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Passer Journal of Basic and Applied Sciences

Passer 7 (Issue 1) (2025) 378-384

Original Article

Effect of Dietary Protein Levels on Growth Performance, Carcass Traits and Economic Returns of Local Quail

Kareem Maulud Hamad *, [1], Dekan Faraidun Omer [1], Qdria Muhammad Salim [1], Zhiran Omer MuhammadAmin [1]

[1] *Department of animal resource, College of Agriculture Engineering Sciences, University of Raparin, Qaladza 46016, Kurdistan Reign, Iraq.*

Received 05 November 2024; revised 04 April 2025;
accepted 25 April 2025; available online 08 June 2025

DOI: 10.24271/psr.2025.487158.1804

ABSTRACT

The study aimed to find out the effects of different levels of dietary protein (control: 26%, T1: 29%, T2: 33%) on the growth Performance, carcass quality and economic returns of local quail. In the experiment 216 quail chicks were used divided into three groups of three replicas each with 24 birds, the birds were bred for 42 days, the results showed a significant effect of protein levels on growth performance, birds in (T1) obtained the best body weight, weight gain and carcass weight compared to control and T2. The effect of different protein levels on the physical properties and chemical composition of local quail meat showed that the best crude protein (80%) and cooking loss (11%) were recorded in (T2) and the thawing loss in (T1) is (4.9%). The sensory tests of both treatments significantly superior to the control for odor, tenderness and general appearance, also the control group had the lowest feed cost (419.8 Iraqi dinars), while T1 and T2 had significantly higher feed costs (531.3 and 533.7 Iraqi dinars, respectively). The results of this investigation revealed that best growth performances were in T1.

Keywords: Quail, Protein, Performance, Dressing, Daily gain, Coturnix japonica.

1 Introduction

Japanese quail (Coturnix coturnix japonica), A tiny, bird species, quail is used extensively in laboratories around the globe and is also raised for its eggs and meat for financial gain. Fast development, early sexual maturity, short generation periods, high laying rates, and lower feed and space requirements per bird than chicken are some of its special characteristics. [1].

Quail meat quality is determined by two extremely important traits –appearance and meat consistency. The appearance of the meat affects the consumer's choice and is determined by the colour of the skin and flesh as well as any defects. When it comes to evaluating quality of meat, the tenderness of meat is more important [2]. It is determined by the thickness of the muscle fibers and the proportion of the main metabolic types of muscle fibers that make up the muscle bundles. The quality of meat with reference to storage and processing depends on pH levels and the water holding capacity (WHC) [3]. Quail meat is excellent and very low in fat. It tastes really natural and isn't at all tedious or gamey. Whenever it's overcooked, it dries out quickly. The chemical composition of quail meat (uncooked meat) of Moisture, Protein, Fat, Carbohydrate, Minerals are (73.93%, 20.54%, 3.85%, 0.56% and 1.12%), respectively [4].

A high-quality protein source with a well-balanced amino acid profile is among the most essential nutrients for quail. [5]. Particularly during the first few weeks of life, protein has a significant effect on the development of bird's growth. Any breeder's objective is to lower the overall cost of raising birds, while feed components make up over 70% of the entire cost, because protein sources are the most expensive when compared to energy sources and other diet components. It is imperative to lower feed costs by using alternatives to protein concentrates [6]. Quail chicks required a high protein level feed such as 26 to 27% CP during starter period of age, in order to maximize feed efficiency and body weight gain [7,8].

At starter stage of quail growth will a higher dietary protein intake have an advantageous effect on performance [9, 10, 11]. This study aimed to assess how different protein levels affect growth and meat quality in local quail. It also evaluated which level offers the best economic return.

* Corresponding author
E-mail address kareem.hamad@uor.edu.krd (Instructor).
Peer-reviewed under the responsibility of the University of Garmian.

2 Materials and Methods

The research investigation was carried out at the Faculty of Agricultural Engineering Sciences - Rabarin University, in the current research, the local 216-day quail chicks were divided into three treatments, each consisting of three replications of 24 birds for each. The treatments as following: Control was given food with 26 % CP; (T1) food containing 29 % CP; (T2) food containing 33% CP food, control and treatments that are freely fed on the diet for (42) days of age (Table 1).

Table 1: The chemical composition of the feed that used in the experiment.

Treatment	Crude Protein %	Metabolizable Energy (Kcal/kg)	Dry Matter %	Ether extract %	Ash %	Crude Fiber %
Control	26	3018	90.1	3.86	5.49	3.7
T1	29	3016	90.43	3.91	5.47	3.8
T2	33	3013	90.67	3.7	5.57	3.72

The quail chicks were reared in a cage system until two weeks of age. The cages were divided into 9 parts of equal dimensions each (50 cm length, 50 cm width and 30 cm height). The lighting and temperature were used depending on the quail management standards [12]. During the first day to six weeks, data was collected for each of the growth characteristics: body weight, food intake, weight gain, food conversion ratio and mortality. At 42 days of age, 2 males and 2 females of each replications as a total 36 birds were slaughtered for carcass characteristics: dressing percentage and carcass parts percentage (breast and thigh) meat quality [13]. Furthermore, the economical traits were calculated for the cost and economic return of the live bird.

2. 1 Statistical Analysis

A Completely Randomized Design was followed in this experiment. Collected data were analyzed using the General Linear Model (PROC GLM) of the appropriate Statistical Analysis System version 9.4 [14]. The Duncan multiple range test was used to differentiate the means at a significance level of $P < 0.05$ [15].

3 Results

3. 1 Growth Characteristics

The weight of the living body is one of the important characteristics to be studied when raising quail because the main purpose is to obtain high weights as the amount of meat produced by the quail and the weights of carcasses and their parts depend on the body weight and increases with increasing the body weight [16].

The data in the Table (2) shows significant ($P<0.05$) the effects of different levels of protein on the quail's live body weight and weight gain, the birds in T1 significantly ($p<0.05$) had the best for the live body weight, weight gain and feed conversion ratio. At age 1-42 day old, the control group had the lowest mortality % rates. This indicates that higher protein levels led to increased feed consumption, likely due to greater metabolic demands for growth. However, excessive feed intake in T1 could suggest inefficiency in nutrient utilization. The higher mortality rates in the T1 and T2 groups, possibly due to excessive protein intake may have caused metabolic stress or organ dysfunction, by excessive nitrogen excretion and its associated impact on renal function. These findings are consistent with those of [17], who found no significant differences in the feed conversion ratio when different levels of protein were used, also agree with [18, 19], according to [20] the varied protein levels (18, 20, 22, 24, 26 percent) showed no significant effect. [21, 22] showed significant differences in feed consumption and protein conversion efficiency between all protein levels.

Table 2: The effect of different levels of protein on production traits of local quail.
The letters a to c indicates significant differences ($P < 0.05$), as shown by means in the same column with different letters.

Treatments	Bodyweight(g/bird)		
	1day	21days	42 days
Control	7.00 b	66.7 a	158.2 b
T1	6.8 b	65.9 a	172.4 a
T2	7.6 a	52.2 b	162.4 ab
SEM	0.1	3.4	4.5
Treatments	Weight Gain (g/bird)		
	(1- 21)days	(21 – 42)days	(1– 42) days
Control	59.3 a	91.5 b	151.2 b
T1	59.1 a	106.4 a	165.5 a
T2	44.6 b	110.2 a	154.9 ab
SEM	3.4	4.9	4.5

Treatments	Feed Intake (g/bird)		
	(1- 21)days	(21 – 42)days	(1– 42) days
Control	168.8c	234.8 c	403.6 c
T1	209.4 a	273.6 a	483 a
T2	182 b	262.7 b	444.8 b
SEM	2.8	3.3	5.7
Treatments	FCR (g feed /g weight gain)		
	(1- 21)days	(21 – 42)days	(1– 42) days
Control	2.9 c	3 a	2.9 b
T1	3.8 b	3 a	3.4 a
T2	5 a	2.4 b	3.7 a
SEM	0.3	0.1	0.2
Treatments	Mortality (%)		
	(1- 21)days	(21 – 42)days	(1– 42) days
Control	1.3 b	2.0 b	3.3 b
T1	2.3 a	3.3 a	5.7 a
T2	2.3 a	3.7 a	6 a
SEM	0.2	0.4	0.4

3. 2 Carcass Traits

The data in Table (3) showed the effect of different levels of protein on the main carcass parts of male and female quails, the results showed the thigh percentage in the T1 was significant ($p<0.05$) higher than the other treatments in male, female and overall, while in the females T2 was significantly superior for dressing percentage and breast percentage on the treatments, this indicates that a higher protein level (T2) might enhance breast meat yield, especially in females.

These findings align with those reported by [19,23] they showed the weight of carcass and breast were affected by feed protein level. Also [24] showed that birds fed low-protein diets in the initial phase had lower breast yield at age 42, 49 and 56 days. Different level protein in food did not affect quail body weight, dressing percentage and breast percentage and leg percentage [25].

Table 3: The effect of different levels of protein on dressing percentage (%) and carcass parts percentage of local quail.

Treatments	Live Weight (g)	Dressing (%)	Breast (%)	Thigh (%)
	Male			
Control	152.7 a	73.4 a	37.9 a	21.9 b
T1	151.7 a	74.6 a	37.1 a	23.4 a
T2	155.8 a	72.8 a	37.3 a	22.9 a
SEM	4.4	0.6	0.4	0.2
Female				
Control	169.3 a	70.5 b	36.1 b	22.1 b
T1	158.7 a	71.1 ab	37.0 b	23.2 a
T2	171.7 a	72.9 a	39.1 a	20.8 b
SEM	4.9	0.8	0.4	0.7
Overall				
Control	158.2 a	72.4 a	37.3 a	22.0 b
T1	154.0 a	73.4 a	37.0 a	23.3 a
T2	161.1 a	72.9 a	37.9 a	22.2 b
SEM	3.6	0.5	0.3	0.3

The letters a to c indicates significant differences ($P < 0.05$), as shown by means in the same column with different letters.

The Table (4) shows the effects of protein levels in feed on the secondary carcass parts of both sex of quails, the results showed the high percentage of wing, back and gizzard significantly ($P < 0.05$) were recorded in T1 in females, while the high percentage of liver and neck were recorded in females of control group, regarding to overall the T2 significantly ($P < 0.05$) superior on control for the percentage of gizzard and neck. The increase in gizzard percentage in T2 birds might be due to a compensatory mechanism in digestion due to protein level variation. The results agree with the findings of [26] that shows Wings proportions were not affected by dietary crude protein level in males [18, 27]. the results disagree with [28] that showed too much protein may delay the development of muscle growth by promoting the rapid catabolism of amino acids.

Table 4: The effect of different levels of protein on Dressing percentage (%) and Carcass parts percentage of local quail.

Treatments	Wing (%)	Liver (%)	Heart (%)	Back (%)	Neck (%)	Gizzard (%)
	Male					
Control	8.2 a	4.1 a	0.6 a	19.6 a	2.1 a	2.4 b
T1	7.8 ab	2.5 c	0.5 a	20.1 a	1.3 b	2.4 b
T2	7.5 b	3.3 b	0.5 a	19.3 a	2.4 a	3 a
SEM	0.2	0.2	0.1	0.5	0.1	0.1
Female						
Control	8.1 ab	5.3 a	0.4 a	18.8 b	2.9 a	2.2 b
T1	8.6 a	2.7 b	0.8 a	21.2 a	1.3 b	3 a
T2	7.9 b	2.7 b	0.9 a	20 ab	2.6 a	2.9 a
SEM	0.2	0.2	0.2	0.6	0.3	0.2
Overall						
Control	8.2 a	4.5 a	0.6 a	19.3 b	2.3 a	2.3 c
T1	8.1 ab	2.6 c	0.6 a	20.4 a	1.3 b	2.6 b
T2	7.7 b	3.1 b	0.6 a	19.5 ab	2.5 a	2.9 a
SEM	0.2	0.2	0.1	0.4	0.1	0.1

The letters a to c indicates significant differences (P < 0.05), as shown by means in the same column with different letters.

3. 3 Chemical and physical characteristics of the meat

The results of the chemical composition of quail meat of the current study are presented in Table (5). The results explained that the T2 in both sex and overall had the higher percentage of crude protein (CP%) and lower percentage of ether extract (E.E.%), This result might be due to its level of protein being higher than the control and needing too much water for the body's metabolism. As the crude protein increased, the ether extract (E.E. %) declined. With regard to physical characteristics, there was a non-significant effect of protein levels in quail feed on the PH, cooking loss (CL%) and thawing loss (TL%). The results disagree with the results of [29] that found as much as energy goes up, it would affect the PH, cooking loss (CL%) and thawing loss (TL%) negatively. If the cooking loss (CL%) and thawing loss (TL%) get high, it means that the meat loses its water-holding capacity (i.e., the tenderness would decrease and the meat gets tougher). and it would affect the consumer's desire. This result confirms that higher dietary protein levels effectively enhance muscle protein deposition in Japanese quail. Also, this suggests that higher protein levels promote lean meat production by reducing fat accumulation. The similar results were reported by [22, 30] that showed the chemical composition of quail meat was affected by dietary protein components, while the cooking loss and pH were not affected. The current results agree with results of [31] which showed significant differences between treatments for chemical composition of quail meat which feed different levels protein.

Table 5: The effect of different levels of protein on the physical characteristics and chemical composition of local quail.

Treatments	D.M%	Ash (%)	C.P (%)	E.E (%)	T.L (%)	C.L (%)	PH
	Male						
Control	28.9 a	1.8 a	69.7 c	24.9 a	5.7 a	13.5 a	5.9 a
T1	30.1 a	1.8 a	71.9 b	22.7 b	5.1 a	12.6 a	5.8 a
T2	31.3 a	1.7 a	79.9 a	17.3 c	6.4 a	10.7 a	5.9 a
SEM	0.8	0.1	0.1	0.1	0.8	1.4	0.1
Female							
Control	30.8 a	1.6 b	69.9 c	24.9 a	4.7 a	15.6 a	5.5 a
T1	30.4 a	2.0 a	71.9 b	22.7 b	4.4 a	13.6 a	5.6 a
T2	28.6 a	2.3 a	79.9 a	17.3 c	5.0 a	11.5 a	5.5 a
SEM	0.9	0.2	0.2	0.2	0.7	1.7	0.1
Overall							
Control	29.3 a	1.7 a	69.7 c	24.9 a	5.5 a	14.3 a	5.7 a
T1	30.2 a	1.9 a	71.9 b	22.7 b	4.9 a	12.9 a	5.7 a
T2	30.4 a	1.9 a	80.0 a	17.3 c	5.9 a	11 a	5.8 a
SEM	0.8	0.1	0.1	0.1	0.7	1.3	0.1

The letters a to c indicates significant differences (P < 0.05), as shown by means in the same column with different letters.

3. 4 Sensory Evaluation

The Table (6) showed that the protein levels in quail feed has a significant (P < 0.05) effect on the sensory tests. The sensory tests of both treatments significantly (P < 0.05) superior to the control for odor, tenderness and general appearance in both sex and overall. This is showed that the protein level of the meat, as it's

goes higher the sensory quality of quail meat goes up too. These results suggest that protein supplementation positively influenced meat aroma and more desirable flavor, possibly due to changes in fat composition or protein breakdown. The slight improvement in tenderness with higher protein levels may be due to reduced collagen content. The results were accordance with findings of [12, 32] that showed significant effect of dietary effect on meat color, flavor, tenderness and juiciness for quail meat. While [33] reported reverse results that reported no significant effect of diet on sensory test of quail meat.

Table 6: The effects of different levels of protein on the sensory test of local quail.

Treatments	Taste	Odor	Color	Tenderness	General Appearance
	Male				
Control	2.8 a	2.2 c	2.7 a	2.6 a	2.8 a
T1	3.4 a	2.8 b	3.1 a	2.5 a	3.2 a
T2	3.1 a	3.5 a	3.1 a	2.9 a	3.3 a
SEM	0.3	0.2	0.3	0.2	0.2
Female					
Control	3 b	3 ab	2.4 b	2.2 a	2.9 b
T1	3.8 a	2.6 b	3.7 a	2.6 a	3.4 ab
T2	4.3 a	3.6 a	2.9 ab	2.6 a	3.7 a
	0.2	0.2	0.3	0.2	0.2
Overall					
Control	2.8 a	2.4 b	2.6 a	2.4 a	2.8 b
T1	3.5 a	2.7 b	3.3 a	2.5 a	3.2 ab
T2	3.5 a	3.5 a	3 a	2.8 a	3.4 a
SEM	0.2	0.2	0.3	0.2	0.2

The letters a to c indicates significant differences ($P < 0.05$), as shown by means in the same column with different letters.

3. 5 Economical return

The effect of different levels of dietary protein on economical return in local quail showed in Table 7. The results revealed that the different levels of protein significantly ($P < 0.05$) affected the cost of feed and the higher feed cost and total cost were recorded in T2 compare with control, this might be due to the high price of feed by using Soyabean meal as protein source and the decrease in economic return with higher protein diets suggests that the additional feed cost was not fully compensated by improved meat yield or market value. The similar results were reported by [34] that the feed cost per bird significantly increased with higher dietary protein levels and supplementation enzyme and yeast. On the contrary, the results contradict those obtained by [35] that economic analyses revealed that diets with 22% and 24% protein had higher feed efficiency than other groups. Furthermore, diets with higher levels of protein tend to improvement feed efficiency and growth performance, but the expense of protein-rich foods may raise feed costs overall [36].

Table 7: The effects of different levels of protein on economical return of local quail.

Treatments	Feed cost / 1 bird (Iraqi dinars)	Total cost / 1 bird (Iraqi dinars)	Total return / 1 live bird (Iraqi dinars)
Control	419.8 b	600.3 b	1899.7 a
T1	531.3 a	759.7 a	1740.3 b
T2	533.7 a	763.2 a	1736.8 b
SEM	7.4	10.6	10.6

The letters a to c indicates significant differences ($P < 0.05$), as shown by means in the same column with different letters.

4 Conclusion

The conclusion of this study can be summarised as adding protein level to 29% (T1) led to increased body weight. Although they have no favourable impact on FCR or mortality, T2 has a larger percentage of dressing and carcass parts. An increased protein level in the diet resulted in an increased protein level in the meat, while cooking loss (CL%) was decreased, and also the best colour and taste of quail meat dealt with the sensory test in T2. There for 29% crude protein is recommended in quail for good performance. This indicates that while specific diets can enhance growth and sensory traits, cost considerations are crucial for optimising profitability in quail production.

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