Protein requirement of Japanese quail (*coturnix coturnix japonica*) chicks in NigeriaBawa, G. S.¹ Lombin, L. H.,¹ Shamaki, D.,¹ Karsin, P. and ¹Musa, U.Department of Animal Science, Ahmadu Bello University,
P.M.B. 1044, Zaria.¹ National Veterinary Research Institute, Vom, Nigeria. **Abstract**

A feeding trial was conducted to determine the effect of varying dietary levels of protein on performance of Japanese quail chicks. Six iso-caloric (2953-3078 kcal/kg, ME) diets were formulated to contain crude protein (CP) at 18, 20, 22, 24, 26 and 28% levels, respectively. Each of the dietary treatment was replicated three times with sixty (60) quail chicks per replicate. A total of 1080 day-old unsexed quail chicks were used for the study and distributed using completely randomized design. The experiment lasted 42 days during which data were collected. Feed and water were provided ad libitum throughout the experimental period. Feed intake, weight gain, feed conversion ratio and protein intake differ significantly ($P < 0.05$) due to dietary treatments. Final live weight and cost per gain were not significantly ($P > 0.05$) different across dietary treatments. Age at first egg and average weight of eggs at point of lay differed significantly ($P < 0.05$) across dietary treatments. The haematological parameters (Total protein, haemoglobin, albumen and red blood cell) were significantly ($P < 0.05$) affected by the dietary protein levels. Carcass weight, dressing percentage, prime cuts and the weight of major organs expressed as percentage of the live weight were not significantly ($P > 0.05$) affected by the dietary treatments. It was concluded that Japanese quail chicks required up to 26% level of dietary protein for optimum performance.

Keywords: Crude protein, performance, haematological parameters, carcass, quail chicks.

Introduction

Japanese quails (*Coturnix coturnix japonica*) are beginning to make useful contribution to egg and meat supply in Nigeria where there is shortage of animal protein. They are endowed with unique characteristics of fast growth, early sexual maturity, high rate of egg production, short generation interval and shorter incubation period that make them very suitable for diversified animal agriculture (Oluyemi and Roberts, 2007). They are fairly resistant to disease and require little demand for vaccination (Jadhav and Saddiqui, 2010). With less feed input and space requirements, the commercial quail farming for table egg and meat production can be started with much lower capital investment as compared to chicken and

duck with almost the same profit margin (Oluyemi and Roberts, 2007). With shorter reproduction cycle, and earlier marketing age, the quail offers quick returns on investment (Haruna *et al.*, 1997 and Musa *et al.*, 2008).

Nutrition plays an important role in maintaining quails in good physical condition for growth and egg production. Since feed accounts for between 60-70% investments at the farm, to derive maximum benefit from quail farming, it is necessary to feed balanced rations which have all the nutrients in the required proportion to support growth and egg production. Precise nutrient supply reduces feed cost, wastage of feed and enhances optimum performance. One of the pre-requisite for

formulating a balance diet for sustainable growth and productivity of quails is to know their nutrient requirements. Generally, information on the nutritional requirements of quails in Nigeria is limited. Most of the formulated diets used for feeding quails are based on the NRC(1994) recommended allowances meant for temperate regions of the world. Protein values found suitable for raising quails in temperate countries may not be appropriate for quail birds in tropical environment. The use of chicken or turkey diets in feeding quails was done because of no adequate information on the nutritional requirements for quails. Appropriate diets formulated specifically for quails in the Nigerian livestock feed market is uncommon. Since the introduction of Japanese quail into the Nigerian poultry industry at the National Veterinary Research Institute (NVRI), Vom, in 1992, few works have been conducted on the protein requirements of Japanese quail with conflicting results (Haruna *et al.*, 1997; Babangida and Ubosi, 2006 and Erakpotobor *et al.*, 2006). The need to generate information on the nutrient requirements of quail at all phases of growth and production for emerging quail farmers cannot be overemphasized. It is against this background that this study was conducted to determine the optimal protein requirement for the starter quails raised under the tropical condition of Vom, Plateau State, Nigeria.

The main objective of this study was to evaluate the effect of varying dietary protein levels on growth response, carcass yield of Japanese quail and to compare the cost benefit effect of experimental diets.

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Materials and Methods

Source of Experimental Birds

The quail chicks for the study were obtained from the Hatchery Unit, Poultry Division of National Veterinary Research Institute, Vom.

Experimental Site

The experiment was conducted at the Quail Research Unit, Poultry Division, National Veterinary Research Institute (NVRI), Vom.

Experimental Diets

Six Iso-caloric (2953-3078 kcal/kg, ME) diets containing 18, 20, 22, 24, 26 and 28% CP, respectively were formulated for the study. The ingredient compositions of the experimental diets are presented in Table 1. The feed ingredients for the study were sourced from Dagwom Farm, NVRI, Vom. Proximate compositions of the diets were carried out at the Biochemistry Division of the National Veterinary Research Institute (NVRI), Vom using the procedures outlined by AOAC (1990).

Experimental Birds and their Management

One thousand and eighty (1080) day-old unsexed Japanese quail chicks with an initial weight of 6.75 ± 0.043 g obtained 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 chicks each in a completely randomized design. All the chicks were subjected to similar management practices (brooding, lighting, feeding and watering) throughout the experimental period except for the diets offered. Lighting regime was 24 hours and brooding temperature gradually decreased from 34°C during the initial 7 days to 26°C by 21 days of age. The birds had free access to water and feed throughout the 6 weeks trial period. Mortality was recorded. The

Table 1: Gross composition of experimental diets for Japanese quail chicks (0-6 weeks)

Ingredients	Varying Levels of Dietary Protein, %					
	18	20	22	24	26	28
Maize	45.50	41.76	37.84	34.03	30.23	26.40
Guinea corn	22.75	20.89	18.93	17.02	15.11	13.20
Soya bean cake	14.96	19.16	23.57	27.86	32.15	36.45
Groundnut cake	4.99	6.39	7.86	9.29	10.71	12.15
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Wheat offal	5.00	5.00	5.00	5.00	5.00	5.00
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	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient levels and cost per kg diet.						
Crude protein (%)*	18.16	20.09	22.20	24.18	26.16	28.02
Metabolizable energy (kcal/kg)	3078.31	3050.74	3021.59	2992.59	2964.18	2935.55
Ether extract (%)*	3.60	3.69	3.78	3.87	3.96	4.05
Crude fibre (%)*	3.07	3.12	3.18	3.23	3.28	3.33
Calcium (%)	1.37	1.39	1.42	1.45	1.48	1.51
Phosphorus (%)	0.84	0.85	0.86	0.90	0.92	0.94
Ca : P ratio	1.63	1.62	1.61	1.61	1.61	1.61
Lysine (%)	1.91	1.05	1.17	1.30	1.43	1.55
Methionine+ cysteine (%)	0.77	0.82	0.86	0.91	0.95	1.00
Cost (₹) per kg diet	53.75	54.77	55.82	56.83	57.86	58.89

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 (B₁) - 720.00mg; Riboflavin (B₂) - 2,000.00mg; Pyridoxine (B₆) - 1,200.00mg; Vit. B₁₂ - 6.00mg; Biotin - 24.00mg; Niacin - 11,000.00mg; Panthothenic acid - 3,000.00mg; Folic acid - 300.00mg; Chlorine chloride - 120,000.00mg; Iron - 8,000.00mg; Manganese - 16,000.00mg; Copper - 1,200.00mg; Zinc - 12,000.00mg; Cobalt - 80.00mg; Iodine - 400.00mg; Selenium - 80.00mg; Antioxidants - 500.00mg * Determined Values.

feed intake and body weight changes were monitored on weekly basis. From the feed intake and weight gain data, feed conversion ratio and cost per unit gain in weight were calculated. Age at first egg and average weight of eggs at point of lay were also monitored.

Blood Sampling and Analysis

Three birds from each replicate group were randomly selected at the end of the feeding trial and 5mls of blood samples were collected into Ethylene Di-amine Tetra Acetic Acid (EDTA) in treated Bijou bottles (1mg/ml) for haematological assay. The blood samples were analysed for packed cell volume, (PCV), haemoglobin concentration (HBC) and red blood cells using the procedures outlined by Lamb (1991) at the Haematology Laboratory, Federal College of Veterinary and Medical Laboratory Technology, Vom. The total protein (TP) and albumin were also assayed at the Chemical Pathology Laboratory,

Federal College of Veterinary and Medical Laboratory Technology, Vom.

Carcass Evaluation

At the end of the 6th week, three birds per replicate were randomly picked, fasted overnight and slaughtered by severing the jugular vein with a knife. After immersing in warm water for about a minute, 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 dressed weight. The organs were weighed and the weight expressed as percentage of the dressed weight.

Statistical Analysis

All data collected were subjected to analysis of variance using SAS (1998) and significant differences between the means were separated by using Duncan's Multiple range test as outlined by Steel and Torrie (1980).

Table 2: Performance of Japanese quail chicks on graded levels of dietary protein

Parameters	Dietary levels of protein (%)						SEM	LOS
	18	20	22	24	26	28		
Initial weight(g/bird)	6.74	6.76	6.82	6.71	6.72	6.73	0.043	NS
Final weight(g/bird)	146.42	147.10	149.83	152.14	155.59	164.82	7.156	NS
Feed intake (g/bird/day)	13.44 ^b	13.73 ^{ab}	13.46 ^{ab}	13.15 ^c	13.59 ^{ab}	14.05 ^a	0.095	*
Weight gain(g/bird/day)	3.21 ^c	3.55 ^b	3.59 ^{ab}	3.61 ^b	3.87 ^{ab}	4.21 ^a	0.114	*
Feed conversion ratio	4.29 ^b	3.90 ^{ab}	3.84 ^{ab}	3.72 ^{ab}	3.52 ^{ab}	3.34 ^a	0.167	*
Protein intake(g/bird/day)	2.42 ^f	2.74 ^e	3.00 ^d	3.15 ^c	3.53 ^b	3.93 ^a	0.022	*
Protein efficiency ratio	1.32 ^b	1.29 ^{ab}	1.20 ^{ab}	1.15 ^{ab}	1.09 ^a	1.07 ^a	0.046	*
Cost per gain, ₦	230.77	210.32	212.30	221.01	204.69	196.69	10.39	NS
Mortality (%)	2.22	0.56	0.00	0.890	0.56	0.56	0.526	NS
Age at first egg(days)	36.00 ^b	36.00 ^b	36.00 ^b	37.00 ^a	35.00 ^c	35.00 ^c	0.255	*
Average weight of eggs at point of lay(g)	7.57	7.59	7.64	8.09	7.93	7.67	0.107	NS

Means in the same row with different superscripts a, b and c differ significantly (P<0.05)

SEM – Standard Error of Mean

Results and Discussion

The effects of graded levels of dietary protein on performance of Japanese quail chicks are shown in Table 2. The average feed intake results showed significant (P<0.05) differences across dietary treatments. Birds fed 28% CP diet had significantly (P<0.05) higher feed intake than those on 18 and 24% CP based diets. The observed significant feed intake for birds on 28% CP compared to their counterparts on lower protein levels in this study corroborated earlier reports (Haruna *et al.*, 1997 and Kaur *et al.*, 2006). These

authors observed an increase in feed intake as the level of dietary protein increased in diets of Japanese quail chicks. Similar works on young rabbit have demonstrated consistent increase in feed intake as the level of dietary protein increases (Aduku *et al.*, 1991; Deshmuk and Pathak, 1991 and Fasanya and Ijaiya, 2002). The feed intake of birds on 28 % CP diet was however not significantly (P>0.05) different from those on 26 % CP diet.

Generally, a linear growth response was observed in terms of weight gain and final weight of the birds. The average weight

Table 3: Haematological parameters of Japanese quail chicks on graded levels of dietary protein.

Parameters	Dietary levels of protein(%)						SEM	LOS
	18	20	22	24	26	28		
Packed Cell Volume (PCV)	42.56 ^{ab}	42.11 ^b	42.56 ^{ab}	43.83 ^{ab}	45.00 ^{ab}	45.87 ^a	0.734	*
Haemoglobin (Hb) (mg/dl)	15.93	15.50	15.57	15.63	15.73	15.83	0.931	NS
Total Protein (TP)(mg/dl)	4.20	4.30	4.36	4.08	4.58	5.36	0.275	NS
Albumin(mg/dl)	4.49	4.30	4.80	4.87	4.94	5.12	0.325	NS
Red blood Cell (RBC)(x 10 ¹² /l)	3.20	3.52	3.46	3.47	3.68	3.98	0.226	NS

Means in the same row with different superscripts a and b differ significantly (P<0.05)

SEM – standard Error of Mean

LOS – Level of Significance

NS - Non Significance

gain increased significantly ($P < 0.05$) with increasing concentration of protein up to 28% dietary protein level. Quail chicks on 28% CP level gained significantly ($P < 0.05$) higher weight (4.21 g/bird/day) than the 18 and 20% CP treatment groups with 3.21 and 3.55 g/bird/day, respectively. However, the rate of gain of birds on 28% CP treatment group were statistically comparable to those on 22, 24 and 26% CP treatment groups with 3.59, 3.61 and 3.87 g/bird/day, respectively. Birds fed 18% CP had significantly lower weight gain compared to all other dietary treatments. The final live weight followed the same trend with rate of weight gain. There was a linear increase ($P > 0.05$) in body weight at 6 weeks of age as the level of protein increased in the diet. However, unlike the weight gain, no significant ($P > 0.05$) influence of dietary protein was observed on final live weight. The weight gain and final live weight of quails at 6 weeks of age supported earlier recommendations of 26% CP for quail chicks (Shivastava and Panda, 1999). Generally, quail performance is closely related to the intake level of nutrients especially protein and energy. The improvement in growth performance of the birds that resulted from a higher rate of protein supplementation was probably as a result of a better balanced protein and caloric density of the diets. In the present study, as the dietary levels of protein increased, there was a corresponding increase in the amino acid profile of the diets. At higher level of protein intake, more amino acids were consumed and effectively used to bring about increased body weight gain and final live body weight. Generally, the recommended crude protein requirements for quails range between 24 to 27% (NRC, 1994; Shrivastava and Panda, 1999). The non-significance ($P > 0.05$) difference in the rate of gain and body

weight among 24, 26 and 28% CP treatment groups agreed with this recommendation but at variance with the 19% dietary crude protein level recommended for growing quails by Whyte *et al.* (2004).

Feed conversion ratio result showed that birds on the 28% CP diets were most efficient compared to those on 18, 20, 22, 24 and 26% CP based diets. Quails on 18% dietary level of crude protein tended to utilize feed less efficiently ($P < 0.05$) as compared to those on 28% dietary level of crude protein. The efficiency of feed utilization increased linearly as the level of dietary protein increased. The result tend to support more efficient utilization of feed at the higher protein levels as earlier observed for chicks and Guinea fowls (Njike, 1979 and Mandal *et al.*, 1999).

Results of the economics of production showed that low protein and cheaper priced feed were not the most profitable. Feed cost usually increase with increase in protein and energy contents and marginally increase with increasing fibre content. Table 1 showed a slight increase in cost per kg diet as the level of dietary protein increased from 18 to 28%. The 18% CP diet was the least expensive, followed by 20, 22, 24, 26 and 28% CP, respectively. However, at higher levels of protein inclusion, weight gain and efficiency of feed utilization improved which might have accounted for the decrease in unit cost per gain for birds on those diets. Despite the fact that the 28% CP diet had the highest cost per kg of diet compared to the other dietary treatments, birds on this diet had the least cost per kg gain. This trend of cost analysis result could be linked to improved feed utilization and tissue deposition by birds on higher levels of dietary protein. The cost per gain were however not significantly ($P > 0.05$) different across the dietary treatments.

Percentage mortality varied from zero to

Table 4: The carcass characteristics of Japanese quails(0-6 weeks) on graded levels of dietary protein

Parameters	Dietary levels of protein (%)						SEM	LOS
	18	20	22	24	26	28		
Live weight(g/bird)	163.71	164.98	164.18	163.36	163.69	164.98	3.559	NS
Carcass weight(g/bird)	122.04	124.82	126.52	125.67	124.64	127.69	1.553	NS
Dressing percentage (%)	74.52	75.98	77.32	77.28	76.20	77.86	1.780	NS
<i>Organs and prime cuts expressed as % of eviscerated weight</i>								
Liver	5.15	4.91	5.20	5.28	5.24	5.27	0.465	NS
Heart	1.62	1.44	1.66	1.84	1.74	2.63	0.561	NS
Gizzard	3.37	2.77	3.19	2.77	3.08	3.47	0.377	NS
Intestine	7.79	7.45	8.34	8.00	7.89	7.55	0.433	NS
Drumstick	20.80	19.65	18.14	19.52	20.04	20.61	0.558	NS
Breast	31.34	31.64	30.00	29.94	30.06	30.18	0.947	NS
Back	23.06	21.14	21.34	22.38	20.84	19.97	1.030	NS
Wings	9.02 ^a	7.30 ^b	8.72 ^a	8.82 ^a	9.04 ^a	8.31 ^{ab}	0.296	*
Neck	7.65 ^{ab}	6.25 ^b	6.07 ^{bc}	6.64 ^{ab}	7.83 ^a	5.83 ^c	0.331	*
Head	6.64 ^a	4.97 ^b	5.08 ^b	5.30 ^b	5.67 ^{ab}	5.59 ^{ab}	0.413	*
Shank	280	2.45	2.69	2.81	3.02	2.79	0.314	NS

Means in the same row with different superscripts a,b and c differ significantly (P<0.05)

SEM – standard Error of Mean

LOS - Level of significance

NS - Non significance

2.22% but there was no apparent relationship between the dietary treatments and mortality. The observed generally low mortality especially during the brooding period (0-4 weeks) in this study supported the fact that quails are hardy birds and perhaps less disease-prone than other poultry birds (Jadhav and Siddiqui, 2010). Age at first egg ranged between 35 to 37 days. Birds on 26 and 28% crude protein had their first egg at 35 days of age, where as birds on 18, 20, 22 and 24 had theirs 2-3 days later. The high plane of nutrition at higher dietary protein levels could be responsible for the birds maturing 2-3 days earlier than those on 18-24% crude protein diets (Atteh, 2004). Considering the age at first egg in this study, quails can be regarded as early maturing with high potential for meeting the meat and egg demand of the populace if properly fed with high protein diets. Dietary treatment had significant (P<0.05) influence on egg weight at point of lay. Birds on the 18% CP diet had significantly (P<0.05) lowered egg weight

at point of lay than those on 24%CP group.

The effects of varying dietary protein levels on haematological parameters are presented in Table 3. The packed cell volume (PCV) differed significantly (P<0.05) across the dietary treatment. The results for haemoglobin, Total protein, red blood Cells and albumin were not significantly (P>0.05) affected by the levels of dietary protein and did not followed a particular trend as the level of dietary protein increased from 18 to 28%. However, haemoglobin (Hb), Total protein (Tp), albumen and red blood cell values were within the normal range reported for healthy birds (Oladele and Ayo, 1999).

The result of the carcass characteristics is presented in Table 4. The live weight, carcass weight and dressing percentage were not significantly (P>0.05) affected by the dietary treatments. The weight of the liver, heart, gizzard, intestine and most of the prime cuts expressed as percentage of the carcass weight were also not affected by the dietary treatments. This observation

suggests that the experimental treatments produced similar influence on these carcass and organ traits.

Conclusion

It was concluded that for optimum growth performance at the least cost of production, 26% dietary protein inclusion for quail chicks is recommended.

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