



Effects of Different Levels of Dietary Metabolisable Energy and Crude Protein on Performance and Carcase Characteristics of Chukar Partridge (*Alectoris chukar*) During Growing Period (8-16 week)

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Abstract: This study was conducted to determine the effects of grower diet with differing Crude Protein (CP) and Metabolisable Energy (ME) levels on the Body Weight (BW), Live Weight Gain (LWG), Feed Consumption (FC), Feed Conversion Ratio (FCR) and carcase characteristics of Chukar Partridge raised in captivity. Chukar Partridges were fed on grower diets containing 3 levels of CP (14, 16 and 18%) and 3 levels of ME (2800, 3000 and 3200 Kcal kg⁻¹) from 8-16 weeks of age. There were no significant effects of ME and CP on BW and LWG at 16 weeks of age. The FC and FCR for 8-16 weeks period were not affected by dietary CP levels. But the daily mean FC and FCR decreased when the ME level of grower diet increased, the lowest FC and FCR were in partridges fed on a diet containing 3200 Kcal kg⁻¹ ME. The carcase and breast+back weights of male partridges affected by dietary ME levels, the lowest carcase and breast+back weights of male partridges were in groups fed on a diet containing 3000 Kcal kg⁻¹ ME. Weights of all carcase components of the male partridges were greater than those of the carcase components of the females. There were no significant interaction between CP and ME levels on BW, LWG, FC, FCR and carcase characteristics. It is concluded that the grower diet for chukar partridge raised for meat production should contain at least 14% CP and 2800 Kcal kg⁻¹ ME.

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INTRODUCTION

The nutritive value of partridge meat is high, because per 100 g of it contains 44.2 MJ gross energy, 24 g crude protein, 4 g fat and 1.5 g minerals. Although, replacement of broiler meat with partridge meat in food basket of people seems unlikely and optimistic, but diversity of provide sources of human protein requirements justify

industrial breeding of this bird. Besides the breeding and duplication of partridge, protect its genetic resources. Moreover improve tourism by freeing it, in nature and attracting hunting enthusiastic people from all around the global.

Very little information is available on protein, energy and other nutrient requirements of chukar partridge. For this reason, nutrients requirements of chukar have been

adjusted according to pheasant and other game birds by grower. However these requirements may not be optimum for partridge. The main factors determining the production cost of partridge are growth rate and feed cost per unit of growth. Energy alone contributes to about 70% of the total cost of poultry diets (Skinner *et al.*, 1992). Since, protein is the most costly ingredient in diets, saving can be made by using diets with optimum energy and protein (Vohra, 1993). In leaflet "Raising chukar partridge" Woodard (1982) recommended that protein and energy contents of starter (0-8 weeks period) and grower (8-16 weeks period) diets for chukar should be 25% CP and 2800 Kcal kg⁻¹ ME and 20% CP and 2700 Kcal kg⁻¹ ME, respectively. Woodard *et al.* (1993) recommended that game bird should be fed on a starter diet containing 28% CP, 2900 Kcal g⁻¹ ME and grower diet containing 20% CP, 2900 Kcal kg⁻¹ ME. Ozek *et al.* (2003) recommended that starter diet for chukar raised for meat production should be contain at least 20% CP, 2800 Kcal Kg⁻¹ ME and grower diet should be contain 15% CP and 3000 Kcal Kg⁻¹ ME. Ozek (2004) concluded that the energy level from 2700-2800 Kcal kg⁻¹ ME is used in partridge starter diets. Turgu *et al.* reported that using high level of CP in partridge diet is not necessary and 24% CP is good enough for first 4 week of age. Ozek (2006) reported that the best of performance were observed in partridges fed 24% CP from hatch to 8 weeks of age. Gertonson *et al.* (1974) reported that the mean carcass weights of male and female chukar at 16 weeks of age were 459 and 386 g, respectively. Ozek *et al.* (2003)

reported that weights of all carcass components of male partridges were greater than those of the carcass components of the females.

The purpose this study was to determine the effects of different levels of dietary metabolisable energy and Crude protein on Body Weight (BW), Live Weight Gain (LWG), Feed Consumption (FC), Feed Conversion Ratio (FCR) and carcass components of chukar partridge (*Alectoris chukar*) during growing period.

MATERIALS AND METHODS

This study was carried at Animal Science Research Institute of Iran. A total of 270 8-weeks-old chukar chicks were used in this study. They were kept in one-deck cages from 8-16 weeks of age. Bird density in each cage was 100 cm²/bird. They were fed on a starter diet containing 20% CP and 2800 Kcal kg⁻¹ ME. The breeding of chukar chicks was done in standard condition with respect to temperature, humidity, light and ventilation. Feed and water consumed *ad libitum* by the birds.

Formulation and composition of the grower diets used in this study are given in Table 1. The grower diets contained 3 levels of CP (14, 16 and 18%) and 3 levels of ME (2800, 3000 and 3200 Kcal kg⁻¹). All diets formulation to contain 1% lysine, 0.45% methionine and 0.8% methionine+cystine. Maize, soybean meal, wheat bran and fish meal analyzed for crude protein, crude fat, dry matter, calcium and phosphorus.

Table 1: Composition of the grower diets (%)

Parameters	Grower diets								
	1	2	3	4	5	6	7	8	9
Ingredients									
Maize	66.55	70.0	69.02	64.03	68.03	63.74	61.52	62.86	58.47
Soybean meal	11.08	12.8	13.97	16.18	18.08	18.73	21.27	22.73	23.49
Wheat bran	14.65	7.91	5.00	12.28	5.00	5.00	9.88	5.00	5.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Vegetable fat	1.00	2.51	5.22	1.00	2.33	5.97	1.00	3.08	6.72
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dicalcium phosphate	1.25	1.29	1.31	1.22	1.25	1.26	1.21	1.21	1.21
Limestone	1.04	1.03	1.02	1.03	1.02	1.02	1.02	1.02	1.01
DL-methionine	0.23	0.27	0.29	0.20	0.25	0.25	0.20	0.20	0.21
L-lysine	0.45	0.44	0.42	0.31	0.29	0.28	0.15	0.15	0.14
Vitamin mix ^a	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral mix ^b	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated composition									
ME (Kcal kg ⁻¹)	28.00	30.00	32.00	28.00	30.00	32.00	28.00	30.00	32.00
Crude protein	14.00	14.00	14.00	16.00	16.00	16.00	18.00	18.00	18.00
Calcium	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Available phosphorus	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Methionine	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Methionine-cystine	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Lysine	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

^aVitamin mix supplied (per kg diet): vitamin A, 1,000 IU; vitamin D₃, 3,500 IU; vitamin E, 100 mg; vitamin K₃, 3 mg; vitamin B₁, 3 mg; vitamin B₂, 6 mg; vitamin B₆, 5 mg; vitamin B₁₂, 0.03 mg; niacin, 45 mg; calcium pantothenate, 15 mg; folic acid, 1 mg; biotin, 0.15 mg; ethoxyquin (antioxidant), 150 mg. ^bTrace mineral mix supplied (mg/kg diet): iron, 60; manganese, 100; zinc, 60; copper, 5; iodine, 2; cobalt, 0.2; selenium, 0.15; choline chloride, 400

Nine grower diets were arranged in 3×3 factorial design with 3 levels of CP and 3 levels of ME. There were three replications in each treatment and 10 chukar chicks (5 male and 5 female) in each replicate. The chukar chicks were weighted at 8, 10, 12, 14 and 16 weeks of age. Feed consumption was obtained for 8-10, 10-12, 12-14 and 14-16 week period and then daily FC, LWG and FCR were calculated from these data for grower period (8-16 weeks). Two partridge of each sex in each replicate were slaughtered at 16 weeks of age for determination of carcass characteristics. Each carcass was eviscerated by splitting down the back, removing the viscera including crop and esophagus. The carcass divided into its components (breast+back, rump, wings, neck and gible) and those components were weighted.

Measurements of BW, LWG, FCR and daily FC were subjected to analysis of variance for a completely randomized 3×3 factorial design that included the 3 levels of CP and 3 levels of ME, using ANOVA-General Linear Model (Minitab, 1990). The data on carcass characteristics were analyzed according to a 3×3×2 factorial design that included 3 levels of CP, 3 levels of ME and 2 sexes. Significant differences between treatment means were identified by Duncan's multiple-range test (Duncan, 1955) with 5% probability.

RESULTS AND DISCUSSION

The results of performance and carcass characteristics in the present trial were presented in

Table 2 and 3, respectively. The final BW and LWG were not affected by both CP and ME levels of the grower diet for 9-16 weeks period. The results of BW are in agreement with results obtained by Ozek *et al.* (2003) for chukar and Vohra (1973) for chukar and quail, but the results of effects of protein on LWG of this study are not in agreement with results obtained by Ozek *et al.* (2003) and Vohra (1973). They found that LWG of chukar, affected by CP levels of grower diets. The present study has shown that grower diet containing 14% CP and 2800 Kcal kg⁻¹ ME was adequate for chukar. The daily mean FC decreased when the ME levels of grower diet increased, the lowest and highest FC were in partridges fed on a diet containing 3200 and 2800 Kcal kg⁻¹ ME, respectively. Similar results were reported for chukar by Ozek *et al.* (2003). CP levels of grower diet did not change (p<0.05) daily mean FC for the 8-16 week period. This finding is not in agreement with result obtained by Ozek *et al.* (2003), they reported that the daily mean FC was affected by CP levels of the grower diets. During the grower period, FCR was affected by ME levels of the grower diet. Although the FCR of birds given a diet containing 3200 Kcal kg⁻¹ ME was lowest (p<0.05) than the other ME groups during the grower period. According to these results, Ozek *et al.* (2003) and Cain *et al.* (1984) reported that the energy levels of grower diets were increased FCR of chukar and pheasant. Additionally, statistical analysis of FCR in different treatments during different weeks, exhibited the fact that a diet containing 3200 Kcal kg⁻¹ ME can cause the FCR to fall in the last 4 week of the growing period. These observation lead us to this idea

Table 2: Body weights, live weight gains, daily means feed intake and feed conversion ratio of chukar partridges of mixed sexes fed diet with different protein and energy levels during growing period

Weeks	Protein levels (%)				Energy levels (Kcal kg ⁻¹)				SEM
	14	16	18	p-values	2800	3000	3200	p-values	
Body weight (g)									
8	268.1	268.6	268.6	0.221	268.5	268.2	268.5	0.538	0.13
10	339.0	339.6	339.6	0.981	340.4	338.1	339.7	0.809	1.29
12	398.6	400.9	398.8	0.790	400.6	394.3	403.4	0.068	1.53
14	446.6	444.7	441.7	0.607	444.0 ^{ab}	437.6 ^b	451.3 ^a	0.040	2.09
16	479.6	475.4	473.2	0.531	475.6	468.8	483.7	0.056	2.39
Live weight gain (g)									
8-10	70.9	74.4	70.9	0.240	71.9	69.9	74.5	0.164	0.97
10-12	59.6	58.0	59.2	0.825	60.2	56.2	60.4	0.304	1.10
12-14	48.0	43.8	42.7	0.069	43.4	43.3	47.8	0.102	1.03
14-16	33.0	30.7	31.6	0.626	31.6	31.3	32.5	0.682	0.94
8-16	211.5	206.9	204.5	0.471	207.1	200.7	215.2	0.062	2.37
Daily mean feed consumption (g)									
8-10	25.7	25.3	25.5	0.940	26.6	24.7	25.2	0.153	0.38
10-12	28.2	28.8	28.1	0.781	29.6	27.4	28.1	0.151	0.42
12-14	29.9	30.5	29.3	0.476	30.1 ^a	30.1 ^a	27.6 ^b	0.001	0.52
14-16	31.7	30.6	31.6	0.879	33.1	32.7	28.2	0.074	0.87
8-16	28.9	28.8	28.6	0.913	30.3 ^a	28.7 ^b	27.3 ^c	0.001	0.33
Feed conversion ratio									
8-10	5.09	4.78	5.04	0.181	5.20	4.95	4.76	0.059	0.08
10-12	6.64	7.01	6.68	0.198	6.92	6.86	6.54	0.193	0.09
12-14	8.82 ^b	9.83 ^a	9.75 ^a	0.030	10.38 ^a	9.87 ^a	8.14 ^b	<0.001	0.25
14-16	13.47	14.14	14.02	0.266	14.74 ^a	14.68 ^a	12.22 ^b	<0.001	0.30
8-16	8.22	7.84	7.87	0.094	8.22 ^a	8.03 ^a	7.11 ^b	<0.001	0.03

^{a,b}Treatment means within each part of a row with superscripts differ significantly

Table 3: Carcase characteristics of chukar partridges fed diet with different protein and energy levels during growing period

Carcase components	Protein levels (%)			p-values	Energy levels (Kcal kg ⁻¹)			p-values	SEM
	14	16	18		2800	3000	3200		
Weights of carcase components of male chukar partridges (g)									
Carcase	383.7	383.1	377.9	0.454	380.7 ^{ab}	375.2 ^b	388.8 ^a	0.041	2.12
Breast+back	172.8	172.6	171.9	0.935	171.3 ^{ab}	168.8 ^b	177.3 ^a	0.009	1.15
Rump	137.8	138	135.4	0.437	137.1	135.4	138.7	0.343	0.85
Wings	44.7	44.4	43.4	0.582	44.5	42.9	45.1	0.235	0.51
Neck	28.4	28.2	27.2	0.797	27.9	28.1	27.7	0.983	0.64
Giblet	22.6	22.4	21.6	0.383	22.2	21.7	22.8	0.408	0.30
Weights of carcase components of female chukar partridges (g)									
Carcase	318.7	317.1	314.8	0.576	318.8	311.5	320.2	0.059	1.59
Breast+back	143.7	144	142.7	0.882	143.7	140.5	145.4	0.107	0.93
Rump	114.3	114.7	112.5	0.380	114.4	112.1	115.1	0.199	0.71
Wings	37.1	36.7	36.7	0.916	37.9	35.8	36.8	0.092	0.39
Neck	23.6	22.8	22.9	0.878	23.0	23.4	22.9	0.964	0.56
Giblet	18.8	18.6	18.1	0.629	18.5	18.3	18.7	0.804	0.25

^{a,b}Treatment means within each part of a row with superscripts differ significantly

that may be divide the growing period of chukar partridge to 2 periods (8-12 and 12-16 week periods) and select the most appropriate ME level of diet for each period. The FCR of treatments for the 8 to 16 week period was not affected by CP levels. These findings are not in agreement with results obtained by Ozek *et al.* (2003), they found that during the grower period FCR was affected by CP concentration of the diet. There was a significant effect of the ME concentration of the diet on carcase and breast+back weights of the male partridges, the lowest carcase and breast+back weights of male partridge were in groups fed on a diet containing 3000 Kcal kg⁻¹ ME. The carcase characteristics of male partridges were not affected (p<0.05) by the CP levels of diets. The carcase characteristics of female partridges were not affected (p<0.05) by both CP and ME levels of diets. Weights of all carcase components of the male partridges were greater (p<0.05) than those of the carcase components of the females. Similar results were reported for chukar by Ozek *et al.* (2003). There were no significant interaction between CP and ME levels on BW, LWG, FC, FCR and carcase characteristics. Mortality was not influenced by CP and ME concentration. Average mortality for the 9-16 week period was 1.85%.

CONCLUSION

The results of this study indicate that when supplemented with synthetic amino acids, grower diet for partridges raised for meat should contain at least 14% CP and 2800 Kcal kg⁻¹ ME. However, according to the results of this present experiment, the diet containing 3200 Kcal kg⁻¹ ME decreased FCR of chukar during the last 4 week of growing period. Therefore

suggest that attention to the FCR of chukar and cost of dietary energy, determine the most expensive diet for last 4 week of growing period. Because the weight of carcase and carcase components of male partridges were greater than the weight of carcase and carcase components of female partridges, male partridges are more suited to meat production.

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