besi maliyetlerine ilişkin değerler

	CC	BCF	CC-BCF
FCR	9.24	5.80	6.00
Feed Cost ($/kg)	0.19	0.34	0.26
Cost of 1 kg Live Weight ($)*	1.76	1.97	1.56

*** Calculated by taking into account the performance of quail fattening between 35-45 days.**

In terms of the effect of different finisher feeds on quail slaughter and carcass weight, the lowest values were determined in the CC group (202.21 g and 150.28 g), and the highest values were determined in the BCF (229.53 g and 172.58 g) and CC-BCF (233.26 g and 174.59 g) groups (Table 3). The difference between the groups fed BCF and CC-BCF in terms of slaughter and carcass weight was not significant (P>0.05), but the difference between both groups (BCF and CC-BCF) and the CC group was significant (P<0.05). In terms of carcass ratio, the difference between the CC (73.62%) and BCF (75.20%) groups were significant (P<0.05), but the differences between the CC-BCF (74.38%) group and other groups (CC and BCF) were statistically insignificant (P>0.05).

Table 3. Slaughter weight (g), carcass weight (g) and carcass ratios (%) of quails fed with different finisher feeds*
Tablo 3. Farklı bitirme yemleri ile beslenen bıldırcınların kesim (g), karkas ağırlığı (g) ve karkas oranları (%)*

Groups	Slaughter weight (g)	Carcass weight (g)	Carcass Ratio (%)
Cracked Corn (CC)	$202.21^{b} \pm 3.84$	$150.28^{b} \pm 3.08$	$73.62^{b} \pm 0.38$
Broiler Chick Feed (BCF)	$229.53^{a} \pm 3.59$	$172.58^{a} \pm 2.82$	$75.20^{a} \pm 0.35$
Mixed (CC-BCF)	$233.26^{a} \pm 3.89$	$174.59^{a} \pm 3.17$	$74.38^{ab} \pm 0.39$

*** Differences between means indicated with different letters in each column are statistically significant (P<0.05).**

Beak length (mm), beak width (mm), head length (mm), head width (mm), folding wing length (mm), back length (mm), tail length (mm), shank length (mm), shank width (mm), middle finger length (mm) and body length (cm) of quails fed with different finisher feeds were not affected by the feed used (P>0.05). However, breast width (mm) and breast length (mm) traits were significantly (P<0.05) affected by the feed used (Table 4). There was no difference in the breast width between the BCF (35.37 mm) and CC-BCF (35.37 mm) groups (P>0.05), but the mean of the CC (32.90 mm) group was found to be significantly lower than both groups (P<0.05). There was no difference between CC (64.34 mm) and BCF (65.40 mm) in terms of breast length (P>0.05), while the CC-BCF (67.30 mm) group had the highest mean (P<0.05).

Table 4. Morphological traits of male quails fed with different finisher feeds*
*Tablo 4. Farklı bitirme yemleri ile beslenen bıldırcınların morfolojik özellikleri**

	Cracked Corn (CC)	Broiler Chick Feed (BCF)	Mixed (CC-BCF)	SEM	P
Body Length (cm)	31.00	31.41	31.07	0.165	0.155
Breast Width (mm)	32.90[b]	35.37[a]	35.37[a]	0.409	0.001
Breast Length (mm)	64.34[b]	65.40[b]	67.30[a]	0.648	0.008
Beak Length (mm)	15.48	15.58	15.71	0.174	0.670
Beak Width (mm)	5.90	5.75	5.75	0.111	0.552
Head Width (mm)	14.92	15.28	15.01	0.175	0.302
Head Length (mm)	29.22	29.15	29.18	0.218	0.972
Back Length (mm)	87.61	88.91	89.99	0.988	0.253
Tail Length (mm)	47.55	49.50	48.45	0.759	0.182
Shank Length (mm)	26.70	26.08	26.31	0.286	0.302
Shank Width (mm)	4.34	4.39	4.41	0.570	0.681
Middle Finger Length (mm)	24.41	24.71	24.56	0.263	0.724
Fold Wing Length (mm)	106.38	107.33	108.18	0.684	0.195

*** Differences between means shown with different letters in each row are statistically significant (P<0.05).**

According to the discriminant analysis applied to the live weight and morphological traits of the quails at 45 days of age, the reassignment success of the quails to their own group was 79.1% on average. The highest correctly classification success was in the BCF and CC groups (82.2% and 82.2%), and the lowest classification success was in the CC-BCF mixture group (71.1%). The first principal component explained 60% of the total variation and the second principal component explained 30% of the total variation, and the highest misclassification rate (Table 5) was observed the CC-BCF to BCF (26.7%) and BCF to CC-BCF (13.3%) groups.

Table 5. Live weight and morphological characteristics of quails fed with different finishing feeds
Tablo 5. Farklı Bitirme yemleri ile beslenen bıldırcınların canlı ağırlık ve morfolojik özellikleri

Groups		Estimated Group Distribution			Toplam
		BCF	CC-BCF	CC	
Number	BCF	37	6	2	45
	CC-BCF	12	32	1	45
	CC	3	5	37	45
%	BCF	82.2	13.3	4.5	100.0
	CC-BCF	26.7	71.1	2.2	100.0
	CC	6.7	11.1	82.2	100.0

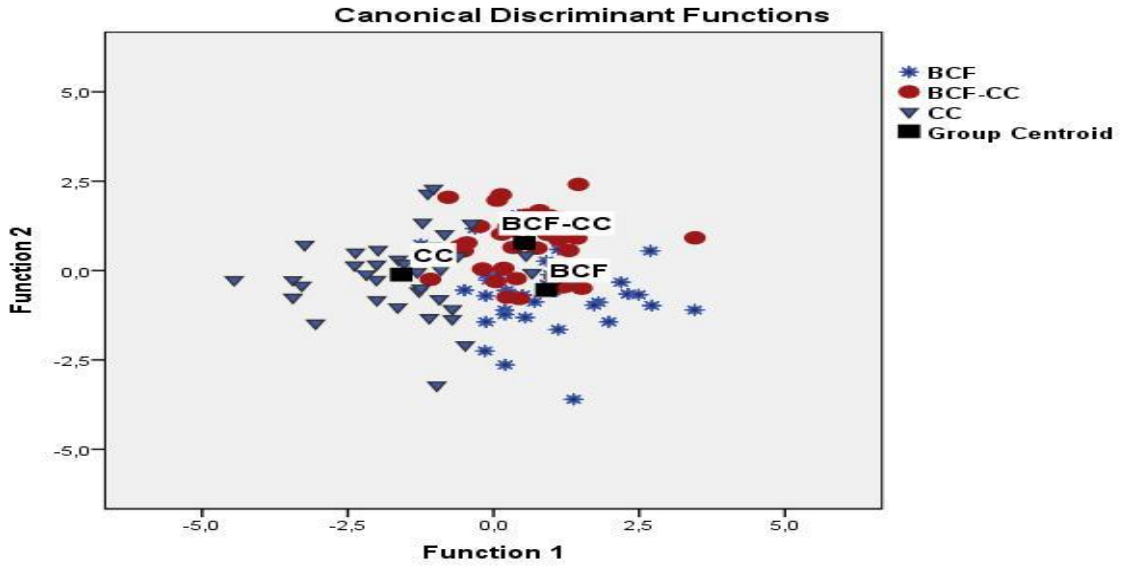

Figure 2. Scatter plots of quails fed with different finisher feeds according to their live weight and morphological traits.
Şekil 2. Farklı bitirme yemleri ile beslenen bıldırcınların canlı ağırlık ve morfolojik özelliklerine göre serpilme diyagramı

DISCUSSION and CONCLUSION

The live weight gain of fattened Japanese quail males after 28 days of age, feed consumption begins to decrease after 35 days of age, the highest carcass yield is reached at 35 days of age, and the feed conversion rate decreases rapidly after 42 days of age (Şeker et al. 2007). In this study, the highest live weight gain was achieved between 35-40 days, with increases in CC, BCF, and CC-BCF groups being 4.69, 28.50, and 24.87 g, respectively. In the last five days, the CC group lost live weight (-1.45 g), while the BCF and CC-BCF groups gained only 4.58 and 6.23 g, respectively. The most appropriate slaughtering age for quails is 5-6 weeks, and quails slaughtered during this period have higher carcass yields than quails slaughtered in the following weeks (Abou-Kassem et al. 2019). After this age, feeding costs also increase by approximately 75% (Walita et al. 2017; Pavlova et al. 2023). The live weight gain in the 5th week of quail fattening corresponds to approximately one-fifth of the total live weight. However, feed consumption in the 5th week is one-third of the total feed consumption (Alarslan, 2006; Lukanov et al. 2021). Consistent with the above reports, the findings of this study showed that a short fattening period of 5 days after 35 days of age is sufficient to produce male quail at the lowest cost.

Evaluating relatively cheap grain feed alternatives is important in reducing production costs (Başer and Yetişir, 2007). In quail farming, as in other poultry animals, the biggest cost is feed, which constitutes approximately 75-80% of the total cost (Çimrin and Tunca, 2012). Studies on the proportions of raw materials that make up the ration to reduce this cost can yield positive results (Tufan and Bolacalı, 2017; Abdel-Moneim et al. 2020; Özcan et al. 2021). In a fattening study conducted on quails with males and females together and males and females separately (Kul et al. 2006), it was observed that keeping males with females increased sexual activity, and this situation negatively affected live weight gain after 35 days of age. In this study, where male quails were fattened separately from females, live weight increased in the first 5 days, and a decrease in live weight gain was observed after 40 days of age. It can easily be thought that the main reason for this decrease in live weight gain is the onset of sexual activity.

Morphological measurements performed in this study show that the development of the bone-skeletal system in the egg-type quail males is largely completed by 35 days of age. Because at the end of the fattening period (45 days of age), no significant differences were observed in other morphological traits related to skeletal system except for the breast length and breast width, which were traits related to the amount of muscles in quails fed with different finisher feeds. It can be said that after the age of 35 days, CC as a finisher feed is sufficient to conserve bone and skeletal system when the Japanese quails are fed ad-libitum. However, as expected, it is clear that higher protein finisher feeds (BCF and CC-BCF) than the CC group were needed for muscle increase (meat production) at the end of the male quail feeding period.

There is a limited number research in literature (Chimezie et al. 2022; Jubril et al. 2022; Tulobaev et al. 2012) used morphometric traits of quail focused on growth and development period. The evaluation of morphological traits combined with multivariate analyses can provide new perspectives for a better understanding parameters of growth and development. The discriminant analyses showed that there is a strong effect on fattening and morphometric traits of male quails feeding by different rations at the finishing period. Both of the ANOVA and discriminant analysis results show that for monitorization of the fattening period in quail are sufficient as breast with and length traits.

In this study, it was determined that a 5-day-old quail fattening period was sufficient to provide live weight gain from 35 days of age. In addition, it was determined that the groups fed with BCF and CC-BCF were similar to each other in terms of live weight gain, carcass yield, and morphological development. On the other hand, the fattening male quail after 35 days of age with a mixing of CC-BCF (1.56 $) instead of CC (1.76 $) and BCF (1.97 $) in a short period of 5 days reduced feed costs by approximately 10-20%. When all the findings were evaluated together, it is shown that there is no need to use relatively expensive high-protein contents in the fattening of egg-type male quails after 35 days of age, and adding cheap grain feeds to the ration is a good alternative for reducing feed cost in finishing period.

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