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Annals of Biological Research, 2011, 2 (1) :149-155
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Effect of varying dietary energy to protein ratio on productive performance and carcass characteristics of Japanese quail

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ABSTRACT

The present study was conducted to determine the optimum of energy to protein ratio on performance and carcass characteristics of Japanese quails from 0 to 21d (starter) and from 21 to 45d (finisher) of age. Two hundred and fifty-two Japanese quails (1-day-old) were used in this experiment. The quails fed with one level of metabolizable energy (ME) 2900 kcal/kg, and three levels of crude protein (CP) include 21, 24 and 27%. Diets fed to birds from 0 to 45d of age. The quails were randomly divided into 36 replicate of 7 chicks each and there were 4 replicates under each diet (9 experimental treatments). Average feed intake (AFI), Feed conversion ratio (FCR) and Average body weight (ABW) were recorded in each period (starter and finisher). AFI and FCR were significant ($P < 0.05$) during starter phase. Effects of different ratio of ME:CP on AFI, ABW and FCR in during the period 0 to 45d were significant differences ($P < 0.05$). Statistically significant differences were found in the percent of breast, legs and back bone ($P < 0.05$). Therefore the result of this experiment suggested that it can be using the diets with 107 ME:CP (for starter diets) and 120 ME:CP (for finisher diets) in Japanese quail to obtain the best performance.

Key words: ME:CP ratio, Carcass characteristics, Growth performance, Japanese quail. Feed conversion ratio.

Abbreviations: *ME, metabolizable energy; CP, crude protein; AFI, average feed intake; FCR, feed conversion ratio; ABW, average body weight.*

INTRODUCTION

The energy and protein requirements as well as the efficiency of feed utilization are still poorly documented, especially for quails. Generally, the energy and protein requirement for this category of poultry were considered to be similar to those farm poultry, especially hens [1]. Japanese quails (Coturnix coturnix japonica) are, in addition to being raised for the purpose of producing eggs and meat, found useful as experimental animals because are small, arrive at puberty early, have a high breeding efficiency and are easily raised. The quail prefers and requires a high protein diet for optimum growth and reproduction [2].

Feeding cost for poultry is usually considered the most expensive item, especially dietary protein sources. Protein are not alike, they vary according to their origin (animal, vegetable), their amino acid composition (particularly their relative content of essential amino acids), their digestibility and texture. Japanese quails, as such as other poultry, require certain minimal quantities of amino acids from a biologically available source as part of a large protein nitrogen intake. The required amounts of these amino acids vary with age, physiological condition and state of health [3]. It is well known that dietary protein level influences the body growth and composition of domestic fowl [4]. Several reports indicated that starter diets for quail should contain protein content of 24% this may become 20% at several weeks later [5]. Panda and Shrivastav [6] indicated slightly higher dietary requirements of 27% protein for starting quail, a content that may be reduced to 24% after three weeks of age [7]. It is reasonable to suppose that amino acid inadequacy and stress caused by the environmental temperature could explain the increased requirement. Also, level of 24 percent of crude protein is recommended for Japanese quails in the rearing period [8]. Among diet nutrients, protein has the highest heat increment; thus, during many years, diets with low protein level were recommended in order to reduce heat production in broiler chickens under heat stress. However, reports have shown that low protein diets have negative effects on broiler performance when environmental temperature is high, because during heat stress, low food intakes associated to a low diet protein induce amino acid deficiencies [9].

This study is therefore aimed to evaluate metabolizable energy to protein ratio on the performance and carcass characteristics of Japanese quail in the starting (0 - 21 days) and finishing (22 - 45 days) periods.

MATERIALS AND METHODS

2.1. Birds and diets

The study included Two hundred and fifty-two Japanese quails (1-day-old) that were randomly allocated to 9 experimental treatments. Commercial male, day-old Japanese quails were assigned into 36 separate floor pens (40 cm × 40 cm) with 7 birds per pen. The quails were randomly divided into 36 replicate (nine treatments) and there were 4 replicates under each diet. The experiment was terminated at 45 days of quail age. All quails received commercial quail diets, one diet from 0 to 21 days, the other from 22 to 45 days of age. The composition of feed mixtures and experimental treatments is given in Table 1 and 2. All birds were kept under similar and standard environmental, hygienic and managerial conditions according to the National Research Council (NRC, 1994) Care Guidelines. Experimental diets with 21, 24 and 27% of crude protein and 2900 kcal/kg of metabolizable energy were fed ad libitum during two periods (0 to 21 and 22 to 45d) (Table 1).

2.2. Measurements and determinations

The amount of the feed intake and the average weight of the quails at the age of (0 to 21d) and (22 to 45d) as well as feed conversion ratio (FCR) and the average body weight for every repetition were calculated. At the end of period, 1 quails from each pen with a weight near to the average weight of their group were selected, weighed and slaughtered. The weight of the carcass, breast, legs, back bone, wings and neck of each quail was measured separately [10].

2.3. Statistical analysis

Data were analyzed by the ANOVA option of the GLM of SAS/STAT software as a completely randomized design of dietary treatment. The treatment comparison test by Duncan test method and was statistically analyzed by the same software [11].

RESULTS AND DISCUSSION

Average feed intake, average body weight and feed conversion ratio and carcass composition data are shown in Table 3 and 4.

3.1. Average feed intake

Average Feed intake was significant difference ($P \leq 0.05$) during starter and finisher periods. The AFI increased at the quails fed with diets containing low crude protein (with high ME:CP ratio) than that diets containing high crude protein (with low ME:CP ratio) in the starter period. The lowest AFI was stated with 463.27g in the finisher period (ME:CP ratio = 120). Maximum AFI in quails fed with ME:CP ratio (ME:CP ratio =138 in starter period, ME:CP ratio =138 in finisher period) and minimum AFI with ME:CP ratio (ME:CP ratio =120 in starter period, ME:CP ratio =120 in finisher period) was observed during the whole rearing period. Bregendhal et al., [12] reported that increasing dietary crude protein decreased the feed intake. Holsheimer et al., [13] showed that the feed intake affected by ME:CP ratio in diet and decreased feed intake in birds fed with normal ME:CP ratio. The results of the present study are in close agreement with those of Nahashon et al., [14] who reported that decreased feed intake with increase in dietary crude protein.

3.2. Average weight gain

There are not significant differences in the average body weight ($P \geq 0.05$) of quails in the starter period (0 to 21 days), but Significant differences were found ($P \leq 0.05$) in the finisher and whole rearing periods. The greatest body weight was observed in quails fed with ME:CP ratio (ME:CP ratio =120 in starter period, ME:CP ratio =120 in finisher period) in the whole rearing period. These findings corroborate results of other studies of [12, 15, 16]. The results of the present study are in close agreement with those of Tarasewicz et al., [17] who found that when lowering fodder protein level and maintaining a similar level of lysine and methionine, a lower body weight, by 4.4 - 4.7%, was observed in the quails of 29 to 43 days. The results are in agreement of the findings of Han et al., [18] who observed that growth depression due to low protein diets may be due to low amino acid profile of such diets. Crude protein levels had no effect on feed intake; nevertheless, body weight and feed conversion were impaired with decreasing protein levels in the diet and not significant effect between dietary CP concentration and FCR [19]. The result of obtained in this experiment was similar with results some authors [15, 19, 20]

Table 1 Ingredients and chemical composition of the experimental diets.

	Protein (%)		
Ingredient (%)	21	24	27
Corn	61.05	51.84	38.85
Soybean meal	29.70	26.63	36.25
Fish meal	5.00	8.00	8.00
Poultry meat meal	0.40	8.00	8.00
vegetable Fat	0.01	1.24	3.58
Limestone	0.50	1.20	1.48
Di-calcium phosphate	1.60	1.50	1.82
Mineral premix	0.30	0.30	0.30
Vitamin premix	0.30	0.30	0.30
Common salt	0.25	0.27	0.34
DL-methionine	0.17	0.007	-
L-lysine HCL	-	-	0.08
Vitamin A	0.10	0.10	0.10
Vitamin E	0.20	0.20	0.20
Vitamin K	0.10	0.10	0.10
Vitamin D	0.10	0.10	0.10
Vitamin B	0.20	0.20	0.20
Chemical composition			
Metabolizable energy (Kcal/kg)	2900	2900	2900
Crude protein (%)	21	24	27
Crude fibre (%)	3.47	3.20	3.59
Linileic acid (%)	1.48	2.08	3.14
Calcium (%)	0.80	1.31	1.50
Availability P (%)	0.55	0.72	0.80
Sodium (%)	0.15	0.20	0.23
Arg (%)	1.37	0.65	0.90
Lys (%)	1.37	1.50	1.72
Met (%)	0.55	0.50	0.60
Met + Cys (%)	0.89	0.89	0.96
Thr (%)	1.20	1.03	1.13
Trp (%)	0.29	0.32	0.38

Table 2 Experimental treatments

T1	138 (ME:CP ratio in starter diets) and 138 (ME:CP ratio in finisher diets)
T2	138 (ME:CP ratio in starter diets) and 120 (ME:CP ratio in finisher diets)
T3	138 (ME:CP ratio in starter diets) and 107 (ME:CP ratio in finisher diets)
T4	120 (ME:CP ratio in starter diets) and 138 (ME:CP ratio in finisher diets)
T5	120 (ME:CP ratio in starter diets) and 120 (ME:CP ratio in finisher diets)
T6	120 (ME:CP ratio in starter diets) and 107 (ME:CP ratio in finisher diets)
T7	107 (ME:CP ratio in starter diets) and 138 (ME:CP ratio in finisher diets)
T8	107 (ME:CP ratio in starter diets) and 120 (ME:CP ratio in finisher diets)
T9	107 (ME:CP ratio in starter diets) and 107 (ME:CP ratio in finisher diets)

3.3. Feed conversion ratio (FCR)

A statistically significant difference was found in the feed conversion ratio at the starter, finisher and whole rearing periods ($P \leq 0.05$). The birds fed with diets containing high crude protein (with low ME:CP ratio) had better feed conversion ratio than those fed with other diets. Improved FCR was observed in quails fed with ME:CP ratio ((ME:CP ratio =107 in starter period, ME:CP ratio =120 in finisher period) during whole rearing period. Sterling et al., [15] reported chicks fed the 26% CP diet with 1.1% lysine consumed less feed and had a lower FCR when compared with chicks fed the 23% CP diet with 1.1% lysine.

3.4. Carcass characteristics

A statistically significant difference was found in the carcass yield between the treatments ($P \leq 0.05$). The greatest of carcass yield was found in the quails with highest body weight. The treatments 8 and 1 with 73.03% and 69.43% had to highest and lowest carcass yield, respectively. The quails fed with diets containing low crude protein (high ME:CP ratio) had lowest carcass yield than those fed with other diets. The percent of breast, legs and back bone between treatments were statistically significant ($P \leq 0.05$). These differences in the percentage of neck and wings between treatments were not statistically significant ($P \geq 0.05$). The quails with higher carcass yield had to better breast meat. The highest and lowest percent of breast observed in 8 and 1 treatments, respectively. Faria filho [19] reported that dietary protein levels reduction from 7 to 21 days of age contributed to lower nitrogen excretion, however, impaired performance, yield and commercial cuts composition in broiler chickens, independent of the rearing temperature.

Table 3 Comparison of (mean±SD) Japanese quail performance in during starter, finisher and whole rearing periods

Parameters[1]	Treatments 1	2	3	4	5	6	7	8	9
ME:CP ratio									
Starter	138	138	138	120	120	120	107	107	107
finisher	138	120	107	138	120	107	138	120	107
AFI									
Starter	220.97^{a} ± 16.96	212.98^{ab} ±18.24	226.67^{a} ±24.80	196.61^{bc} ±10.66	189.24^{bc} ±1.03	193.04^{bc} ±23.20	176.16^{c} ±17.78	180.47^{c} ±6.03	192.40^{bc} ±5.64
finisher	467.62^{ab} ±18.67	469.7^{ab} ±18.31	471.73^{ab} ±33.20	522.98^{a} ±9.77	463.27^{b} ±56.60	501.87^{ab} ±42.10	499.80^{ab} ±17.37	478.98^{ab} ±20.10	504.49^{ab} ±41.60
Whole period	714.31^{a} ±12.00	680.14^{ab} ±19.00	698.40^{ab} ±41.3	719.59^{a} ±16.45	647.64^{b} ±54.2	692.41^{ab} ±54.3	674.36^{ab} ±36.2	649.04^{b} ±29.1	694.10^{ab} ±37.1
ABW									
Starter	117.11 ±6.70	115.79 ±10.31	119.95 ±16.32	119.08 ±5.90	117.48 ±16.32	118.93 ±9.41	108.97 ±13.57	123.12 ±12.73	125.18 ±2.70
finisher	246.73^{b} ±9.38	259.32^{ab} ±13.77	252.29^{ab} ±20.6	254.96^{ba} ±11.30	260.91^{ab} ±21.10	268.96^{ab} ±14.52	239.76^{b} ±22.5	276.31^{a} ±20.6	264.86^{ab} ±19.40
Whole period	243.17^{c} ±7.60	257.63^{abc} ±12.20	252.29^{abc} ±20.6	254.96^{abc} ±11.30	256.67^{abc} ±19.43	267.71^{ab} ±16.74	239.32^{c} ±23.3	273.83^{a} ±17.31	263.55^{abc} ±17.98
FCR									
Starter	2.00^{a} ±0.07	1.97^{ab} ±0.17	2.01^{a} ±0.09	1.75^{cd} ±0.01	1.82^{bc} ±0.14	1.72^{cde} ±0.13	1.73^{cde} ±0.76	1.56^{e} ±0.13	1.63d^{e} ±0.66
finisher	3.96^{a} ±0.25	3.32^{c} ±0.22	3.62^{abc} ±0.48	3.85^{ab} ±0.29	3.18^{c} ±0.27	3.41^{abc} ±0.62	3.85^{ab} ±0.37	3.18^{c} ±0.24	3.63^{abc} ±0.20
Whole period	3.03^{a} ±0.14	2.72^{bdc} ±0.09	2.85^{bac} ±0.15	2.90^{ba} ±0.08	2.59^{dc} ±0.9	2.67^{bdc} ±0.35	2.92^{ba} ±0.19	2.44^{d} ±0.18	2.71^{bdc} ±0.08

[abcd]*Means with different letters on the same row implies significant differences ($p < 0.05$).*

[1]*MFI: mean feed intake; MBW: mean body weight; FCR: feed conversion ratio.*

Table 4 Comparison of (mean±SD) carcass characteristics and organs of Japanese quail

	treatments								
Parameters[1]	1	2	3	4	5	6	7	8	9
Carcass	69.43^{c}	71.36^{ab}	72.10^{ab}	69.48^{c}	72.48^{a}	71.58^{ab}	70.48^{bc}	73.03^{a}	72.36b^{a}
	±1.66	±0.64	±0.89	±1.12	±0.48	±0.59	±1.09	±1.59	±1.69
Breast	36.09^{d}	37.06^{ab}	36.74^{bcd}	36.24^{cd}	37.44^{a}	36.72^{bcd}	36.36^{cd}	37.52^{a}	36.87^{abc}
	±0.53	±0.14	±0.41	±0.67	±0.60	±0.20	±0.29	±0.38	±0.24
Legs	26.23^{abc}	25.85^{bcd}	25.48^{d}	26.40^{a}	25.58^{d}	25.79^{cd}	26.31^{ab}	25.50^{d}	25.80^{cd}
	±0.31	±0.41	±0.25	±0.43	±0.34	±0.36	±0.24	±0.17	±0.15
Back bone	22.90^{a}	22.13^{ab}	21.41^{b}	22.81^{a}	21.07^{b}	21.77^{ab}	22.71^{a}	20.91^{b}	21.48^{b}
	±0.32	±0.56	±0.71	±0.34	±0.64	±0.54	±0.68	±1.61	±0.59
Wings	6.84	7.16	7.00	6.90	7.07	6.93	6.83	7.45	6.89
	±0.19	±0.34	±0.39	±0.22	±0.53	±0.18	±0.20	±0.70	±0.53
Neck	7.72	7.15	7.57	7.61	7.13	7.22	7.44	7.20	7.11
	±0.30	±0.56	±0.39	±0.22	±0.37	±0.46	±0.24	±0.34	±0.25

^{abcd}Means with different letters on the same row implies significant differences ($p < 0.05$).
[1]MFI: mean feed intake; MBW: mean body weight; FCR: feed conversion ratio.

The results of the present study are agreement with findings of Corrêa et al., [21] who found that reported that while body weight and carcass and breast weights were linearly affected and a significant crude protein level sex interaction was observed for breast yield, females showing linear response in function of crude protein level, while no effect on male breast yield was observed. Tarasewicz et al., [17] was found that a lowered level of protein in fodder did not affect quail body weight, slaughter yield, or breast part and leg participation in body weight. The results are in agreement of the findings of Salmon et al., [22] who showed that birds fed low-protein diets in the initial phase had lower breast yield at 42, 49 and 56 days of age.

CONCLUSION

Therefore the result of this experiment suggested that it can be using the diets with 107 ME:CP ratio (for starter diets) and 120 ME:CP ratio (for finisher diets) in Japanese quail to obtain the best performance.

Acknowledgment
This research was carried out as M.Sc thesis in 2009 in Islamic Azad University - Qaemshahr Branch, Qaemshahr – Iran. The authors are grateful to the laboratories of Animal Science Qaemshahr University.

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