Response of Japanese quail chicks (*Cortunix cortunix japonica*) to various dietary energy levels in a tropical environment

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Abstract

A total of one thousand and eighty (1080) unsexed day-old quail chicks with an average initial weight of 7.68±0.39g were used in a feeding trial to determine the growth response of quail chicks fed iso-nitrogenous rations to various dietary energy levels in Nigerian (tropical) environment. Six iso-nitrogenous (26% CP) diets containing 2500, 2600, 2700, 2800, 2900 and 3000 Kcal/kg ME were used in a complete randomized design, respectively for the study. The birds were fed feed and water ad libitum for 6 weeks at the end of which 10 birds from each replicate were randomly selected for carcass analysis. There were significant (P<0.05) differences in the final live weight, weight gain, cost per gain and age at 1st egg across dietary treatments. Feed intake decreased non-significantly (P>0.05) as the level of energy increased in the diets. Total protein, Haemoglobin, packed cell volume, red blood cell and white blood cell were non significantly (P>0.05) affected by dietary treatments and were within the normal range for quails. The cholesterol level however, increased non-significantly (P>0.05) as the level of dietary energy increased. Except for the carcass weight and abdominal fat, the carcass parameters were not significantly (P>0.05) affected by the dietary treatments. It was concluded that a dietary energy level of 2800 Kcal/kg ME, will be adequate for optimum performance of quail chicks under the condition of this experiment.

Key words: Quail chicks, Dietary energy, performance, tropical environment.

Introduction

Energy is an essential component of poultry diet that must be supplied in adequate amount to meet up the birds' requirements for maintenance, optimum growth, egg production and reproduction. Oluyemi and Roberts (2007) opined that the amount of feed consumed daily by birds fed *ad libitum* is controlled by the energy content of the diet, provided it is balanced with all other essential nutrients. Although, information on the metabolizable energy requirements of quails is scanty, available reports from literature have shown that Japanese quails have higher body metabolic rate inspite of the small body size and therefore may have similar energy requirement like that of the egg-type chicken (Dafwang, 2006) and guinea fowl (Oguntona, 1986). There is some evidence that most chickens have the ability to adjust feed intake in order to obtain the necessary energy required for optimum performance (Willson and Payne, 1989 and Oguntona, 1986). It has also been reported that chicks and guinea fowl keets aged day-old to 4-6 weeks were not able to adjust feed intake to dietary energy variations and thus tend to consume slightly more energy as the energy level of the diet increases (Oguntona, 1986 and Olomu, 1995). Similar information on quail chicks is still lacken.

Results from the very few reports on the energy requirements of quails vary widely, ranging from 2600 kcal/kg ME to 2900 kcal/kg ME (Farrel *et al.*, 1982, NRC, 1994 and Dafwang, 2006). These values were obtained from work done in temperate regions. It has been suggested (Olomu, 1995, Oluyemi and Robberts, 2007 and Balogun *et al.*, 1988) that the energy requirements of monogastric animals raised in the hot regions of the world would differ from those in temperate regions particularly those with very low temperatures. The all-year round high ambient temperature in Nigeria might have an effect of lowering the dietary energy requirements for quails compared to those of temperate regions with very low temperatures. Since most nutrients are related to energy metabolism in the body and are therefore required in proportion to energy usage (Farrel *et al.*, 1982), the knowledge of the optimum dietary energy requirement of quail in a defined environment is essential. This study is therefore designed to determine the growth response of quail chicks to various dietary energy levels in the tropics.

Materials and Methods

Experimental site

The experiment was conducted at the Quail Research Unit, Poultry Division, National Veterinary Research Institute, Vom, Plateau State, Nigeria. The study area is located on Latitude 9^0 43'N and Longitude 8^0 45'E at a altitude of 4200ft (128m) above sea level. The mean annual rainfall ranges between 1300 to 1500mm with a Relative Humidity ranging between 14 to 72%. The rainy season extends from March to early October. The average daily temperature ranges between 17^0 C to 28.6^0 C while the vegetation is derived Savannah.

Experimental diets

Six iso-nitrogenous (26 % CP) diets varying in caloric densities (2500, 2600, 2700, 2800, 2900 and 3000 kcal/kg ME) were used for the study. Soya oil sludge obtained as a by-product of soybean extrusion was used to raise the energy levels of the diets to 2600, 2700, 2800, 2900 and 3000 kcal/kg ME, respectively. The composition of the experimental diets is shown in Table 1. The proximate analysis of the experimental diets was carried out at the Biochemistry and Applied Molecular Biology Departments, National Veterinary Research Institute, Vom, using the procedures outlined by AOAC (1990).

Experimental birds management and design

A total of one thousand and eighty (1080) day-old unsexed Japanese quail chicks with an average initial weight of 7.68 $\pm$ 0.39g sourced from the Hatchery Unit, Poultry Division, National Veterinary Research Institute (NVRI), Vom were used for the study which lasted for 6 weeks. The birds were weighed and randomly distributed into 6 treatments with three replicates of 60 quail chicks each in a completely randomized design. All the quail chicks were subjected to the same management practices (brooding, lighting, feeding and watering) through out the experimenta period expect for the experimental diets tha were fed. Lighting regime was 24 hours an brooding temperature gradually decrease from 34^0 C during the initial 7 days to 26^0 by 21 days of age. The birds were fed *libitum* through out the experimen period. Feed intake and body wei changes were monitored on weekly ba From the feed intake and weight gain d feed conversion ratio and cost per unit in weight were calculated. Age at first in-lay and average weight of egg at poi lay were also monitored.

Blood sampling and analysis

Five birds from each replicate group sacrificed at the end of the feeding tria 5mls of blood samples were collecte Ethylene Di-amine Tetra Acetic (EDTA) in treated Bijou bottles (1n for haematological assay. The

Table 1: Percent Composition of Experimental Diets with Varying Dietary Energy Levels for quails (0 – 6 weeks)

Ingredients	Dietary Energy Levels, kcal/kg, ME					
	2500	2600	2700	2800	2900	3000
Maize	28.71	26.29	21.51	38.02	33.18	29.79
Groundnut cake	29.44	29.86	30.63	33.10	33.97	35.36
Soya bean meal	10.00	10.00	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	25.00	25.00	25.00	10.00	10.00	10.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Common salt	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin Premix[1]	0.25	0.25	0.25	0.25	0.25	0.25
Soya oil sludge	-	2.00	6.00	2.00	6.00	8.00
Enzyme (Marxigrain®)	0.10	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrients levels and cost per Kg diet						
Crude Protein*	26.00	26.17	26.21	26.09	26.41	26.02
Metabolizable Energy ME, Kcal/Kg	2556	2625	2772	2832	2971	3032
Ether Extract, %*	5.71	7.61	11.53	7.65	12.86	13.52
Crude fibre, %*	5.09	5.04	4.96	4.48	4.38	3.84
Calcium, %	1.30	1.30	1.30	1.30	1.30	1.30
Phosphorus, %	1.06	1.06	1.05	0.93	0.92	0.92
Ca: P ratio	1.23	1.23	1.24	1.39	1.40	1.40
Lysine, %	1.29	1.29	1.29	1.27	1.27	1.27
Methionine + cysteine, %	1.07	1.06	1.05	0.95	0.96	0.97
Cost per keg diet (N)	46.11	46.23	46.51	52.15	52.42	52.46

[1]Biomix® chick supplied per kg ration: Vit. A - 4,000,000.00 IU; Vit D3 – 800,000.00IU; Vit. E – 9,200.00mg; Vit K – 800.00mg; thiamin (B_1) – 720.00mg; Riboflavin (B_2) – 2,000.00mg; Pyrodixine (B_2) – 1,200.00mg; Vit. B_{12} – 6.00mg; Biotin – 24.00mg; Niacin – 11,000.00gm; Panthothenic acid – 3,000.00gm; Folic acid – 300.00gm; Chlorine chloride – 120,000.00gm; Iron – 8,000.00gm; Manganese – 16,000.00gm; Copper – 1,200.00gm; Zinc – 12,000.00gm; cobalt – 80.00mg; Iodine – 400.00gm; Selemium – 80.00gm; Antioxidants – 500.00mg
*Determined Values

samples were analyzed for packed cell Volume(PCV), Haemoglobin concentration (HBC) and red blood cells (RBC) using the procedures outlined by Lamb (1991) at the Haematology Laboratory, Federal College of Veterinary and Medical Laboratory Technology, Vom. Total protein (TP), albumin and cholesterol were also assayed at the Chemical Pathology Laboratory, Federal College of Veterinary and Medical Laboratory Technology, Vom.

Carcass evaluation

At the end of the feeding trial, five birds per replicate were selected based on the average pen weight, fasted overnight and used for the study. After severing the jugular vein of the birds, they were immersed in warm water for about a minute and then the feathers were manually plucked. Each bird was cut into parts and the relative weight was calculated by expressing the weight of cut part as percentage of carcass weight. The organs were weighed and the weight expressed as percentage of carcass weight.

Statistical analysis

All data obtained in the study were subjected to analysis of variance (ANOVA) and significant differences in means were separated using Duncan's Multiple Range Test (SAS, 1998).

Table 2 Effects of varying dietary energy levels on performance of Japanese quails (0 – 6 weeks).

	Varying Energy Levels, kcal/kg, ME							
Parameters	2500	2600	2700	2800	2900	3000	SEM	LOS
Initial weight (g/bird)	7.50	8.05	7.50	7.50	7.50	8.05	0.39	NS
Final live weight (g/bird)	133.71^{ab}	137.01^{ab}	135.19^{ab}	141.47^{a}	132.84^{ab}	125.65^{b}	3.96	*
Feed intake (g/bird/day)	13.74	13.91	13.88	12.53	12.75	12.92	0.44	NS
Weight gain (g/bird/day)	3.60^{ab}	3.69^{ab}	3.65^{ab}	3.83^{a}	3.58^{ab}	3.36^{b}	0.12	*
Feed conversion ratio	3.52	3.77	3.80	3.27	3.56	3.84	0.39	NS
Cost per gain (N)	183.3^{ab}	178.91^{ab}	176.74^{ab}	170.53^{a}	186.76^{ab}	201.45^{b}	7.32	*
Mortality (%)	9.45	6.67	3.33	3.09	2.78	6.11	1.98	NS
Age at 1^{st} egg (Days)	36.00^{ab}	35.00^{ab}	38.00^{ab}	35.00^{a}	38.00^{b}	38.00^{b}	0.81	*
Egg weight (g)	7.05	7.16	7.64	7.62	7.89	8.89	0.96	NS

^{ab} Means with different superscripts are significantly different (P<0.05)

NS - Not significant different

Results and Discussion

Performance characteristics of the experimental birds as affected by the different dietary energy levels is shown in Table 2. No significant (P>0.05) influence of dietary energy on feed intake was observed among the treatment groups. However, a linear decrease (P>0.05) in feed intake as the level of dietary energy increased was noticed among the dietary treatments. Birds on 2500, 2600 and 2700 kcal/kg, Metabolizable energy diets tended to eat more feed than those on 2800, 2900 and 3000 kcal/kg), Metabolizable energy treatment groups. The relatively high (P>0.05) feed consumption of birds fed diets containing 2500 to 2700 kcal/kg, metabolizable energy compare to those on 2800 to 3000 kcal/kg, Metabolizable Energy supported earlier reports that feed consumption in birds is governed by the energy level of the diet and that birds eat primarily to satisfy their energy needs (Bamgbose and Tewe, 1994; Angulo *et al.*, 1993; Idowu et al., 2003 and Abeke *et al.*, 2008). To arrive at 2500, 2600 and 2700 kcal/kg ME, in the present study, wheat offal was used at 25% in the diets. On the other hand, to fix the energy levels at 2800, 2900 and 3000 Kcal/kg ME, respectively, the wheat offal was reduced to 10% of the diets. Consequently, apart from lowered caloric value, the 2500, 2600 and 2700 kcal/kg, ME diets were bulkier with more dietary fibre (Table 1) than the 2800, 2900 and 3000 kcal/kg ME diets. The birds probably had to consume more of the bulkier and relatively high fibre diets to adjust to their caloric need. Incorporation of feedstuff high in fibre has been proved to affect physical texture of rations and increase feed intake of birds in attempt to satisfy energy needs (Longe and Adetola, 1983). Mateos *et al.*, 1982 reported that a higher oil level in the diet can increase transit time of ingesta in the gastro intestinal tract, hence reduced intake of feed in birds. In the present study, soya oil sludge was used at 2, 6 and 8% to balance up 2800, 2900 and 3000 kcal/ kg ME diets, respectively. However, the feed intake of birds on these diets were neither significantly (P>0.05) affected or followed a particular trend. The feed intake result obtained in this study is in consonance with Olubamiwa *et al.*, 1999 who reported a linear decrease in feed intake as the level of dietary energy increased in Japanese quail diets.

Birds on 2800 kcal/kg ME diet, had significantly (P>0.05) higher weight gain than those on 3000 kcal/kg ME, diet. The weight gain for the 2800Kcal/kg ME, treatment group was also numerically higher (P>0.05) than those of other treatment groups (2500, 2600, 2700 and 2900 Kcal/kg, ME), although the difference was not significant (P>0.05). The average daily weight gain for quails on 2900 and 3000 kcal/kg, ME diets followed the same trend as average daily feed intake observed for birds on those treatment groups. This suggest that reduced feed intake observed on birds fed 2900 and 3000 kcal/kg, ME diets play an important role in depressing their weight gain compare to birds on other dietary treatments. The results obtained herein tallied with that of Olomu (1976) who observed slightly higher growth rate of broilers fed 2800 kcal/kg diet than those fed 3000 kcal/kg diet. The established trend of increased weight gain as dietary energy levels increased reported for broilers (Lott *et al.,* 1992); growing pullets (Adamu, 1999) and cockerel (Sobamiwa *et al.,* 2998) was not closely followed in the present study. There was a downward decrease in weight gain as the metabolizable energy of the diets increased beyond 2800 kcal/kg ME. Final live weight of the birds at 6 week of age followed the same trend as that of the weight gain. Birds on 2800 kcal/kg diet had significantly (P<0.05) higher body weight than those on 3000 kcal/kg ME, diet. However, the body weight of birds on 2800 kcal/kg ME diets were not significantly (P>0.05) different from those on 2500, 2600, 2700 and 2900 kcal/kg ME treatment groups, respectively. Generally, metabolizable energy value of 2600 to 3000 kcal/kg diet has been recommended for temperate regions (Farrell *et al.,* 1982). Olubamiwa *et a l*(1999) observed that dietary energy levels of 2500 to 2800 kcal/kg diet supported optimum performance of growing quails in the tropics. The non-significant (P>0.05) difference in the rate of gain and body weight for birds on 2800 kcal/kg ME, treatment group compare to those fed 2500, 2600, 2700 and 2900 kcal/kg ME diets was in support of the recommendation of early workers. It appear, the 2800 kcal/kg ME, diet supported better (P>0.05) weight gain and body weight compared to the other dietary treatments in this study.

Feed conversion ratio were not significantly (P>0.05) influenced by the dietary energy levels. However, birds on 2800 kcal/kg ME, diet were most efficient in feed utilization compared to those on 2500, 2600, 2700, 2900 and 3000 kcal/kg ME diet. Quails on 3000 kcal/kg ME, diet tend to utilize feed less efficient (P>0.05) than those on other dietary treatments. It is interesting to note that there was no significant (P>0.05) difference in the efficiency of feed utilization despite the wide variation in the energy content of the diets. This suggest that quail can utilize low energy diet as efficient as the high energy diet as earlier observed by Begin (1968). However, due to the feed wastage characteristics of quail, their relatively small body size and fidgety nature, quails are much less efficient in feed conversion than chicken and guinea fowl (Ayorinde, 1994 and Olubamiwa *et al.,* 1999).

The economic analysis revealed an upward increase in cost of feed (N/kg) with increased dietary energy level. This is expected as maize and groundnut cake which constituted the major expensive components of the diets increased with increased dietary energy level. The cost per unit gain was significantly (P>0.05) better for the 2800 kcal/kg ME, treatment group than for 3000 kcal/kg ME, treatment group. The cost per gain values were however, statistically similar (P>0.05) for 2500, 2600, 2700, 2800 and 2900 kcal/kg, ME treatment groups. It was obvious from the study that 2800 Kcal/kg ME, diet supported least cost per kg gain in weight than other dietary treatments.

The variations obtained in percent mortality among the treatment groups were non significant (P>0.05) and could not be traced to the effect of varied dietary energy levels on the experimental birds. It suffices to mention however, that one of the birds on 3000 kcal/kg ME diet, died of fatty liver disease as observed during postmortem examination. Age at first egg ranged from 35 to 38 days and did not follow a particular pattern. Birds on 2800 kcal/kg ME diet had their first egg three days earlier than those on 2900 and 3000 kcal/kg, ME diets despite the fact that their feed intake were almost similar. This suggest that dietary energy at 2800 Kcal/kg, would be better utilized for fast growth and attainment of physiological maturity and that beyond this dietary energy level, onset of egg laying could be delayed in quails. Egg weights at onset of lay were not significantly affected by the dietary treatment. However, quails on 3000 kcal/kg ME, diet had better egg weight of 8.89g compare to 7.05, 7.16, 7.64, 7.62 and 7.89 for birds on 2500, 2600, 2700, 2800 and 2900 kcal/kg, ME, respectively. Judging from the weight of eggs obtained from 2900 and 3000 kcal/kg, ME diets in the present study, it could be inferred tha egg weight increased with increase in dietary energy. A further study on the effec of varying energy levels on performance o laying quails is recommended to confirm the relationship between the caloric density of diet and egg weight.

The mean values for blood metabolites as measured for quails in the study are shown in Table 3. The Total protein Haemoglobin, pack cell volume, red blood cell and white blood cell obtain in the study were statistically similar (P>0.05) and fel within the normal ranges for quails a reported by Anon (1980). This implies tha all the birds were healthy throughout th period of the study. The serum albumi were not significantly (P>0.05) differer among treatment groups. This coul probably be attributed to the iso nitrogenous nature of the tested diets.

The dietary energy levels had no significan (P>0.05) influence on the serum cholester level. However, a linear increase in th cholesterol level was observed amon treatment groups as the dietary energy lev increased. About 6 and 8% soy oil sludge good source of fatty acid) were used attempt to jack up the dietary energy leve to 2900 and 3000 kcal/kg ME, respectivel It is therefore possible that the relative higher (P>0.05) cholesterol mean valu

Table 3: Effects of Varying Dietary Energy Levels on Haematological Parameters of Japanese quails

Parameters								
Dietary Energy Levels, kcal/kg, ME	2500	2600	2700	2800	2900	3000	SEM	LOS
Packed Cell Volume (%)	44.00	43.89	45.11	45.44	49.33	44.33	0.761	NS
Haemoglobin (g/d)	14.86	16.96	14.96	14.04	15.67	13.80	0.831	NS
Albumin (g/l)	23.41	22.38	23.84	22.32	22.84	22.84	0.793	NS
Red Blood Cell (RBC)x10^{12}/l	3.64	3.72	3.94	3.53	3.55	3.42	0.218	NS
White Blood Cell x 10^9 /L	2.11	2.22	2.23	2.06	2.12	2.06	0.120	NS
Cholesterol (mmol/l)	3.43	3.98	3.76	4.10	4.38	4.73	0.260	NS

NS - Non significant (P>0.05)
SEM - Standard Error of Mean
LOS - Level of Significance

Table 4: Effects of varying dietary energy levels on Carcass Characteristics of Japanese Quails (0 – 6 weeks)

	Varying Energy Levels, kcal/kg, ME							
Parameters	2500	2600	2700	2800	2900	3000	SEM	LOS
Live weight (g/bird)	190.03	197.80	199.80	191.60	205.53	191.13	7.37	NS
Carcass weight (g/bird)	122.97[b]	126.57[ab]	122.57[b]	133.90[a]	129.00[ab]	119.63[b]	3.19	*
Dressing percentage (%)	64.71	63.99	61.35	69.89	62.76	62.59	1.71	NS
Prime cuts and major organ weights expressed as percentage of carcass weight.								
Thigh	20.00	21.80	20.97	22.23	21.77	21.54	0.54	NS
Breast	44.27	44.43	39.10	45.87	43.07	43.07	2.08	NS
Back	15.00	13.87	14.40	14.50	15.20	14.40	0.83	NS
Wings	8.90[a]	8.80[ab]	7.90[ab]	7.50[b]	8.00[ab]	7.93[ab]	0.41	NS
Neck	5.30	5.03	4.83	4.73	8.80	5.83	1.72	NS
Shank	2.67	2.87	2.73	2.92	2.37	2.73	0.22	NS
Liver	4.20	5.33	4.43	3.59	4.37	3.60	0.82	NS
Heart	1.50	1.47	1.37	1.43	1.47	1.30	0.09	NS
Intestine	8.77	9.83	8.57	8.03	7.90	8.63	0.66	NS
Gizzard	4.13	4.37	4.35	4.33	4.28	4.63	0.67	NS
Abdominal fat	2.43[b]	2.57[b]	2.67[b]	3.10[ab]	3.17[ab]	5.27[a]	5.27[a]	0.69

[ab] Means with different superscripts are significantly different at 5%,

NS - Non significant

for birds on 2900 and 3000 kcal/kg ME, diets could be a reflection of the saturated fatty acid components of the diets which might have served as the base for cholesterol synthesis. The slightly lower (but not significant) blood serum cholesterol for birds on 2500, 2600 and 2700 kcal/kg ME diets could be due to the relatively higher levels of dietary fibre of those diets. Wheat offal, a fibre source was used at 25% level of inclusion as against 10% for the other dietary treatments to balance up the 2500, 2600 and 2700 kcal/kg ME diets, respectively. It was possible that at relatively higher levels of fibre as observed for 2500, 2600 and 2700 kcal/kg ME, diets in this study, the level of blood cholesterol was decreased. Blood cholesterol reduction have been associated with the ability of the dietary fibre to reduce cholesterol absorption, bind the bile salt in the gastro intestinal tract or shortening of the intestinal transit time and increasing the faecal sterol excretion. Table 4 shows the carcass characteristics of growing quails fed varying level of dietary energy. There was a significant (P>0.05) effect of dietary treatment on the carcass weight. Birds on 2800 kcal/kg, ME treatment group had significantly (P>0.05) higher carcass weight than those on 2500, 2700 and 3000 kcal/kg ME diets, respectively. This result was at variance with the findings of Osei and Duodu (1988) that dietary treatment seldomly exert significant influence on carcass weight. The final live weight and dressing percentage were however, statistically the same (P>0.05) across the dietary treatment groups. Results of prime cut parts weight showed no significance (P>0.05) effect of the dietary treatment. No significant differences were observed for the relative weight of liver, heart, intestine and gizzard expressed as a percentage of carcass weight (P>0.05). However, there were significant differences (P>0.05) among treatment groups for the relative weight of the abdominal fat expressed as a percentage of carcass weight. The significant (P>0.05) difference in the percent abdominal fat as the level of dietary energy increases is expected. Usually excess energy and fat are stored in the form of fat around the abdominal cavity and some major organs in the body (Bawa *et al.*, 2007).

Conclusion

It can be concluded that quail chicks required 2800 kcal/kg, Metabolizable energy, for optimum growth response and carcass characteristics in the tropics.

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