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Growth performance, haematological characteristic and serum biochemistry of Japanese quails fed with diets containing African pear seed meal

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Target Audience: Animal scientist, Poultry farmers, Nutritionist, Researchers.

Abstract

The growth, haematological characteristics and serum biochemistry of one hundred and thirty-five Japanese quails fed diets containing African Pear Seed Meal (APSM) was investigated in a completely randomised design experiment with five treatments and each treatment was replicated three times. APSM was fed at 0%, 15%, 30%, 45% and 60% levels of inclusion as partial and total replacement for maize. Data collected included average feed intake (AFI), average weight gain (AWG), specific growth rate (SGR), operating protein efficiency ratio (PER), feed conversion ratio (FCR), haemoglobin (Hb), packed cell volume (PCV), white blood cell (WBC), red blood cell (RBC), Mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) serum total protein (PRO), Albumin (ALB), glucose (GLU), creatinine (CREAT), cholesterol (CHOL) and Alkaline phosphatase (ALP). Results revealed that the increasing level of inclusion of APSM significantly (P<0.05) depressed the weight gain, specific growth rate, protein efficiency ratio, and feed conversion ratio of the birds. The increasing level of APSM significantly (P<0.05) influenced all the haematological variables except RBC and serum biochemical variables except ALB and CREAT. Birds fed with diet containing 15% had the optimum performance; hence, APSM can be included at 15% in the diets of quails.

Keywords: African pear seed, quail birds, Nutritional values, Haematology, Blood Biochemistry

Description of Problem

Coturnix coturnix are birds mainly produced for meat, eggs and used as laboratory animal. They are also viable due to their short generation interval, early maturity, growth rate, excellent disease resistance, low feed and floor space requirement (1). Maize is the major source of energy in poultry feed and usually accounts for over 60% of livestock feed. It determines farmers profit because it constitutes 60 - 70% of the total cost of poultry production and if farmers must ensure that poultry produce are available at affordable prices to the populace, the cost of feeding livestock must be reduced completely (2). Hence, research needs to be encouraged towards searching for alternate feed ingredients to ensure reduction in the cost of feeding

farm animals by exploiting underutilised feed resources which will not have negative impact on their growth and welfare (3).

African pear tree (*Dacryodes edulis*) is a medium-sized evergreen plant belonging to the family of *Burseraceae.* The seed of *Dacryodes edulis* is rich in carbohydrate, lipid, protein, crude fibre, potassium, calcium, magnesium and phosphorus**,** It is also rich in amino acids such as lysine, phenylalanine, leucine isoleucine, contains a considerable amount of fatty acid such as palmitic, oleic and linoleic acids (4; 5; 6). The proximate analysis of the seed showed that it contained dry matter of 89.56%, ether extract of 8.98%, crude fibre of 7.42%, crude protein of 6.89%, ash of 3.36% and Nitrogen free extract of 73.26% (6). In Nigeria the seeds are usually available in large amount from May to October which is the fruiting season and are disposed after the fleshy pericarp has been eaten by man (7). Studies have shown that *Dacroydes edulis* seeds are suitable as supplement in poultry diets (4). This work therefore evaluated the growth performance, haematological characteristics and serum biochemistry of Japanese quail fed with diets containing African pear seed meal (APSM) so as to determine its suitability as energy source in their diet.

Materials and Methods

The study was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Production Technology, Lagos State Polytechnic Ikorodu, Lagos State. The African pear fruits were obtained from Ayedere fruit market in ketu, Ikosi-Isheri LGA, Lagos State, during the fruiting season. The fruits were kept for some days to soften the pericarp and endocarp which were later removed by hand. The tough leathery coat of the seed was removed to expose the cotyledon. The cotyledon was separated carefully from the seed using knife and hand and the seed was sun dried for five days thereafter oven dried and crushed to form African pear seed meal (APSM). The APSM was incorporated into the feed at 0%, 15%, 30%, 45% and 60% as partial/total replacement for maize as shown in table 1.

One hundred and thirty-five (135) three (3) weeks old Japanese quails were randomly allocated to five dietary treatments with three replicates in a completely randomized design experiment. The experimental birds were housed and fed *ad-libitum* in an improvised battery cage with improvised feeder and drinker in each of the cubicle. All management and medications were strictly observed throughout the 13 weeks of the study. African pear seed meal and the experimental diets were analysed for proximate composition using the methods of the association of the official analytical chemist method (6). At the end of four weeks of feeding, blood samples were collected from each replicate into labelled Ethylene Diamine Tetra-acetic Acid (EDTA) bottles and lithium heparin bottles for haematological and serological analyses using the procedure described by (9). Data were collected weekly on body weight gain and feed intake. Feed conversion ratio and protein efficiency ratio were calculated as feed intake per

unit weight gain and weight gain per protein intake respectively.

The Specific growth rate was calculated as follows:

Specific growth rate (SGR) = $\frac{(\ln W_f - \ln W_i \times 100)}{T}$

Where:

$\ln W_f$ = the natural logarithm of the final weight

$\ln W_i$ = the natural logarithm of the initial weight

T = time (days) between $\ln W_f$ and $\ln W_i$

Table 1: Composition of Experimental Diets

Feed Ingredient	T1	T2	T3	T4	T5
Maize	60	45	30	15	0
APSM	0	15	30	45	60
GNC	24	24	24	24	24
Fish meal	1	1	1	1	1
PKC	7	7	7	7	7
Blood meal	3	3	3	3	3
Bone meal	2.1	2.1	2.1	2.1	2.1
Palm oil	1	1	1	1	1
Limestone	1	1	1	1	1
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.3	0.3	0.3	0.3	0.3
Salt	0.25	0.25	0.25	0.25	0.25
Determined Proximate Composition					
Dry matter	89.5	89.75	87	87.5	88.35
Crude protein	20.58	20.34	20.17	19.884	19.5
Ether extract	4.122	5.622	7.122	8.622	10.122
Crude fibre	4.07	4.205	4.34	4.475	4.61
Ash	4.33	4.61	3.96	4.1	4.23
Nitrogen free extract	56.398	54.973	51.408	50.419	49.888
Gross energy (Kcal/Kg)	3100.77	3164	3153.85	3230.86	3320.5

Haematological parameters evaluated include erythrocyte (RBC), leucocytes (WBC) packed cell volume (PCV) and Haemoglobin (Hb) while the MCV, MCH and as follows:

i. Mean corpuscular volume (MCV) = $\frac{PCV\,(\%)}{RBC\,(T/L)}$

ii. Mean corpuscular Haemoglobin = $\frac{Hb\ (g/dl)}{RBC\ (T/L)}$

iii. Mean corpuscular Haemoglobin Concentration (MCHC) = $\frac{MCH\ (pg)}{MCV\ (F/L)}$

Serological variables such as total protein concentration (g/dl), Glucose concentration (g/dl), Albumin concentration (g/dl), Creatinine (mg/dl), cholesterol concentration (mg/dl) and alkaline phosphatase (u/l) were also determined.

All data were subjected to analysis of variance and all significantly differences mean were separated with Duncan Multiple Range Test using the Assistat-statistical Assistance 7.6 beta software (10).

Results and Discussion

The proximate composition of APSM in Table 2 revealed that it contained dry

matter of 85.25% which falls within the range 85.25- 89.53% reported by (6). Similarly, the crude protein value of 4.36% also falls within the range of 1.45 to 6.98% reported by (6; 11). Ether extracts 14.5%, crude fibre 2.49%, ash 3.19%, nitrogen free extract 60.71%. The gross energy of APSM was 4271.58Kcal/Kg. The dry matter used in this study recorded falls within the range 85.25- 89.53% reported by (6). The crude protein of APSM used in this study falls within the range of 1.45 to 6.98% reported by (6; 11). The ether extract 14.5% used in the study is higher compared to the one reported by (6) which is 8.98%. The crude fibre value obtained 2.49% from the study was much lower than the range of 7.42 to 48.5% reported by (4; 6).The ash content obtained 3.19 was similar to 3.36% reported by (6). The nitrogen free extract 60.71% of APSM obtained in study was lower compared to 73.26% reported by (6). The gross energy 4271.58Kcal/Kg obtained in the study is much higher than 3820.74Kcal/Kg reported by (6). The differences in the chemical composition of APSM used in this study and those of the literature might be attributed to the difference in the soil and climate condition of the regions they were obtained (12). The lower ash and crude fibre of APSM used in the study may be as a result of the fact that the seed coat was removed during processing, since seed coats contained relatively higher fibre and mineral content when compare with the whole seed (13).

Table 2: Proximate composition of African Pear Seed Meal

Variable	APSM
Dry matter	85.25
Crude protein	4.36
Ether extract	14.5
Crude fibre	2.49
ASH	3.185
Nitrogen free extract	60.71
Gross energy (Kcal/Kg)	4271.58

Growth performance of Japanese quails fed with African Pear Seed Meal is shown in Table 3. The results revealed that there were significant differences ($P<0.05$) in weight gain, protein efficiency ratio, specific growth rate and feed conversion ratio of birds. The increasing levels of APSM significantly ($P<0.05$) influenced the growth performance indices of the birds. The feed intake and weight gain reduced as the level of APSM increased. These results are similar to that of (14) who reported decrease in feed intake and weight gain of broiler fed varying levels of APSM and that the reduction might be attributed to the turpentine smell of the seed. Bird fed 15% (T2) APSM had the highest weight gain (3.49g) followed 2.39g (T3), 1.93g (T4) and 1.49g (T5). The birds fed least level of APSM had better and comparable growth rate with those fed with maize (control diet) but increase in the inclusion of APSM beyond 15% (25% replacement value for maize) depresses the growth

performance of the birds. This result confirms the findings of (15) that the growth of broilers were significantly (P<0.05) depressed when levels of maize substitution with APSM in their diets exceeded 30%.

Table 3: Growth performance of Japanese quail fed with African pear seed meal

Parameters	T1	T2	T3	T4	T5	SEM
Feed intake (g/bird/day)	23.54	25.75	22.85	22.96	21.95	6.80
Weight gain (g/bird/day)	2.72^{b}	3.49^{a}	2.39^{c}	1.93^{d}	1.49^{e}	0.25
FCR	8.63^{C}	7.36^{c}	9.55^{bc}	11.92^{b}	14.74^{a}	2.61
PER	0.56^{ab}	0.69^{a}	0.53^{b}	0.43^{b}	0.35^{c}	0.14
SGR	0.032^{ab}	0.034^{a}	0.020^{c}	0.027^{b}	0.01^{d}	0.0004

$^{abcd}\rightarrow$ mean with the same superscript on the same row are not significantly different (P>0.05).
SEM →Standard error of means

Haematological indices of the Japanese quail bird fed APSM are shown in Table 4. The varying levels of APSM significantly (P<0.05) influenced the haematology parameters of the birds except RBC. The highest value of Hb (14.91g/dl) was recorded among birds on diet 4 (45% APSM) which was statistically different from birds fed with diet 1 (maize control diet). The Hb value is slightly higher than value reported by (16). This observation may probably be due to the higher concentration of iron in African pear seed compared to maize (17) reported that the iron content of African pear seeds ranges from 42.78 – 64.11mgKg^{-1} while the iron content of maize is 48mgKg^{-1} (18). Iron has been reported to increase blood cell and haemoglobin concentration (19). The packed cell volume (PCV) values of quail fed graded levels of APSM ranged from 24% in diet 2 to 42% in diet 4 and were significantly different (P< 0.05) from one another. These values were within normal range of 23-53% reported (19) and for quail. The red blood cell count increased as the level of APSM increased in the diet. The high level obtained in this study may be attributed to increased PCV. PCV is useful in assessing the protein and nutritional status (20).

Table 4: Haematological In dices of Japanese quail birds fed with African pear seed meal

Parameters	T1	T2	T3	T4	T5	SEM
HB (g/dL)	8.61^{c}	7.87^{c}	11.33^{b}	14.91^{a}	9.77^{bc}	1.25
PCV (%)	26.00^{d}	24.00^{e}	34.00^{b}	42.00^{a}	28.00^{c}	3.26
WBC (10^{3}/mm^{3})	7.008^{c}	7.040^{b}	6.016^{e}	6.304^{d}	8.064^{a}	0.36
RBC (10^{6} /mm^{3})	3.01	2.97	3.73	4.67	3.31	0.31
MCV (fl)	86.38^{b}	80.81^{c}	91.15^{a}	89.94^{a}	84.59^{a}	1.86
MCH (pg.)	28.61^{b}	26.50^{c}	30.38^{ab}	31.93^{a}	29.52^{b}	0.91
MCHC (g/L)	33.12^{c}	33.54^{bc}	33.57^{ab}	35.50^{a}	34.89^{a}	0.44

$^{abcd}\rightarrow$mean with the same superscript on the same row are not significantly different (P>0.05)

RBC falls within the normal range for matured quail birds reported by earlier workers (21). The increase in RBC may likely be due to the iron content of APSM since iron is important for red blood formation. MCV, MCH and MCHC followed a similar trend as the Hb, PCV and RBC which is expected as all the above mentioned parameters are descriptors of the function and concentration of erythrocyte (red blood cells) in the blood (22). Hence, the inclusion of APSM did not adversely affect the health condition of the birds. WBC ranged from 6.016 ($x10^3/mm^3$) in birds fed diet 3 to 8.064 ($x10^3/mm^3$) in birds fed diet 5. There were significant differences among the treatment groups with birds on diet 5 having the highest value. The increase in WBC count is an indication that the birds were reacting to some conditions which could be inflammatory condition, dietary condition or other factors.

Table 5: Serum Biochemistry of Japanese quail birds fed with African pear seed meal

Parameters	T1	T2	T3	T4	T5	SEM
PRO (g/dl)	39.93^{bc}	41.10^{ab}	44.62^{a}	38.99^{c}	42.98^{a}	1.02
ALB (g/dl)	4.82^{a}	5.32^{a}	5.41^{a}	5.28^{a}	5.23^{a}	0.10
GLU (/mg/dl)	146.89^{b}	135.84^{b}	132.61^{b}	144.13^{b}	186.95^{a}	9.77
CREAT (mg/dl)	1.02	0.79	0.75	0.91	0.75	0.05
CHOL (mg/dl	137.41^{b}	227.21^{a}	152.38^{b}	136.65^{b}	153.74^{b}	16.82
ALK (u/l)	96.60^{a}	74.54^{bc}	82.80^{b}	88.32^{ab}	91.08^{ab}	3.76

^{abcd} means within row different superscripts are significantly different ($P<0.05$)

The results of the biochemical indices are given in Table 5. Statistical analyses revealed that the varying levels of APSM significantly ($P<0.05$) influenced the serum biochemical parameters investigated except for albumin and creatinine. The total protein values ranged from38.99g/dl in birds fed diet 4 (45%APSM) to 44.62g/dl in birds fed diet 3 (30% ASPM). These values were comparable lower than the values of 67.65- 68.55g/l reported in earlier literature (23). The highest serum creatinine content was recorded among birds fed with diet 1 and lowest in those fed with diet 3 and diet 5. Serum creatinine and total protein had been reported to depend on the quality and quantity of protein supplied in the diet (24; 25); the creatinine value of the birds fed with the experimental diets was within the range of
the value reported by (15) but lower than 1-2g/dl reported for healthy birds. Birds fed with diet 1(0%APSM) had the lowest serum albumin while those fed with diet 3(30%APSM) had the highest serum albumin content. The albumin of the birds fed with the experimental diets falls within the range for adult Japanese quail (26). The highest value of alkaline phosphatase was recorded in birds fed with diet 1 and lowest in birds fed with diet 3. The highest serum glucose was recorded in birds fed with diet 5(60%APSM; 100% replacement value for maize), while the lowest was observed in those fed with diet 3(30%APSM). Generally the serum glucose of birds fed with the control diet

and those fed with lower levels of APSM were similar (P>0.05) but were significantly (P<0.05) lower than those fed with diet 5(60%APSM; 100% replacement value for maize). High serum glucose is an indication of pancreatic or liver disease (27); hence the high serum glucose observed in birds fed with higher levels of APSM might be an indication of pancreatic or liver distress arising from the prolonged feeding of APSM which contain high amount of fat. Prolonged consumption of fatty food has been implicated in liver disease and obesity (28). This result confirms the assertion of (14) that prolonged feeding of APSM might predispose animals to liver stress as a result of excessive fat intake.

Conclusions and Applications

The result of the study confirms the following facts:

1. African Pear Seed Meal is relatively low in protein, high in fat and possesses comparable energy content with maize.
2. Feeding of Japanese quails with diets containing 45% APSM did not adversely affects the health of the birds
3. The increasing levels of APSM in the diet of quail birds negatively influenced the growth performance of birds.
4. Birds fed with diet 2 (15% APSM; 25% Replacement value for Maize) had a relatively better performance than those on the maize control diet.

Therefore, APSM can be used to replace 25% of maize in the birds' diets and processing of APSM to enhance its feeding value is however recommended.

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