

cheaper feed ingredients for the increased production of these birds.

A cheaper and alternative source of feed ingredient for broiler with corresponding good performance could be the Africa locust bean (*Parkia biglobosa*) pulp (Kwari and Igwebuike, 2002). Locust bean pulp (LBP) which is the yellow pulp obtained from the African locust bean tree is called “Dorowa” in Hausa, “Igba” in Yoruba though it does not attract much attention like the beans. It is a potential source of energy because it is very high in carbohydrates and a cheaper source of energy (Afolayan *et al.*, 2012). Blood parameters have been shown to be major indices of physiological, pathological and nutritional status of an animal. A change in the constituent compounds of blood when compared to interpret the metabolic state, health status of an animal as well as quality of feed (Babatunde *et al.*, 1992; Odeomelan *et al.*, 2014a). Therefore, this study was designed to determine the effect of African Locust bean pulp containing diet on the haematological and biochemical indices of Japanese quails.

Materials and Methods

Location of Study Area

The study was conducted at the Poultry Research Unit of the Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola, Girei Local Government Area, Adamawa state. It is located within the Guinea Savannah Zone. It lies between Latitude 9⁰ and 11⁰ North of the equator and Longitude 11⁰ and 14⁰ East of the Greenwich meridian. It shares boundary with Taraba State in the South and West, Gombe state in the North-West and Borno State to the North. Adamawa State has an international boundary with Cameroon Republic along Eastern border (Adebayo, 1990)

The State is characterized by tropical climate marked by dry and rainy season. The rainy season usually commence in the month of April and ends up in October. The dry season then starts in late October and ends in April. The

annual rainfall is 700mm-1600mm with an average minimum temperature of 18⁰C and maximum temperature of 40⁰C.

Experimental Birds, Design and Management

Two hundred and forty Japanese quail birds were selected after brooding and were divided into five treatment groups of forty-eight birds each in a completely randomized design (CRD). Day-old quails were purchased from a certified farm in Jalingo, Taraba State. Each treatment group was further subdivided into four replicates of twelve birds each. The birds were housed in cages of 18×18 inches on a deep litter. Vaccination against Newcastle disease was done at 4 weeks of age and other routine poultry management practices were maintained. The experiment lasted four 42 days.

Experimental diets

The African Locust Bean Pulp was sourced from the local market in which the seeds have been removed from the pulp. It was milled by the milling machine and incorporated in the diets of the birds in graded levels of 0, 5, 10, 15 and 20% representing T1, T2, T3, T4 and T5 respectively. All diets were formulated according to National Research Council (1994) standards for Japanese quails (Table 1). The African locust bean pulp is processed by first of all sun-drying, after which the fruits are removed manually by scrapping it off with the aid of a knife and dehulling of the seed is done with the aid of mortar and pestle to separate the cotyledon from the seed coat and the yellow pulp is the dried as described by Olujobi (2012).

Table 1: Composition of Starter/Grower Experimental Diets (3-6weeks)

Ingredients	Treatments				
	T1	T2	T3	T4	T5
Maize	50.00	47.50	45.00	42.50	40.00
Locust bean pulp	0.00	2.50	5.00	7.50	10.00
Soyabean meal	41.00	41.00	41.00	41.00	41.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Maize offal	5.00	5.00	5.00	5.00	5.00
Bone meal	1.25	1.25	1.25	1.25	1.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
*Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Energy (ME kcal/kg)	2872.09	2846.79	2821.49	2796.19	2770.89
Crude protein (%)	24.72	24.58	24.44	24.30	24.17
Crude fibre (%)	3.58	3.80	4.02	4.24	4.46
Ether extract (%)	2.68	2.60	2.58	2.44	2.36
Calcium (%)	0.70	0.71	0.73	0.74	0.76
Phosphorus (%)	0.67	0.66	0.66	0.66	0.66
Lysine (%)	1.35	1.35	1.35	1.35	1.35
Methionine (%)	0.62	0.62	0.62	0.63	0.63

*Vitamin-Mineral premix (Animal Care- Optimix poultry) provided per Kg the following: Vitamin A 10,000,000iu; Vitamin D₃ 2,000,000iu; Vitamin E, 10,000mg; Vitamin K₃ 2,000mg; Vitamin B₁, 1500mg; Vitamin B₂, 5000mg; Vitamin B₆, 3000mg; Vitamin B₁₂, 15mg; Folic acid, 1000mg; Niacin, 20,000mg; Calpan, 8000mg; Biotin, 50mg; Antioxidant, 125,000mg; Cobalt, 200mg; Selenium, 200mg; Iodine, 1,000mg; Iron, 20,000mg; Manganese, 60,000mg; Copper, 5,000 mg; Zinc, 50,000mg; Choline chloride 100,000mg.

Proximate Analysis

Sample of the African locust bean pulp and experimental diets were subjected to proximate analysis to determine the dry matter (DM), Crude protein (CP), Crude fibre (CF), Ether extract (EE), Nitrogen free extract (NFE) and total ash contents according to AOAC (2002).

Blood Collection

On the last day of the experiment, 5ml of blood sample was collected from eight Japanese quails with one per treatment. Blood samples were taken in the morning via the jugular vein as they were slaughtered by severing them into labeled specimen bottles containing anticoagulant Disodium salt of ethylene diaminetetra-acetic acid (EDTA) and another with no anticoagulant for biochemical analysis. Packed cell volume (PCV), haemoglobin (HB), red blood cells (RBC) and white blood cells (WBC) count were determined as reported by Ajagbona *et al.* (1999) and Uko *et al.* (2000). Mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) were obtained from PCV, HB, and RBC by computing according to standards reported by Jain (1986). The biochemical indices such as serum total protein (STP), albumin, urea, cholesterol, creatinine and glucose were determined by biuret method (Reinhold, 1953). Globulin concentration was

obtained by subtracting Albumin from Serum total protein.

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) using the statistical package for social scientist (SPSS, 2011) version 20 and significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Results and Discussion

The results of the proximate composition of African locust bean pulp (ALBP) as are presented on Table 2. The results show that crude protein (CP) value of 6.49% was similar to the reports of Kwari and Igwebuike (2002) and Alabi *et al.* (2005) who obtained 6.70% and 6.62% CP respectively. The ether extract (EE) content of the African locust bean pulp of 5.04% obtained in this study was higher than the percentage values of 3.09% and 3.00% reported by Bot (2011) and Kwari and Igwebuike (2002) respectively, however lower than 18.00% reported by Bello *et al.* (2008). The low fat content of the African locust bean pulp has a tendency to give a long shelf life to the African locust bean pulp during storage under the right temperature without spoilage and can also be recommended for inclusion in weight reducing diets (Bot, 2011).

The crude fibre (CF) content of the African locust bean pulp obtained in this study was 11.27% and is comparable to 11.49% and

12.00% (12.00g/100g) reported by Bot (2011) and Bello *et al.* (2008) but was lower than 18.00% obtained by Kwari and Igwebuike (2002). The difference in crude fibre content may be due tough texture, especially at maturity and probably due to presence of waxy substances (Zoberi, 1973 and Bot, 2011). According to Shiawoya and Adeyemi (2003), low fibre content of feeds could stimulate feed intake as well as enhance the quality and digestibility of the feed. The value of Nitrogen free extract (NFE) of the African locust bean

pulp recorded in this study was 61.59% which is slightly comparable to 58.00% reported by Kwari and Igwebuike (2002) but was lower than 68.32% (Bot, 2011).

Ash content of 7.54% was higher than 4.08% and 4.18% investigated by Bot (2011) and Gernah *et al.* (2007) respectively but lower than the value of 13.00% reported by Alabi *et al.* (2005). The values of Dry matter (DM) and Moisture contents obtained in the study were 91.9% and 8.07% respectively.

Table 2: Proximate Composition of African Locust Bean Pulp

Nutrients	Percentage composition
Dry matter (Dm)	91.93
Moisture	8.07
Crude protein (Cp)	6.49
Ether extract (EE)	5.04
Crude fibre (Cf)	11.27
Nitrogen free extract (NFE)	61.59
Ash	7.54

Table 3: Proximate Composition of the Experimental Diets (Starter) 2-6 weeks

Nutrient/composition	Graded levels of African locust bean pulp				
	T ₁	T ₂	T ₃	T ₄	T ₅
Moisture	6.93	6.99	7.37	7.11	6.10
Dry matter (DM)	93.07	93.01	92.63	92.89	93.90
Crude protein (CP)	24.94	24.89	24.67	24.79	24.40
Crude fibre (CF)	5.79	5.77	6.53	6.27	6.75
Ether extract (EE)	5.51	4.72	4.72	4.69	4.27
Ash	8.72	8.55	8.55	6.33	8.39
Nitrogen free extract(NFE)	49.03	49.08	49.08	50.41	50.09
*Metabolisable energy (ME)	3081.40	3049.37	3085.99	3036.00	3030.28

*ME (Kcal/kg) = $37 \times \text{CP} (\%) + 81.8 \times \text{EE} (\%) + 35.5 \times \text{NFE} (\%)$ (Pauzenga, 1985)

The results of the haematological indices are presented in Table 4. The results show that there was no significant difference ($P < 0.05$) among the treatments for all the parameters. This is an indication that it did not have any deleterious effect on the birds. The blood profiles have been used widely to establish the health status of animals particularly when they are subjected to dietary treatments that have the tendency of affecting their wellbeing (Ibrahim *et al.*, 2014). The range values of the PCV (52.17-57.30%) and HBC (15.15-16.77g/dl) varied from the ranges of 40.00-44.00% and 10.33-12.00g/100ml respectively investigated by Akade *et al.* (2012) but similar to the values reported by Sohrab *et al.* (2012) for the haemoglobin concentration. The non-significant value of PCV and HBC relative to the control was reported by Ibrahim *et al.* (2014)

which implies that the animals were not anaemic.

The RBC in all the treatments falls within the ranges for matured quails as reported by Woodard *et al.* (1973); Babangida and Ubosi. (2006) and Akade *et al.* (2012). The values ranged from 3.13-3.75 and were not significantly ($P > 0.05$) different across all the treatment groups. The WBC result also showed that there was no significant different ($P > 0.05$) across all the dietary treatments but numerically, a higher value was obtained in the control. The non-significant ($P > 0.05$) value of WBC obtained in this study indicates that the diet did not affect the immune system of the birds. Tuleun *et al.* (2009) also observed a non-significant ($P > 0.05$) difference in all the haematological parameters across the treatments for feeding value of toasted

mucuna seed meal on growing Japanese quails which was said to indicate that the diets contain adequate nutrients to support the health of birds, also nutrients has been recognized as one

of the factors that can compromise and cause alterations in the stability and functions of blood parameters.

Table 4: Haematological Indices of Japanese Quails Fed Graded Levels of African Locust Bean Pulp

Parameters	Graded levels of African locust bean pulp					SEM
	T ₁ (0%)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)	T ₅ (20%)	
Haematological indices						
PCV (%)	52.17	57.20	56.53	53.10	57.30	3.23 ^{NS}
WBC (×10 ³ /μL)	286.70	272.97	272.57	270.70	273.17	2.28 ^{NS}
HBC (g/dL)	15.17	16.77	17.23	15.40	16.37	1.11 ^{NS}
RBC (×10 ⁶ /μL)	3.13	3.20	3.75	3.30	3.41	0.21 ^{NS}
MCV (fL)	166.73	178.73	151.00	162.33	168.00	5.38 ^{NS}
MCH (pg)	48.27	52.27	46.07	46.73	48.00	1.63 ^{NS}
MCHC (g/dL)	29.03	29.27	30.57	28.87	28.53	0.74 ^{NS}

SEM=Standard error of means, NS= Not significant. PCV= Packed Cell Volume, WBC=White Blood Cell, HBC= Haemoglobin Concentration, RBC= Red Blood Cell, MCV= Mean Corpuscular Volume, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration

The results of the biochemical indices of Japanese quails are presented in Table 5. Total protein, albumin globulin and cholesterol values were not significantly ($P>0.05$) different among the treatment groups, except creatinine, urea and glucose which were significantly ($P<0.05$) different. The values for the total protein ranged from 53.50-62.25g/l. Birds fed (5%) locust bean pulp were seen to have the highest value (62.25g/l) and further decreases from that treatment across the treatment groups which indicate that with an increase in African locust bean pulp, there was a corresponding decrease in the total protein. However, since it was not significantly ($P>0.05$) influenced, it had no effect on the total protein. The values obtained by Nazifi and Akasi (2001) which range from 22.30-26.70g/l and were significantly ($P<0.05$) different. The albumin and globulin followed the same trend with the exception of the treatment that contain (0%) locust bean pulp to decrease across the the treatments (5-20%) with increase in locust bean pulp. There was no significant difference ($P>0.05$) observed among the treatment groups on the cholesterol with birds fed 0% locust bean pulp had the highest value of cholesterol numerically. This reveals that African locust bean pulp tend to reduce the level of cholesterol in the bird's blood. This was supported by the report of Al-Harthi and El-Deek (2009) cited by Alfred. (2014) who stated that the cholesterol level reduced as dietary sesame increase in comparison to the control diet. The reduced cholesterol compared to birds fed (0%) locust bean pulp according to Kwari *et al.* (2011) is an added advantage as this will result in lower

cholesterol deposition in poultry products (meat and eggs) and reduce the incidence of coronary heart disease in humans following the consumption of these products as cited by Alfred (2014).

The values obtained for Creatinine and urea were significantly influenced ($P<0.05$) by the dietary treatment. This result is in agreement with the reports of Okosum (1987) and Bamgbose *et al.* (2003) in a study on cockerels who found that serum creatinine and uric acid were influenced by the sources and types of dietary protein used.

The serum glucose was observed to be significantly different ($P<0.05$) among the treatment groups. The values ranged from 12.90-15.15mmol/l. The highest value was observed in birds fed T₃ (15.15mmol/l). African locust bean pulp however had no detrimental effects on the health of the birds. Flurharty and Loerich (1996) as cited by Alfred (2014) who stated that high energy did not have any detrimental effects on the health of the animals, but rather it increases the growth rate in the tropics. Mayes (1996) as cited by Alfred (2014) reported that continuous supply of glucose is necessary as a source of energy especially for the nervous system and the erythrocytes. However, glucose level in the study revealed the birds were well fed and were not just surviving at the expense of the tissues of their bodies. Odeomelam *et al.* (2014b) similarly, obtained a non-significant ($P>0.05$) effect of Basil leaf meal and antibiotic growth promoter (Oxytetracycline Hcl) on the total protein, albumin and globulin with a significant ($P<0.05$) difference obtained for creatinine and

glucose of broiler chickens. However, cholesterol unlike in this study was significantly ($P<0.05$) influenced. This

variation could be due to age or type of bird, test ingredient used, season and procedures of analysis.

Table 5: Biochemical Indices of Japanese Quails Fed Graded Levels of African Locust Bean Pulp

Graded levels of African locust bean pulp						
ParametersT ₁ (0%)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)	T ₅ (20%)	SEM	
Total protein (g/L)	58.50	62.25	59.50	57.75	53.50	2.36 ^{NS}
Albumin (g/L)	20.90	21.48	20.00	19.15	17.93	1.29 ^{NS}
Globulin (g/L)	37.60	40.78	39.50	38.60	35.58	2.72 ^{NS}
Cholesterol (mg/dL)	186.75	168.00	156.50	152.50	169.50	13.98 ^{NS}
Creatinine (mmol/L)	227.25 ^{bc}	242.50 ^c	175.25 ^a	184.25 ^{ab}	183.50 ^{ab}	11.77 [*]
Urea (mmol/L)	12.05 ^{ab}	14.45 ^b	10.15 ^a	10.48 ^a	9.95 ^a	0.82 [*]
Glucose (mmol/L)	13.80 ^{bc}	13.30 ^{ab}	15.15 ^d	12.90 ^a	14.40 ^c	0.35 [*]

SEM=Standard error of means, NS= Not significant, *= Significant ($P<0.05$). abcdMeans on the same row with different superscripts differ ($P<0.05$) significantly.

Conclusion

It can be concluded that African Locust Bean Pulp can be incorporated into the diets of Japanese quails up to 20% as energy source without any adverse effect on the blood chemistry of the birds.

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