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Crude Protein and Energy Requirements of Japanese Quail (*Coturnix coturnix japonica*) During Rearing Period

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ABSTRACT

Present experiment was conducted to evaluate the effect of diets containing different levels of metabolizable energy (3000, 3100 and 3200 kcal metabolizable energy/kg) and crude protein (20, 22, 24 and 26% crude protein) on performance of growing Japanese quail. 288 two-week old quail chicks were assigned into 12 treatments and 3 replicates with 8 birds in each. Birds were randomly allocated to each dietary treatment. For 3000, 3100 and 3200 kcal metabolizable energy/kg levels of energy, crude protein levels of 26, 24, 22 and 20% were assigned. Data on performance and nutrient digestibility were recorded and analyzed using a completely randomized design with a 4×3 factorial arrangement during 6 weeks of age. Metabolizable energy significantly affected ($P < 0.05$) total and daily feed intake. Level of crude protein also had a significant effect on the crude protein intake and protein efficiency ratio of growing Japanese quails. Level of crude protein and metabolizable energy had no significant effect on the body weight gain. The metabolizable energy significantly affected ($P < 0.05$) the ether extract digestibility while crude protein significantly affected ash digestibility. The results indicated that a diet of 26% crude protein and 3200 kcal metabolizable energy/kg is suitable for optimum performance of Japanese quail in terms of weight gain.

Keywords: Japanese quail, Crude protein, Metabolizable energy, Digestibility, Performance

INTRODUCTION

One way of increasing the protein supply is to diversify poultry production as well as increasing the production of other micro-livestock species with a short generation interval (Mandel et al., 2006). Japanese quail (*Coturnix coturnix japonica*) is among such micro-livestock animals which described as an excellent and cheap source of animal protein for Nigerians (Babangida and Ubosi, 2006).

The nutrient requirements of Japanese quail have been documented to a greater extent in some regions of the world than those of other game bird species (Ayasan and Okan, 2006), largely due to the bird's widespread functionality as a producer of meat and eggs renowned for high quality protein, high biological value, low caloric content (Haruna et al., 1997; Olubaniwa et al., 1999), nutritional and medicinal value (Dowarah and Sethi, 2014), their use as research animals and ease in handling, propagation, and reproduction for amateur bird fanciers and hobbyists. Adequate energy must be supplied by the diet to make efficient use of dietary protein. It has been discovered that production results are determined not by protein amount, but first of all by energy to protein ratio (Zofia et al., 2006). Alaganawy et al. (2014) reported that adequate amino acid balance is the most important nutrient for Japanese quails, while Reda et al. (2015) reported crude protein and energy levels of 22% and 2900 kcal ME/kg, respectively, as adequate during the first few weeks of growth. Jahanian and Edriss (2015) reported CP and energy levels of 26% and 3000 kcal ME/kg respectively, for the same period.

Japanese quail requirements for energy and protein in Nigeria (a tropical country) as well as the efficiency of feed utilization are still poorly documented. Thus, it was the aim of this study to investigate the energy and crude protein requirements of the Japanese quail in tropical environment during the rearing period by feeding different dietary levels of protein and energy to growing Japanese quail.

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MATERIALS AND METHODS

Three hundred and twenty 1-day-old Japanese quail chicks were purchased from a local hatchery. They were fed a basal diet for two weeks *ad libitum*. At the end of two weeks, they were weighed and 288 of them were randomly distributed into 12 treatments with 3 replicates in each treatment and 8 birds per replicate. Birds were reared in cages of dimension 60 cm × 60 cm. The study was conducted at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Nigeria.

The experimental diets were corn-soybean based with 4 levels of protein (20, 22, 24 and 26% CP) at either of 3 levels of energy (3000, 3100 and 3200 kcal ME/kg diet). The composition of the experimental diets is presented in table 1. The birds in all the treatments were subjected to similar management practices throughout the experimental period. Birds in each replicate were group weighed at weekly interval to know the gain in weight and weekly feed intake was also recorded on replicate basis. At the end of week six, total faeces voided by each replicate group was collected and weighed consecutively for three days, bulked and frozen until needed for further analysis. The faeces were dried at 55^0C in a hot air oven. Dried faeces were grounded and analyzed for proximate composition, gross energy, phosphorus and calcium.

Table 1. Summary of the composition of experimental diets fed to quails during 6 weeks of age

Treatment Number	Dietary metabolizable Energy (Kcal ME/ kg)	Metabolizable Energy level	Dietary crude Protein (%)
1	3000	Low	20
2	3100	Medium	20
3	3200	High	20
4	3000	Low	22
5	3100	Medium	22
6	3200	High	22
7	3000	Low	24
8	3100	Medium	24
9	3200	High	24
10	3000	Low	26
11	3100	Medium	26
12	3200	High	26

Data analysis

Data of feed offered and body weight were recorded weekly and used to calculate feed intake, weight gain, feed conversion ratio and protein efficiency ratio.

Nutrient digestibility

Proximate compositions of the feed and the faecal samples were determined using methods of AOAC (1996). The proximate compositions of the feed and excreta samples were used to calculate the percent digestibility of nutrients on dry matter basis using the following formula;

Digestibility (%) = [Nutrient intake - Nutrient output / Nutrient intake] × 100

Statistical analysis

Data were subjected to analysis of variance (ANOVA) using SAS statistical package (SAS, 2003) as a 4×3 factorial arrangement in a completely randomized design. Significant means were separated using Duncan multiple range test at P<0.05.

RESULTS AND DISCUSSION

The results of performance of growing Japanese quail fed varying levels of CP and energy are presented in table 2. The different dietary protein levels had a significant effect (P<0.05) on the total feed intake/bird. Birds on the 26% CP had the highest total feed intake when compared with birds fed with other protein levels. This supports the result of Dowarah et al. (2014) who reported that Japanese quail fed with 26% CP recorded the highest feed intake at 4-5 weeks of age. It could be concluded that the increase in feed intake at the finisher phase compensated for the reduced feed intake at the starter phase so that the overall effect of reduced intake becomes unnoticeable at the end of finishing phase. It was also observed from the study that total feed intake was reduced as the energy level increased. This supports the findings of Barque et al. (1994) and Attia et al. (2006) who reported that bird fed ration containing 3000 kcal ME/kg feed apparently consumed less feed compared to birds fed 2600 and 2800 Kcal ME/kg diet. Abbasali et al. (2011) further explained that a higher feed intake with decreased dietary energy concentration was mainly to compensate the energy intake, most importantly at finisher phase during which their energy requirements is relatively higher than starter and grower phases.

The results of the effect of protein and energy on body weight gain showed no significant differences (P>0.05) although 26% CP fed group recorded the highest (107.7 gram) weight gain, which comes from the fact that proteins build muscles. Abbasali et al. (2011) observed that the mean body weight was significantly higher and influenced by increased dietary protein level (P<0.05) in the growing phase thus emphasizing the importance of dietary protein and also amino acid concentrations in growing quail diet. The increase in weight gain at 6 weeks of age obtained in the present study though not significant can be attributed to the increased weight gain of chicks at starter phase although the different phases in the rearing periods were not considered separately in the present study.

Dietary energy level had no significant effect (P>0.05) on the body weight gain of birds. This is in agreement with the findings of Barque et al. (1994) who reported that various levels of energy did not affect weight gain of quail chicks. Elangovan et al. (2004) reported that body weight gain was significantly higher in the diet with 2900 and 2700 Kcal ME/kg than 2500 Kcal ME/kg diet. This is in agreement with the present study where it was observed that birds on the HE (3200kcal ME/Kg) and ME (3100Kcal ME/Kg) had the highest body weight gain.

Table 3 shows the effect of different levels of protein, energy and their interaction on the performance of growing Japanese quails. Inclusion of varying levels of protein in the diet of Japanese quails had a significant effect (P<0.0001) on crude protein intake, average daily crude protein intake and protein efficiency ratio of the birds. Also, energy had a significant effect (P<0.0001) on the total feed intake and average daily feed intake of birds. The interaction of protein and energy on all the performance parameters was not significant.

Table 2. Performance of growing Japanese quail birds fed with varying levels of protein, energy and different combinations of protein and energy during 6 weeks of age

Treatments	Initial body weight (gram)	Final body weight (gram)	Weight Gain (gram)	Daily weight gain (gram)	Feed Intake (gram)	Daily feed intake (gram)	CP intake (gram)	Daily CP intake (gram)	PER	FCR
VLP-LE	49.88	148.25	98.38	3.51	585.21^{a}	20.90^{a}	108.03^{i}	3.86^{i}	0.91^{bcd}	5.98
VLP-ME	49.71	152.92	103.21	3.69	572.04^{bc}	20.43^{bc}	106.40^{j}	3.80^{j}	0.97^{ab}	5.56
VLP-HE	50.00	160.29	110.21	3.94	565.54^{c}	20.20^{c}	104.80^{k}	3.74^{k}	1.05^{a}	5.16
LP-LE	50.08	156.13	106.04	3.79	584.29^{a}	20.87^{a}	118.60^{g}	4.24^{g}	0.89^{bcde}	5.51
LP-ME	50.54	160.04	109.50	3.91	569.13^{bc}	20.33^{bc}	115.93^{h}	4.14^{h}	0.94^{abc}	5.23
LP-HE	50.13	146.67	96.54	3.45	567.58^{c}	20.27^{c}	115.17^{h}	4.11^{h}	0.84^{cdef}	5.89
MP-LE	50.18	156.29	106.21	3.79	586.92^{a}	20.96^{a}	130.77^{d}	4.67^{d}	0.81^{def}	5.54
MP-ME	50.25	153.25	103.00	3.68	573.00^{bc}	20.46^{bc}	128.06^{e}	4.57^{e}	0.80^{def}	5.57
MP-HE	49.67	151.50	101.83	3.64	568.08^{c}	20.29^{c}	125.69^{f}	4.49^{f}	0.81^{def}	5.63
HP-LE	49.79	154.46	104.67	3.74	591.00^{a}	21.11^{a}	142.17^{a}	5.08^{a}	0.74^{f}	5.66
HP-ME	50.04	157.21	107.17	3.83	576.25^{b}	20.58^{b}	139.35^{b}	4.98^{b}	0.77^{ef}	5.39
HP-HE	50.00	160.58	110.58	3.95	568.42^{c}	20.30^{c}	137.02^{c}	4.89^{c}	0.81^{def}	5.18
SEM±	0.85	4.97	4.67	0.17	2.33	0.08	0.47	0.02	0.04	0.25

^{a,b,c,e,f,g,h,i,j} Means in the same row with different superscripts are significantly different (P<0.05). VLP: Very Low Protein (20%), LP: Low Protein (22%), MP: Medium Protein (24%), HP: High Protein (26%), LE: Low Energy (3000 kcal ME/kg), ME: Medium Energy (3100 kcal ME/kg), HE: High Energy (3200 kcal ME/kg)

Table 3. Effect of different levels of protein, energy and their interaction on the performance of growing Japanese quails at 6 weeks of age

Parameters	P value		
	Protein	Energy	Protein × Energy
Initial body weight (g/bird)	0.950	0.941	0.998
Final body weight (g/bird)	0.770	0.841	0.302
Weight gain (g/bird)	0.723	0.849	0.256
Daily weight gain (g/bird/day)	0.723	0.849	0.256
Total feed intake (g/bird)	0.071	< 0.0001	0.849
Daily feed intake (g/bird/day)	0.071	< 0.0001	0.849
Crude protein intake (g/bird)	< 0.0001	0.370	0.274
Daily crude protein intake (g/bird/day)	< 0.0001	0.370	0.274
Protein efficiency ratio	< 0.0001	0.324	0.180

Feed conversion ratio	0.822	0.348	0.221

Table 4. Effect of different levels of protein, energy and their combinations on nutrient digestibility of growing Japanese quail at 6 weeks of age

Treatments	Dry matter	Crude protein	Ether extract	Crude fibre	Ash
Effect of protein					
VLP	66.59	35.07	73.59	42.15	29.92^{b}
LP	65.67	35.53	75.11	40.83	29.53^{b}
MP	69.69	45.89	78.08	48.51	50.51^{a}
HP	65.73	38.12	76.69	39.79	40.89^{ab}
SEM±	2.69	4.91	2.02	5.21	4.50
Effect of energy					
LE	64.91	34.43	72.76^{b}	40.58	33.48
ME	69.15	43.29	79.46^{a}	46.59	44.28
HE	66.70	38.23	75.68^{ab}	41.28	35.39
SEM±	2.33	4.25	1.95	4.51	3.89
Effect of Protein × Energy					
VLP-LE	64.58^{ab}	31.43^{ab}	71.10^{b}	41.59	19.82^{c}
VLP-ME	69.03^{ab}	40.55^{ab}	78.53^{ab}	47.20	32.43^{bc}
VLP-HE	66.16^{ab}	33.23^{ab}	72.32^{b}	37.66	37.49^{bc}
LP-LE	70.58^{ab}	45.77^{ab}	75.53^{ab}	46.52	38.07^{bc}
LP-ME	61.73^{ab}	28.94^{b}	74.24^{ab}	34.74	26.82^{bc}
LP-HE	64.71^{ab}	31.87^{ab}	75.56^{ab}	41.21	23.71^{bc}
MP-LE	59.24^{b}	26.66^{b}	68.93^{b}	34.06	33.98^{bc}
MP-ME	77.14^{a}	59.73^{a}	85.42^{a}	69.85	69.48^{a}
MP-HE	72.69^{ab}	51.27^{ab}	79.89^{ab}	51.63	48.08^{ab}
HP-LE	65.22^{ab}	33.88^{ab}	75.48^{ab}	40.17	42.03^{bc}
HP-ME	68.71^{ab}	43.95^{ab}	79.64^{ab}	44.57	48.39^{ab}
HP-HE	63.24^{ab}	36.54^{ab}	74.95^{ab}	34.51	32.26^{bc}
SEM±	4.65	8.50	3.50	9.02	7.79

[a,b] Means in the same row with different superscripts are significantly different (P<0.05) VLP: Very Low Protein (20%), LP: Low Protein (22%), MP: Medium Protein (24%), HP: High Protein (26%), LE: Low Energy (3000 kcal ME/kg), ME: Medium Energy (3100 kcal ME/kg), HE: High Energy (3200 kcal ME/kg)

Table 5. Effect of different levels of protein, energy and their interaction on the nutrient digestibility of Japanese quail at 6 weeks of age

Parameters	P value		
	Protein	Energy	Protein× Energy
Dry matter digestibility (%)	0.687	0.444	0.200
Crude protein digestibility (%)	0.393	0.351	0.190
Ash digestibility (%)	0.008	0.133	0.083
Ether extract digestibility (%)	0.512	0.040	0.288
Crude fibre digestibility (%)	0.643	0.595	0.529

Nutrient digestibility

All levels of protein had no effect on digestibility of dry matter, crude protein, ether extract and crude fibre. Ash digestibility for 24% CP fed group was highly significant (P<0.05) when compared with HP, LP and VLP. The LP and VLP ash digestibility was not significant. Ether extract digestibility was numerically highest at MP 24% CP fed diet. This is partly in support with Dowarah and Sethi (2014) who observed the highest significant differences in ether extract digestibility in white and colour plumage Japanese quail fed 25% CP diet. Crude fibre and ash digestibility were best in MP fed diet. This supports the findings of Dowarah and Sethi (2014) that the highest CF digestibility was achieved at 25% CP supplemented diet. Crude protein digestibility was the highest in the MP fed group. This implies that the HP fed group was unable to efficiently utilize the protein intake as the MP fed group. All the nutrient digestibility parameters with the exception of crude fibre across diets were significantly different (P<0.05). No significant effect was observed in the dry matter and crude protein digestibility of VLP, LP and HP fed group regardless of their energy levels. The DM digestibility was the highest (77.14%) in the MP-ME fed group. Ash, ether extract and crude protein digestibility were also the highest in birds fed with MP-ME combination as compared with other combinations (P<0.05). It can then be summarized that the MP-ME fed group were able to digest and utilize their nutrients better than the birds fed with other energy-protein combinations. These findings are comparable to the reported CP level of 26% and ME of 3000 kcal ME/kg by Jahanian and Edriss (2015) which resulted in efficient nutrient utilization by growing Japanese quails. The crude fiber digestibility was not affected by the different dietary levels of energy and protein combinations.

Table 5 shows a significant effect (P<0.05) of protein on ash digestibility. The inclusion of different levels of energy resulted in a significant effect (P<0.05) on ether extract digestibility of the birds. Ether extract digestibility was the highest in the diet with high inclusion of soya oil, this is emphasizing its use in increasing fat content as supported by Dowarah and Sethi (2014). The interaction effect of protein and energy on Japanese quail birds had no significant effect (P>0.05) on the digestibility parameters.

CONCLUSION

It can be concluded from the study that the optimum level of dietary metabolizable energy and protein are 3200 kcal ME/kg and 26% CP respectively for weight gain during finisher period. Digestibility of nutrients also caused the best result at 24% CP and 3100 kcal ME/kg. This indicated that regardless of the total feed intake for each category of birds, the 24% CP and 3100 kcal ME/kg fed group efficiently utilized their intake mostly for performance.

Competing interests

Authors have declared that there is no competing interest.

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