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ORIGINAL ARTICLE

Response of Chukar Partridge Performance and Blood Parameters to Different Dietary Crude protein

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ABSTRACT

The optimum crude protein (CP) levels in different growth stage of chukar partridges were investigated. 144, one-day-old male and female chukar partridge chicks, were divided into six groups and each group was divided into four replicates, tow replicates for males and tow replicates for females, and each replicate containing six chukar partridge chicks. The partridges fed with diets containing 160-260 CP (g/kg) (1-4 weeks), 140-240 (g/kg) CP (5-8 week) and 120-220 (g/kg) CP (9-14 week). The body weight (BW), feed consumption (FC) and feed conversion ratio (FCR) data were obtained for each group at 4, 8 and 14 weeks of age. blood samples were taken at 14 weeks of age and analyzed for total protein, cholesterol, triglyceride, glucose, calcium, phosphorus and urea. The partridges fed on a finisher diet containing 180 and 200 (g/kg) CP had significantly the highest weight gain but the lowest FC and FCR observed in group with 200(g/kg) CP, Also the male partridges had better performance than females. Serum total protein, calcium and phosphorus concentration were affected by different CP. In conclusion, result of this study suggested that CP level significantly affect the performance and blood parameters of male and female partridges.

Key words: partridge, crude protein, blood parameter, body weight, feed conversion ratio

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INTRODUCTION

Partridges are the game birds which are raised mainly for the following reasons: releasing in the nature, Hunting, Meat and eggs production as a new source of protein and Hunting tourism [1-4]. The growing desire for partridge meat consumption has resulted to increase of industrial breeding of this species [2].

Final body weight (BW) and feed conversion ratio (FCR) are the most important economical problems of partridges breeding for meat production. Feed contributes to about 60-70% of the total game birds production cost, also protein is the most expensive major nutrients in the diet, so by using lower protein level of the diet, the cost can be reduced. Nowadays, due to lack of sufficient information and some discrepancy, the diets recommended for other poultry and game birds usually have been used in industrial farms by partridge growers.

Woodard [5]) found that protein contents of starter and grower diets for chukar partridge should be 250 and 200(g/kg) respectively. It was shown that game birds should be fed on a starter diet containing 280 and 200(g/kg) CP shown that the best FCR and feed consumption (FC) were observed in partridges fed on diet containing 240 (g/kg) CP when supplemented with methionine and lysine.

It has been reported the best level of dietary protein in Red-Legged partridge at the 0-4 weeks of age, with the dietary energy Metabolize Energy (ME) of 2600, 2800 and 3000 Kcal/Kg, are 176, 190 and 204 (g/kg) CP, respectively [6]. Most studies conducted to determine the best diet for improving male partridge weight gain and growth performance in a short time of growth period and sometimes are different and limited information is available for hematology and biochemistry of the chukar partridge in relation with different crud protein levels of diet.

The present study were designed to investigate the effect of different dietary CP content in starter (0-4 week), grower (5-8 week) and finisher diet (9-14 week) on the male and female partridge growth performance and some blood constituents.

MATERIALS AND METHODS

A total of 144 one day old grey chukar partridge (*Alectoris chukar*) chick were separated by an expert technician according to their physical characteristics and phallus appendage. The chicks were randomly divided into six groups (24 birds per group) and each group consists of two subgroups including 12 male and 12 female chicks with 2 replications. Birds were kept until 14 weeks of age in the same cages, the nipple drinker and bucket type feeder, with approximately 420 cm^2 of floor space per bird were provided. Feed and water were consumed ad libitum by the birds, and the birds were kept under continuous fluorescent light. The chicks were started at a brooding temperature of 35˚C and then temperatures were reduced 2.5˚C weekly and reached to 18˚C until last days of breeding. The partridge chicks were given starter, grower and finisher diets from 0-4, 5-9 and 9-14 weeks of age respectively. The starter diets contained concentrations of six protein level; 160, 180, 200, 220, 240, 260)(g/kg) with constant energy 11.72 MJ ME and the grower diets contained six concentrations of CP; 140, 160, 180, 200, 220, 240 (g/kg) with constant energy 12.14 MJ ME and The finisher diets contained six concentrations of CP; 120, 140, 160, 180, 200, 220 (g/kg) with constant energy 12.5 MJ ME (Table 1). The chicks were weighed at hatch and the BW, FC and FCR data were obtained for each group at, 4, 8 and 14 weeks of age, Synthetic methionine and lysine were used to balance the methionine and lysine contents of the diets.

Blood samples were collected from each treatment at 14 weeks of age. Serum was separated by centrifugation at 3000 rpm for 10 minutes and stored at -20 until analysis. Total protein, uric acid, total cholesterol, glucose, calcium and phosphorus were determined according to Nazifi *et al* [7].

One-Way ANOVA analysis of variance and Independent- samples T-Test was used for statistical analysis. Significant differences among group means ($P \leq 0.05$) were identified with the Duncan test.

RESULTS

Starter Period (0- 4 Weeks of Age)

There was significant effect of protein content on BW of partridge chicks, It was observed that partridge chicks fed diets containing 220, 240, 260(g/kg) CP with significantly have no difference in final BW at the first 4 weeks of age and had higher BW than other groups (Table 2).

FC were affected significantly by the protein content, For the 0 to 4 week period, the partridges fed a diet containing 160 and 180(g/kg) had no significant difference among FC and the partridge in the groups 5, fed by diet containing 240(g/kg) CP, had significantly the lowest FC (Table 3).

The protein content of the diet had significant effect on the FCR at the starter period, FCR significantly was lower in partridge fed a diet containing 240(g/kg) CP than other groups and the highest FCR belonged to the groups with 160, 180, 200 and 260(g/kg) crude protein (Table 4).

Grower Period (5-8 Weeks of Age)

During 5 to 8 week of age, the protein content had significant effect on body weight gain, there were no significant difference between partridge chicks fed diet containing 160, 180 and 240(g/kg) CP but the highest BW was found in the partridges fed the a diets containing 200 and 220 (g/kg) CP and the lowest BW belonged to the group 1 with 140(g/kg) crude protein (Table 2).

For the 5-8 week period, the partridge significantly have had different pattern in feed intake at the groups and the lowest feed was consumed by the partridges fed with 220 and 240 (g/kg) CP in diet and the highest FC related to groups with 14 and 160(g/kg) CP. The FC in the partridges fed a diet containing 200 (g/kg) crude protein was significantly different with other groups (Table 3).

There was significant effect of protein content on FCR at the grower period. Partridge fed diet containing 220(g/kg) CP had significantly lower FCR than other groups and the group with 140 (g/kg) protein content in diet had significantly highest FCR than other treatments (Table 4).

Finisher Period (9-14 Weeks of Age)

The CP content had significant effect on the body weight gain during finisher period, the highest body weight gain found in the partridges fed diet containing 180 and 200(g/kg) CP. The groups fed by 120 and 140 (g/kg) CP had the lowest BW (Table 2).

The daily mean FC was affected by CP, during 9-14 weeks of age, the partridge fed diet containing 140(g/kg) CP consumed more feed than other group and significantly the lowest FC related to the partridge fed diet containing 200(g/kg) CP (Table 3).

The FCR had significant difference between the treatment groups in 14 weeks of age; interestingly the partridge fed with 200(g/kg) crude protein content in finisher diet had lower FCR than other groups with a significant difference (Table 4).

Hematology

Effect of different crud protein levels on blood parameters are given in table 5. The blood parameters were not shown any difference between male and female partridge significantly. serum total protein, calcium and phosphorus concentration increased linearly with the CP of the diets, the serum glucose, triglyceride, cholesterol and uric acid revealed no significant differences attributable to the feeding of different protein levels for chukar partridges.

Table1. Composition Of The Diets (Kg)

Ingredient	Different Experimental Diets (Group)																		
		1			2			3			4			5			6		
		S[1]	G[2]	F[3]	S[1]	G[2]	F[3]	S[1]	G[2]	F[3]	S[1]	G[2]	F[3]	S[1]	G[2]	F[3]	S[1]	G[2]	F[3]
	ME MJ	11.7	12.14	12.5	11.7	12.14	12.5	11.7	12.14	12.5	11.7	12.14	12.5	11.7	12.14	12.5	11.7	12.14	12.5
	CP g/kg	160	140	120	180	160	140	200	180	160	220	200	180	240	220	200	260	240	220
Corn		523	464	434	507	502	465	620	485	510	576	601	490	530	554	580	472	509	546
Soya Bean		195	128	60	262	199	133	340	265	205	375	344	250	395	378	347	440	398	350
Barely		225	313	313	190	225	292	-	190	196	-	-	170	-	-	-	-	-	-
Fish Meal		-	-	-	-	-	-	-	-	-	14	0	15	40	14	0	48	40	35
Calcium Phosphate		15	15	15	15	15	15	15	15	15	12	15	15	9	12	15	7	9	12
Oyster		15	15	15	15	15	15	15	15	15	13	15	15	12	13	15	11	12	13
Fat		-	20	20	-	17	35	-	19	32	-	15	34	5	19	33	13	23	34
Methionine		2.7	3.5	3.7	2	2.7	3.5	1.4	2	2.7	1.4	1.4	2	0.5	1.4	1.4	0.5	0.5	1.4
L-Lysine		2.7	3.5	6	1	2.7	3.5	-	1	2.7	-	-	1	-	-	-	-	-	-
Vitamin Mix		3	3	2.65	3	3	3	3	3	2.8	3	3	3	3	3	3	3	3	3
Trace Mineral Mix		3	3	2.65	3	3	3	3	3	2.8	3	3	3	3	3	3	3	3	3
NaCl		2	2	2	2	2	2	2.5	2	2	2.5	2.6	2	2.5	2.6	2.6	2.5	2.5	2.6
Wheat Bran		14	30	43	-	14	30	-	-	14	-	-	-	-	-	-	-	-	

1.S: starter, 2.G: Grower, 3.F: Finisher. The diets were supplemented by limiting amino acids and the Vitamin/Mineral supplement levels per kg of diet: Retinol acetate, 1080 mg; Cholecalciferol, 20mg; α-Tocopheryl acetate, 14400 mg; menadione nicotinamide bisulphite, 800 mg; Thiamine hydrochloride, 710 mg; Riboflavin-5-phosphate sodium, 2640 mg; Pyridoxine hydrochloride,1176 mg; Cobalamin, 6mg; Niacin, 11880; Folic acid 400 mg; Biotin , 40 mg; Copper 4000 mg; Iron 20000 mg; Iodine 397 mg; Manganese 39680 mg; Selenium 80 mg; Zinc, 33880 mg; Choline chloride, 100000 mg.

Table 2. Mean Body Weight of Male and Female Partridge

G[1]		Weight					
	W[2]	4		8		14	
	S[5]	M[3]	F[4]	M[3]	F[4]	M[3]	F[4]
1		140.2±3.4[a]	126.5±1.6[b]	330.6±5[a]	301.67±3[a]	521.0±4.35[a]	457.3±4[a]
2		139.5±2.9[a]	123.4±1.7[a]	336.4±2[b]	305.1±3.58[b]	523.1±4.68[a]	460.8±6[ab]
3		141.25±3[a]	128.1±2[bc]	338.7±2[b]	309±4.3[c]	527.3±5.03[b]	462.3±5[b]
4		144.56±2.3[b]	130.0 ±2.6[d]	350.1±3.5[c]	319.8±3.03[d]	545.5±5[c]	483.3±5.26[c]
5		145.3±2.3[b]	129.5±2 [cd]	347.5±3.5[c]	318.5±2.82[d]	542.5±4.6[c]	480.0±5.23[c]
6		143.6±2.7[b]	129.3±3.1[cd]	337.3±2.7[b]	305.4±3.05[b]	527.4±4.7[b]	463.4±5.8[b]

1.G: Group, 2.W: Week, 3.M: Male, 4.F: Female. 5.S: Sex. Means and Standard Deviations Of Male and Female Partridge Body Weight. The body weight was measured at the 4, 8 and 14 weeks of age in each group.

[a.b.c.d] Different superscripts denote significant differences among means in columns for main effect ($P \leq 0.05$).

Table 3. Mean Feed Consumption in Male and Female Partridge

G[1]		Feed Intake							
	w[2]	4		8		14		0-14	
	S[5]	M[3]	F[4]	M[3]	F[4]	M[3]	F[4]	M[3]	F[4]
1		170.2±1.9 [c]	164±0.5 [c]	367±0.5[d]	360±1[e]	618±3.3[d]	600±3.8[d]	2569±4[e]	2497±8[e]
2		169.5±0.6 [c]	167±0.6 [e]	368±1.7[d]	354±1[d]	639±2.5[f]	622±1.7[f]	2583.5±6[f]	2503±4.8[f]
3		171.9 ±0.9[d]	166.8±0.7 [e]	359±1[b]	344±0.8[b]	605±1.6[c]	588±2[c]	2509±4.6[b]	2452±8[c]
4		168±0.9 [b]	163±0.6 [b]	361±1.7[c]	350±2[c]	596±1.7[b]	582±1.3[b]	2520±7[c]	2446±4[b]
5		161.9±0.9 [a]	158±1 [a]	355.1±1.7[a]	344±0.9[b]	585±2.1[a]	576±2.5[a]	2486±6.6[a]	2419±5[a]
6		171.8±0.7 [d]	165.9±0.9 [d]	355.8±1.9[a]	341±1.5[a]	628±1.5[e]	612±3[e]	2534±5.4[d]	2464±4.7[d]

1.G: Group, 2.W: Week, 3.M: Male, 4.F: Female. 5.S:Sex. Total feed consumption was measured at the 4, 8 and 14 weeks of age in each group.

[a. b. c. d. e. f.] Different superscripts denote significant differences among means in columns for main effect (P ≤ 0.05).

Table 4. Mean Feed Conversion Ratio (FCR) in Male and Female Partridge

G[1]		FCR					
	W[2]	4		8		14	
	S[5]	M[3]	F[4]	M[3]	F[4]	M[3]	F[4]
1		1.69±0.04[c]	1.81±0.02[d]	2.64±0.04[e]	2.81±0.03[e]	4.93±0.04[e]	5.19[c]
2		1.7±0.03[c]	1.88±0.02[e]	2.58±0.01[d]	2.76±0.03[d]	4.94±0.04[e]	5.43±0.07[c]
3		1.7±0.04[c]	1.810.03[d]	2.53±0.01[c]	2.67±0.03[c]	4.76±0.04[c]	5.3±0.06[b]
4		1.63±0.02[b]	1.75±0.03[b]	2.46±0.02[b]	2.6±0.02[b]	4.62±0.04[b]	5±0.05[a]
5		1.57±0.02[a]	1.69±0.02[a]	2.42±0.02[a]	2.55±0.02[a]	4.54±0.03[a]	5±0.05[a]
6		1.67±0.03[c]	1.77±0.03[c]	2.52±0.02[c]	2.7±0.02[c]	4.8±0.04[d]	5.31±0.06[b]

1.G: Group, 2.W: Week, 3.M: Male, 4.F: Female. 5.S: Sex. Total feed consumption was measured at the 4, 8 and 14 weeks of age in each group.

[a. b. c. d. e.] Different superscripts denote significant differences among means in columns for main effect (P ≤ 0.05).

Table 5. Effect of diet containing different CP levels on the blood parameters of chukar partridge

Sex	G	Cholesterol	TG	Glucose	Ca	Phosphorus	Total Protein	Uric Acid
		Mmol/l					Mg/l	µmol/l
M	1	4±0.35	1.6±0.28	16.8±1	2.1±0.09[a]	1.8±0.18[a]	35±0.8[a]	166±5.4
	2	3.9±0.3	1.5±0.12	17.6±0.8	2.1±0.07[ab]	2±0.12[b]	35.1±0.9[a]	171.7±8.3
	3	4±0.43	1.4±0.21	16.4±1	2.2±0.07[b]	2±0.12[b]	37±0.96[b]	170.2±9.5
	4	4±0.35	1.4±0.27	16.8±1.2	2.4±0.11[c]	2.17±0.04[bc]	40±0.89[c]	169.5±6
	5	4±0.44	1.4±0.32	17.2±0.8	2.7±15[d]	2.3±0.14[cd]	40.9±0.97[c]	172.8±7.9
	6	3.9±0.33	1.3±0.17	17.7±0.7	2.7±0.09[d]	2.4±0.12[d]	41.1±0.78[c]	169.5±8.2
F	1	4.1±0.3	1.5±0.15	17±1.15	2.1±0.07[a]	1.95±0.17[a]	34.1±0.89[a]	171.9±7.4
	2	4.1±0.22	1.6±0.43	17.2±1.6	2.1±0.1[a]	2.1±0.12[b]	35.1±0.1[a]	175.4±7
	3	4.1±0.28	1.5±0.12	17.1±1.1	2.2±0.07[a]	2.18±0.12[b]	37.1±0.9[b]	169.5±5.8
	4	4.1±0.27	1.5±0.37	16±1	2.4±0.09[b]	2.18±0.11[b]	40.5±0.83[c]	174±6.8
	5	4.1±0.22	1.5±0.35	17.2±1	2.7±0.12[c]	2.3±0.1[c]	40.8±1.19[c]	173±5.2
	6	4.1±0.3	1.6±0.35	17.5±1.4	2.7±0.13[c]	2.42±0.05[c]	41.5±1[c]	174±7.1

G: Group, TG: Triglyceride, Ca: Calcium; M: Male, F: Female, The blood parameters were measured at 14 weeks of age in each group

[a. b. c. d.] Different superscripts denote significant differences among means in columns for main effect (P ≤ 0.05).

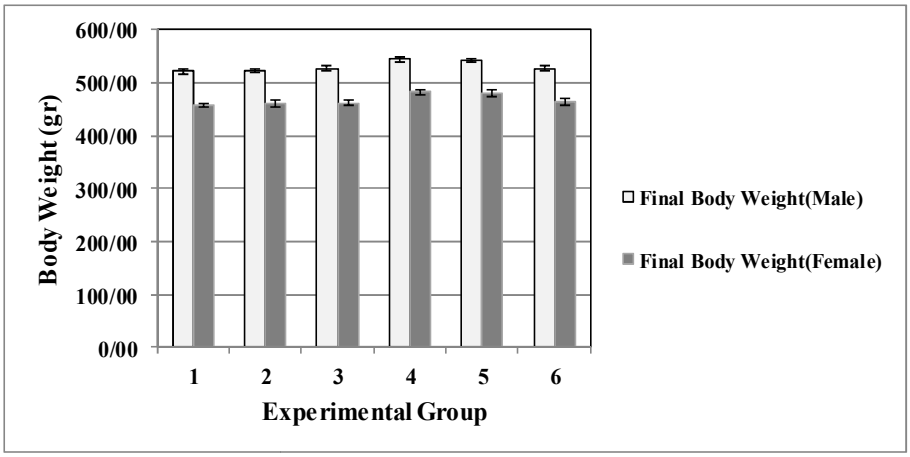

Fig 1. Means and Standard Deviations of final body weighet in the male and female partridges at different experimental groups

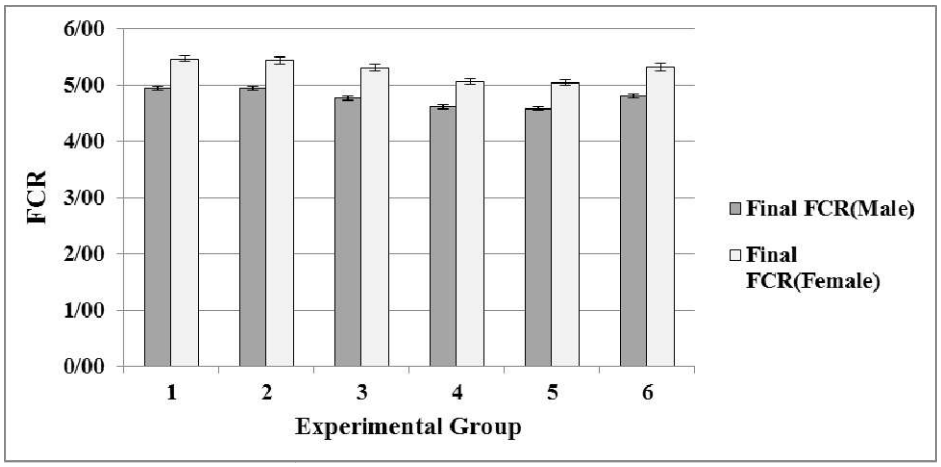

Fig 2. Means and Standard Deviations 0f final FCR in the male and female partridges at different experimental groups.

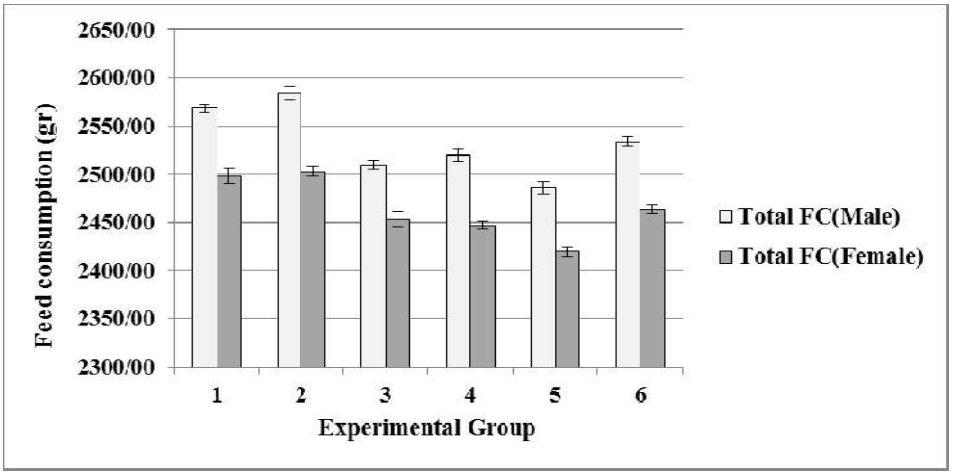

Fig 3. Means and Standard Deviations of final Feed Consumption in the male and female Partridges at different experimental groups

DISCUSSION

The growing desire for partridge meat consumption are going to be increased during these years and it resulted to development of industrial breeding of this species, however most studies designed to

determine a suitable diet for improving male partridge weight gain and growth performance in a short time of growth period and sometimes are different, also there is a large discrepancy between some limited investigations on the blood parameters of chukar partridge when fed on diets containing different levels of crude protein, thus, In this study we have used different levels of protein in diets from 0-14 weeks of age to gain an optimum protein level for male and female partridges in different developmental stage and investigate effect of CP on the blood parameters of chukar partridge.

During starter period the BW of partridge chicks increased from approximately 15 gr at hatching to nearly 140 gr at 4 weeks of age and the BW improved when protein content increased from 200 to 220, 240 and 260(g/kg) and there was no significant difference between BW in these groups, but the lowest food consumption and FCR related to the partridge given a starter diet with 240 (g/kg) CP. It has been shown that poultry fed with reduction protein content about 2 percentage units resulted in better performance than poultry fed diets containing higher protein levels if the low crude protein diets are supplemented with the limiting amino acids (lysine, methionine, and threonine) [8, 9, 10]. Moreover, It has been observed the partridge fed a diet containing less than 240(g/kg) CP consumed lower food and the lowest and highest FC related to the partridges fed the diets containing 240 and 200 (g/kg) protein, respectively [3, 11] and some researcher suggesting 260(g/kg) CP in diet for first 4 week of age [12].

However, BW were not affected by different levels of CP (300gr/kg and 260 gr/kg) but FCR was improved in the partridge fed diet containing 300 gr/kg CP in comparison with low level of CP during 0-4 weeks of age (13). Baldini *et al*. [15] reported Bobwhite quail had good performance on a diet containing 200(g/kg) if dietary lysine was increased to about 13.0 g/kg. It were shown that FC of pheasant had a linear relationship with dietary protein content [15]. The final body weight, feed consumption and FCR of partridges through 0-4 weeks of age were not affected by different crude protein levels [16].

During grower period, the partridge fed a grower diet containing 200 and 220(g/kg) CP obtained the highest body weight but in continuous the lowest food consumption and FCR belonged to the group 5 with 220(g/kg) CP. It has been shown supplemented diet with essential amino acids containing lower than 200(g/kg) CP in comparison with the diets containing 200, 240 and 280(g/kg) CP was not able to improve body weight gain and had higher FCR at 8 weeks of age [11].

However, Blake *et al.* [13] reported during growing period BW were not influenced by different levels of protein (260 gr/kg and 220 gr/kg) but in contrast, FC and FCR were greater in those partridges given diet containing higher protein levels (260 gr/kg). It has been demonstrated that partridge fed diet containing 200 and 280(g/kg) CP could not affect growth performance at the first 8 weeks of age (1, 11, 3).Different CP level during 0-14 week period had significantly effect on final BW, FC and FCR, As the presented in the Table 4.

At the finisher period, the groups fed diet with 180 and 200(g/kg) CP acquired the highest final body weight. At all the lowest final FC and FCR related to the partridge given diets containing 240, 220 and 200(g/kg) CP at starter, grower and finisher period respectively. It has been reported in the 9-16 week of age, the group fed a diet containing 150(g/kg) CP had significantly greater weight gain than the groups given a diets with 175 or 200(g/kg) CP, but at all during 0-16 weeks of age, body weight gain were not affected by different levels of protein [11]. Also Ozek (2006) shown that the partridge given a diet containing 175(g/kg) CP consumed significantly less feed than the group given a diet with 225(g/kg) during 9-16 weeks of age. It were shown the highest growth rate in pheasant was obtained by consumption a grower diet containing 190(g/kg) CP but feeding by a diet containing 220(g/kg) CP had no significant effect on body weight gain [17], also during 8-13 weeks of age by using different levels of CP(220 gr/kg and 180 gr/kg) BW of the partridges were not affected significantly but FC and FCR were improved in the partridges received diet with high levels of protein [13].

Moreover, It has reported pheasant fed on a grower diet containing 160(g/kg) CP had inadequate growth and weaker FCR than the pheasants fed the diet with 190 and 220(g/kg) CP during grower period [18], also Woodard *et al*. [12] reported during the first 14 to 15 weeks of age, the pheasant fed diets containing 200(g/kg) CP or less, had a slow growth rate.

As presented in the tables 2, 3, 4, The BW, FC and FCR were affected by different levels of protein in female partridge such as male partridge and approximately had same pattern but as indicated at Figure 1, 2 and 3, the male partridge significantly were heavier, consumed higher feed and had lower FCR than female for all weeks. Ozek *et al*. [11] shown the carcass weight and weights of all carcass components of male partridges were significantly greater than those of female partridges, but in contrast, It has shown the partridge fed diet containing different levels of CP had no significant effect among male and female partridge from beginning to end of 4 weeks but Male partridges were heavier than females for all weeks [16].

The effect of diet containing different CP levels on the serum parameters are given in table 5, serum parameters were not shown any difference between male and female partridge significantly, also total protein showed no differences by sex [7]. However, Woodard *et al.* [12] reported the serum total protein in female partridge (1 and 7 years of age) was higher than male partridge.

The highest Serum total protein was observed in the partridge given diet containing180, 200 and 220 (g/kg) CP in finisher period. The values of 3 to 5 g/dl of the serum total protein level were reported as normal range in the most birds [20, 21, 22, 23]. Moreover Rodriguez *et al*. [24] reported values of 3.2 g/dl and 3.6 g/dl total protein in male and female 4-month-old red-legged partridges, respectively which is support the findings of present study. Serum total protein of Japanese quails were affected by different crude protein levels and increased when the quails received diet containing higher CP, whiles different levels of ME (11, 11.72, 12.55 MJ ME) had no effect on serum total protein [25]. However, Ozek et al. (2004) obtained that serum total protein was significantly lower in partridge fed a diets containing 240/200 and 280/225 than 200/175 (g/kg) CP (starter/ grower). Serum total protein was decreased when the breeding method and stocking density changed [27] which could be due to stress.

The serum concentration of calcium and phosphorus was increased linearly as the partridges were received diets containing higher CP. The serum calcium level in selected companion avian species has been reported from 8-14 mg/dl (28, 26, 29) also the finding of the present study are in agreement with the results.

Moreover, values of the calcium in combined age (1 and 7 years) in male and female partridge were obtained 12.5 and 13.1 mg/dl respectively (19), but the serum calcium concentration of present study was lower than the results, which could be due to age differences. Also they obtained values of phosphorus concentration 3.3 and 3.8 mg/dl in combined age (1 and 7 years) in male and female partridge respectively, but in contrast, serum phosphorus concentration of the present study was higher than the Woodard *et al*. [12] findings. Mossad and Iben [25] shown that diets containing different levels of CP can affect the serum calcium and phosphorus concentration of Japanese quails and there was a direct relation between CP levels of diets and serum calcium and phosphorus, whereas, serum calcium and phosphorus were not influenced by different level of ME. However, in contrast with this finding, It observed that serum calcium and phosphorus of partridge were not influenced when fed on diets containing different crude protein levels, whereas calcium and phosphorus were affected by different ME [26] which was not in agreement with the present investigation**.**

CONCLUSION

In Conclusion**,** the results of this study indicated that performance of the chukar partridge were influenced by different crud protein levels and adequate growth can be obtained in the chukar partridge when they fed diet with 220-240(g/kg) CP in starter period (0-4 week), 200-220(g/kg) CP in grower period (5-8 week) and 180-200(g/kg) CP in finisher stage (9-14 week), and the male partridges had better growth performance than the females, Also the serum total protein, calcium and phosphorus concentration of partridges were affected by CP and the sex had no significant effect on the serum parameters concentration.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

STATEMENT OF HUMAN AND ANIMAL RIGHTS

All institutional and national guidelines for the care and use of laboratory animals were followed.

REFERENCES

1. Woodard, A.E. (1982) Raising chukar partridges, University of California.
2. Leeson, S., Summers, J.D. (2005) Feeding program for gamebirds, ratites and pet birds. In: Commercial poultry nutrition, Nottingham University Press, Canada, 485-493.
3. Ozek, K. (2006) The Optimum Protein Content in High-Energy Starter Diet for Chukar Partridge (Alertons chukar chukat). Int J Poult Sci 5: 522-525.
4. Arslan, C.P. (2009) Effect of dietary probiotic supplementation on growth performance in the rock partridge (Alectoris graeca). Turk J Vet Anim Sci 28: 887-891.
5. Denton, V., Vohra, P., Woodard, A. (1993) Commercial and ornamental game bird breeders handbook, Surrey, BC, Hancock House, Canada, 272.

6. Hermes, J.C., Woodard, A.E., Vohra, P., Snyder, R.L. (1984) The effect of light intensity, temperature, and diet on growth in Red-Legged partridge. Poultry Sci 63: 871-874.
7. Nazifi, S., Mosleh, N., Ranjbar, V.R., Khordadmehr, M. (2011) Reference Values of Serum Biochemical Parameters in Adult Male and Female Iranian Chukar Partridge (Alectoris Chukar) Australian Journal of Basic and Applied Sciences 5(3): 252-256.
8. Han, Y., Suzuki, H., Parsons, C.M., Baker, D.H. (1992) Amino acid fortification of a low-protein corn and soybean meal diet for chicks. Poultry Sci 71: 1168-1178.
9. Moran, E.T., Bushong, R.D., Bilgili, S.F. (1992) Reducing dietary crude protein for broilers while satisfying amino acid requirements by least-cost formulation: live performance, litter composition, and yield of fast-food carcass cuts at six weeks. Poultry Sci 71: 1687-1694.
10. Kidd, MT., Kerr, B.J., Firman, J.D., Boling, S.D. (1996) Growth and carcass characteristics of broilers fed low-protein, threonine-supplemented diets. J Appl Poultry Res 5: 180-190.
11. Ozek, K., Yazgan, O., Bahtiyarca, Y. (2003) Effects of dietary protein and energy concentrations on performance and carcase characteristics of chukar partridge (Alectoris chukar) raised in captivity. Brit Poultry Sci 44: 419-426.
12. Woodard, A.E., Ernst, R.A., Vohra, P., Nelson, J.R. L., Price, F.C. (1978) Raising game birds. University of California
13. Blake, J.P., Hess, J.B., Berry, W.D. (2013) Effect of 2 protein regimens and 2 lighting intensities on performance of the Hungarian partridge (Perdix perdix). J Appl Poultry Res 22: 365–369.
14. Baldini, JT., Roberts, R.E., Kirkpatrick, C.M. (1953) Low protein rations for the Bobwhite quail. Poultry Sci 32: 945-949.
15. Woodard, A.E., Vohra, P., Snyder, R.L. (1977) Effect of protein levels in the diet on the growth of pheasants. Poultry Sci 56: 1492-1500.
16. Senguf, T., Cetin, M., Soguf, B., Gurbuz, Y. (2006) A Study on Determining Protein Level in Diet of Partridge (Alectoris chukar) During Growing Period (0-4 Wk). Int J Poult Sci 5: 428-431.
17. Cain, J.R., Weber, J.M., Lockamy, T.A., Creger, C.R. (1984) Grower diets and bird density effects on growth and cannibalism in ring-necked pheasants. Poultry Sci 63: 450-457.
18. Cain, J.R., Creger, C.R. (1975) Dietary-protein and pen density effects on pheasants. Poultry Sci 32: 1741.
19. Woodard, A.E., Vohra, P. (1983) Blood Parameters of One-Year-Old and Seven-Year Old Partridges (Alectoris chukar) Poultry Sci 62:2492-2496.
20. Coles, E.H., Campbell, T.W. (1986) Veterinary Clinical Pathology, Saunders, Philadelphia, 279-291.
21. Coleman, S., Fraser, J.D., Scanlon, P.F. (1988) Hematocrit and protein concentration of black vulture and turkey vulture blood. Condor 90: 937-938.
22. Kaneko, J.J., Harvey, J.W., Bruss, M.L. (1997) Clinical biochemistry of domestic animals, Academic, California.
23. Khazraiinia, P., Saei, S., Mohr, Mi., Haddadzadeh, HR., Darvisihha, H.R., Khaki, Z. (2006) Serum biochemistry of ostrich (Striothio camelus) in Iran. Comp Clin Pathol 15: 87-89.
24. Rodríguez, P., Tortosa, F., Millán, J., Gortazar, C. (2004) Plasma chemistry reference values from captive red-legged partridges (Alectoris rufa). Brit Poultry Sci 45: 565-567.
25. Mosaad, G.M.M., Iben, C. (2009) Effect of dietary energy and protein levels on growth performance, carcass yield and some blood constituents of Japanese quails (Coturnix coturnix Japonica). Die Bodenkultur 60 (4).
26. Ozek, K., Bahtiyarca, Y. (2004) Effects of sex and protein and energy levels in the diet on the blood parameters of the chukar partridges (Alectoris chukar). Brit Poultry Sci 45: 290-293.
27. Ozbey, O., Esen, F. (2007) The effects of breeding systems and stocking density on some blood parameters of rock partridges (Alectoris graeca). Poultry Sci 86: 420-422.
28. Harr, K.E. (2002) Clinical chemistry of companion avian species: A review. Vet Clin Path 31: 140-151.
29. Suchy, P., Strakova, E., Kroupa, L., Steinhauser, L., Herzig, I. (2010) Values of selected biochemical and mineral metabolism indicators in feathered game. Acta Veterinaria Brno 79: S9-S12.