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EFFECTS OF PAWPAW (*Carica papaya*) LEAF MEAL ON HAEMOTOLOGICAL AND SERUM BIOCHEMICAL PARAMETERS OF JAPANESE QUAILS

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ABSTRACT
A study was conducted to evaluate the haematological and serum biochemical responses of Japanese quails fed diets containing graded levels of pawpaw leaf meal (PLM) as a potential alternative protein source. A total of 270 quails were randomly assigned to five dietary treatments (0, 5, 10, 15, and 20% PLM) in a completely randomized design with three replicates each. Blood samples were analyzed for haematological and biochemical indices at six weeks of age. Results showed significant ($p<0.05$) increase in packed cell volume and red blood cell counts at 20% inclusion levels, while haemoglobin concentration remained within the normal physiological range, indicating no anaemia and adequate oxygen-carrying capacity. White blood cell counts and mean corpuscular volume exceeded reference values, possibly reflecting immune responses to dietary saponins. Serum analysis revealed significantly higher total protein and albumin in birds fed 20% PLM, while globulin, glucose, triglycerides, AST, ALT, creatinine, and albumin:globulin ratio were not significantly ($P>0.05$) affected. Cholesterol levels, however, increased in birds fed diets containing 15 and 20% PLM. Creatinine values remained within normal ranges, suggesting no impairment of liver or kidney function. In conclusion, pawpaw leaf meal can be included up to 20% in quail diets without adverse effects on blood health, though higher inclusion levels may elevate cholesterol.

Keywords: Pawpaw leaf, haematology, serum, Japanese quails, meal

DESCRIPTION OF THE PROBLEM

Protein malnutrition remains one of the most pressing nutritional challenges in sub-Saharan Africa, where the average individual consumes only about one-third of the recommended daily animal protein requirement [1]. A promising strategy to bridge this gap lies in the development of the poultry subsector, particularly through the rearing of fast-growing species like the Japanese quails (*Coturnix coturnix japonica*). Quails are hardy, fast-growing, and early-maturing birds that require minimal space and feed inputs [2]. Despite these advantages, the greatest impediment to expanding quail production remains the high cost of feed, which accounts for up to 70% of production expenses [3]. In response, researchers have intensified the search for unconventional, affordable, and locally available feed resources [4]. Leaf meals have emerged as promising alternatives in poultry nutrition. They are inexpensive, locally available, and provide not only crude protein but also vitamins, minerals, and bioactive compounds that may enhance animal health and product quality [5, 6, 7]. Among these, pawpaw (*Carica papaya*) leaves have attracted attention due to their high crude protein content (~30%) and relatively low fibre (~5%), proteolytic enzymes such as papain and chymopapain, and appreciable levels of micronutrients and antioxidants [7, 8, 9]. This study was therefore designed to evaluate the haematological and serum biochemical parameters of Japanese quails fed diets containing graded levels of pawpaw leaf meal.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Samaru, Zaria; Kaduna State.

Experimental Design and Management of Birds

Two hundred and seventy (270) Japanese quail birds were randomly assigned to five dietary treatments, with three replicates of 18 birds each, in a Completely Randomized Design (CRD). All routine management practices and necessary biosecurity measures were implemented. Water and feed were provided *ad libitum*.

Haematological and Serum Biochemical Study

At the end of the growing phase (week 6 of age), 1.0ml of blood was collected at the point of slaughter of three quails in each replicate into sterile bottles containing Ethylene Diamine Tetraacetic Acid (EDTA) as an anti-coagulant to determine haematological parameters, while another portion (1.0ml) was collected in sample bottle for serum biochemical analysis. Samples were taken to the Clinical Pathology Laboratory, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for analysis.

RESULTS AND DISCUSSION

Effect of diets containing graded levels of pawpaw leaf meal on haematological parameters of Japanese quails

The haematological indices (Table 1) result revealed distinct responses across parameters. Birds on 20% PLM diets recorded significantly higher ($p<0.05$) packed cell volume, while haemoglobin levels were comparable among treatments except for a reduction in the 20% PLM group. Red blood cell counts were significantly elevated ($p<0.05$) in birds on 5% PLM, whereas higher inclusion levels (10–20%) showed no variation from the control. White blood cell counts and mean corpuscular volume remained unaffected ($p>0.05$) by PLM inclusion. Mean corpuscular haemoglobin was highest in birds fed 0%, 15%, and 20% PLM, with the lowest values in the 5% group. Mean corpuscular haemoglobin concentration was similar in birds on 0%, 5%, and 20% PLM, though significantly reduced in the 10% group relative to 15% PLM. Lymphocyte and neutrophil counts were not significantly influenced by dietary treatments.

Packed cell volume, haemoglobin concentration, and red blood cell counts varied significantly across treatments but remained within the normal range reported by Agina *et al.* [10], indicating that the birds were not anaemic.

According to Akintunde [11], a PCV value below 35% suggests anaemia. Haemoglobin values recorded fell within the recommended concentrations for healthy birds 7–18.6 g/dl [12]; 8.61–20.57 g/dl: [10]. Similarly, RBC counts were within the normal range (2.02–6.9 × 10^6/uL) [10], confirming good health status and high oxygen-carrying capacity. Birds with high haemoglobin concentrations are better able to resist respiratory stress, while those with low oxygen-carrying capacity are more susceptible to respiratory diseases [11].

Table 1: Effect of diets containing graded levels of pawpaw leaf meal on haematological parameters of Japanese quails

Parameters	Inclusion levels of pawpaw leaf meal (%)						
	0	5	10	15	20	SEM	Ref Value
PCV (%)	49.42^{b}	54.42^{b}	54.03^{b}	53.27^{b}	61.53^{a}	3.49	25.00 - 66.00+
Hb (g/dl)	17.68^{a}	18.19^{a}	17.77^{a}	17.90^{a}	16.30^{b}	0.59	8.61 - 20.57+
RBC (10^6/uL)	3.01^{b}	3.57^{a}	3.37^{ab}	3.47^{ab}	3.12^{ab}	0.24	2.02 - 6.9+
WBC (10^3/uL)	130.19	127.09	126.61	134.06	124.81	5.65	-
MCV (fl)	145.86	154.27	155.88	149.53	148.21	8.63	64.68 - 131.91+
MCH (pg)	55.81^{ab}	49.72^{b}	44.22^{b}	59.80^{ab}	72.82^{a}	10.95	20.72 - 69.08+
MCHC (g/dl)	35.34^{ab}	40.09^{ab}	29.10^{b}	52.32^{a}	49.07^{ab}	11.21	20.77 - 64.28+
Lymphocytes (%)	82.68	83.98	85.58	86.30	78.99	5.27	40 – 100++
Neutrophil (%)	6.98	9.50	7.40	8.68	9.77	3.01	3.30 – 11.05++

a,b, = means with different superscripts on the same row are significantly different ($p<0.05$).PCV = Packed Cell Volume, HB = Haemoglobin, RBC = Red Blood Cells, WBC = White Blood Cells, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration. SEM = Standard Error of Means, + = *Agina et al. [10], ++ Anzai et al. [17].*

White blood cell counts and mean corpuscular volume were not significantly different among treatments but exceeded the normal range [10] possibly reflecting increased immune activity

against anti-nutritional factors such as saponins in PLM. This is consistent with the role of WBCs in antibody production and phagocytosis as well as their function in providing rapid defense against pathogens [13; 14; 15]. Mean corpuscular haemoglobin was slightly above the normal range as reported by Agina *et al* [10] while mean corpuscular haemoglobin concentration remained within the normal range, suggesting nutritional adequacy of the diets [11]. Lymphocyte values (78.99–86.30) were slightly lower than those reported by Akintunde *et al.* [11] (87.10–94.89 g/dl) but higher than values obtained by Banjoko *et al.* [16] in broilers fed PLM, with differences likely due to feed type, inclusion levels, and species variation. Neutrophil percentages (6.98–9.77) were comparable to those reported by Anzai [17] (3.30–11.05) and Akintunde *et al.* (2016) (4.67–10.03) for Japanese quails fed alternative feed resources.

Effect of diets containing graded levels of pawpaw leaf meal on serum biochemical composition of Japanese quails

The result of serum biochemical composition obtained for Japanese quails fed diet containing Pawpaw Leaf Meal at graded levels is presented in Table 2. Total Protein and Albumin were significantly ($p<0.05$) higher in birds fed 20% PLM compared to other treatment groups. Globulin and Glucose were not significantly ($p>0.05$) influenced by the inclusion of Pawpaw Leaf Meal in the diet of Japanese quails. Total cholesterol was significantly higher in birds fed 15% and 20% PLM compared to other treatment groups. Triglycerides, AST, ALT, Creatinine and the ration of Albumin to Globulin were not significantly ($p>0.05$) influenced by the inclusion of Pawpaw Leaf Meal in the diet of Japanese quail birds.

Total protein values across treatments were within the ranges reported by Agina *et al*. [10] and [18] but lower than those observed by Akande *et al*. [19] in quails fed cassava peel meal fortified with brewer's grain. Such variation may reflect differences in protein intake [20]. Serum protein concentration is a function of hormonal balance, nutritional status, water balance, and overall health [21]. As noted by Eggum [22] diet protein correlates with total serum protein and serves as an indicator of protein quality. Serum proteins play key roles in osmotic regulation, immunity, and transport [18]. Albumin levels in this study were below the mean reported by Helal *et al.* [23] but within the physiological range documented by Agina *et al*. [10] Albumin is a marker of hydration status and organ function [24] Globulin values showed no significant differences and were within the normal range [10] indicating healthy birds, since globulin levels reflect immune activity and inflammation [24]

Table 2: Effect of diets containing graded levels of pawpaw leaf meal on serum biochemical composition of Japanese quails

Parameters	Inclusion levels of pawpaw leaf meal (%)						
	0%	5%	10%	15%	20%	SEM	Ref Value (Min – Max)
Total Protein (g/dl)	2.68^{ab}	2.41^{b}	2.61^{b}	2.56^{b}	3.40^{a}	0.37	2.75 - 7.84^{++}
Albumin (g/dl)	1.44^{ab}	1.26^{b}	1.44^{ab}	1.23^{b}	2.02^{a}	0.34	1.08 - 5.47^{++}
Globulin (g/dl)	1.24	1.15	1.17	1.33	1.38	0.23	1 – 3.11^{++}
Glucose (mg/dl)	131.60	128.06	125.80	128.18	121.45	5.32	188.58-197.42^{+}
Total Cholesterol (mg/dl)	253.38^{b}	271.74^{b}	339.86^{ab}	385.94^{a}	379.67^{a}	44.35	33.33 – 266.67^{++}
Triglycerides (mg/dl)	1643.60	1716.30	1477.90	1774.60	1810.70	232.25	-
AST (μ L)	59.11	64.44	61.78	63.00	65.11	3.30	23.85 – 90.70^{++}
ALT (μ L)	33.33	35.00	26.78	33.33	28.56	4.39	10.17 – 38.51^{++}
Creatinine (mg/dl)	0.62	0.60	0.75	0.80	0.58	0.16	0.15 – 0.92^{++}
A:G ratio	1.27	1.22	1.42	1.04	1.71	0.45	0.43 – 3.81^{++}

a,b = means with different superscripts on the same row are significantly different $p<0.05$).ALT = Alanine aminotransferase, AST = Aspartate aminotransferase, A:G = Albumin-Globulin ratio, SEM = Standard Error of Means ++ = *Agina et al.* [10].

Glucose levels were not significantly affected across treatments, though lower than values reported by Kabir [25] possibly due to variations in feed intake and metabolism. Cholesterol values in the control diet fell within the range reported by Agina *et al*. [10] but PLM inclusion appeared to elevate cholesterol, a condition linked with metabolic and hormonal

disorders [24]. Enzyme activity (ALT and AST) was not significantly different among treatments and remained within normal ranges for quails [26, 10], suggesting normal liver function and no toxic effects of PLM inclusion. Creatinine values were lower than those of Mnisi, and Mlambo [27] but within the range suggested by Agina *et al*. [10] indicating unimpaired kidney function. The albumin–globulin ratio also fell within the physiological range of Agina *et al*. [10], though below the mean of Agina *et al*. [23] a disparity likely attributable to dietary treatments.

Conclusion and Application

In can be concluded that the inclusion of pawpaw leaf meal in the diet of quails does not pose any serious deleterious effect on the health of the birds as shown by the result obtained on haematological and serum biochemical profile of the birds where most parameters were within the normal physiological range for healthy quails. Thus, pawpaw leaf meal can be used by farmers as a very good protein source.

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