PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 10 (3): 254-259, 2011
ISSN 1680-5194

Effect of Feeding Graded Levels of *Dacryodes edulis* Seed Meal on the Haematological and Serological Indices of Broiler Chickens in the Tropics

L. Bratte
Department of Animal Science, Delta State University, Asaba Campus, Asaba, Nigeria

Abstract: The effect of partial replacement of dietary maize with seeds of the African Pear (*Dacryodes edulis* G. Don, H.J. Lam) in the diets of broiler chickens on the haematological and serological indices of broilers was investigated. Two hundred and twenty-five (225) day-old Anak broilers were randomly assigned to five dietary treatments with 45 birds per treatment made up of three replicates of 15 bids each in which *Dacryodes edulis* Seed Meal (DESM) replaced maize at 0% (control), 15%, 30%, 45% and 60% levels at the starter (0-28 days) and finisher (29-56 days) phases of production. The birds in each treatment were provided feed and water *ad libitum*. Variations in the experimental diets (treatments) had no significant effect ($p>0.05$) on all the haematological and serological indices measured except blood cholesterol, which showed highly significant ($p<0.01$) differences with changes in the levels of dietary DESM. Weekly variations were, however, significant ($p<0.05$) for mean Packed Cell Volume (PCV), Haemoglobin (Hb) and urea and highly significant ($p<0.01$) for mean Red Blood Cell (RBC) count, Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and mean blood cholesterol, glucose, creatinine, albumins, globulins and total proteins. Significant ($p<0.05$) Treatment x Time (Weeks) interaction effects occurred in mean PCV, WBC, Hb and in blood cholesterol. It was concluded, on basis of the similarity in the haematological and serological indices between the control diet and the other dietary treatments, that *Dacryodes edulis* Seed Meal could safely replace as much as 60% of the maize in conventional broiler diets without deleterious effects on broilers.

Key words: *Dacryodes edulis*, haematology, serology, broilers, tropics

INTRODUCTION

Seeds of the African pear (*Dacryodes edulis* G. Don, H.J. Lam) are usually discarded after the highly cherished oily pulp has been consumed due, perhaps, to a dearth of information as to the possible uses to which the seeds can be put. They are known to create serious environmental waste problems whenever the fruit is in season (Iyawe, 2009). In the wet humid regions of Africa, where this valuable tree resource is widely cultivated, its area of distribution extends from Sierra Leone through Nigeria and the Cameroons to Angola, Uganda and Zimbabwe (Ajibesin, 2010). Preliminary studies on the nutrient composition of the seed (Bratte *et al*., 2010) indicate that it is high in energy (in the form of lipids and soluble carbohydrates) and so could be used for partially replacement of maize in commercial non-ruminant diets (Bratte *et al*., 2010). However, seeds of the African pear have also been reported to contain some anti-nutrient factors such as tannins, oxalates, phytates and trypsin inhibitors (Iyawe, 2009; Bratte *et al*., 2010) which may interfere with nutrient utilization and create undesirable effects in non-ruminants by making vital nutrients unavailable to the animals. While reduction of feed costs in commercial non-ruminant production is essential for reducing the cost of livestock products in the tropics through substitution of expensive conventional feed ingredients (such as maize) with cheaper non-conventional alternatives (such as seeds of the African pear), some caution is advised in order not to subject animals to health hazards arising from the use of such non-conventional ingredients. This study was therefore carried out to determine the effects of feeding graded levels of *Dacryodes edulis* seed meal on the haematological and serological indices of broiler chickens.

MATERIALS AND METHODS

Experimental site: The study was carried out at the Poultry Unit of the Teaching and Research Farm, Delta State University, Asaba Campus, Asaba, Nigeria (longitude 60 45' E and latitude 60 12' N). It has a Derived Savannah vegetation type, with annual rainfall ranges of 1800mm to 3000mm and maximum day temperatures of 27.5-30.9°C.

Preparation of the feed ingredient and diets: Seeds of the African pear, *Dacryodes edulis* (G. Don, H.J. Lam), which are usually discarded during the fruiting season in Nigeria, were picked up from the environment, washed in water to remove all sand particles and dehulled. The cotyledons were carefully separated by hand, sun-dried for several days until a safe moisture level of 10-13% was attained and ground with a hammer mill to obtain *Dacryodes edulis* Seed Meal (DESM). Five

broiler diets in which DESM replaced maize at 0, 15, 30, 45 and 60% were formulated for the starter phase (0-28 days) and finisher phase (29-56 days) of feeding, with 0% DESM for maize diets being the control diets. The diets in each phase were formulated to be isocaloric and isonitrogenous with the starter diets containing approximately 2900 kcal/kg ME and 23% crude protein and the finisher diets containing approximately 3000 kcal/kg and 20% crude protein as earlier reported in Bratte *et al*. (2010).

Experimental animals and their care: Two hundred and twenty-five (225) day-old Anak broiler chicks were randomly allotted to five treatment groups of 45 chicks each and intensive brooded for a week. On the 8th day, the chicks in each group were divided into three replicates of 15 chicks each and brooding continued for the next 3 weeks. They were reared on deep litter, fed the experimental starter diets for the rest of the 4-week brooding period and fed the finisher diets from 5-8 weeks of age. Fresh feed and clean, cool drinking water were provided *ad libitum*. The broilers were routinely vaccinated against Gumboro and Newcastle diseases.

Blood collection and evaluation: At the end of four weeks of feeding, one bird from each of the replicates was selected at random, weekly, for bleeding. Blood was collected by wing venipuncture from the right wing. Five millilitres (5 ml) of blood was gently drawn out with the aid of a 5 ml hypodermic syringe. Three millilitres (3 ml) of the blood was put into a labeled blood collection vial containing Ethylene Diamine Tetra-acetic Acid (EDTA) as anticoagulant and the rest of the blood (approximately 2 ml) put into a vial that contained no anticoagulant. The vial with EDTA was gently shaken to facilitate the dissolution of the anticoagulant in order to prevent clotting of the blood. The blood samples which contained no anticoagulants were kept at room temperature for approximately 45 min in order to clot and the serum decanted into clean, labeled tubes. Hemolyzed blood samples were discarded.

Parameters evaluated or calculated included Red Blood Cell Counts (RBC) Packed Cell Volume (PCV), Haemoglobin (Hb) content, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and total leucocytes (WBC). From the blood serum, the following parameters were evaluated: total protein, albumins, globulins, glucose, urea, creatinine and cholesterol. RBC was determined with a Coulter Electronic Counter (Model ZF by Coulter Electronics Ltd., London). Values were displayed number of red blood cells (x 10^{12}) per litre of blood. PCV was determined through the Wintrobes microhaematocrit technique. Some quantity of uncoagulated blood was allowed to flow by capillarity into capillary tubes sealed at one end and centrifuged at approximately 3000 rpm to separate the blood into its cell and non-cell components. The height occupied by the red blood cells was expressed as a percentage of the column of the whole blood. Haemoglobin (Hb) content was determined with a Cecil colorimeter (Model CE 400 by Cecil Instruments, Cambridge) at a wavelength of 625nm after blood had been mixed with Drabkin's solution in a ratio of 1:250 (blood: Drabkin's solution) and expressed in g/dl units. MCV was obtained as 10PCV/RBC femcolitres. MCH was computed 10Hb/RBC pictogram. MCHC was computed 100Hb/PCV (%). WBC was obtained by mixing one part of blood with 399 parts of physiological saline (v/v) and counting with a Neubauer haemocytometer under a light microscope. Total serum protein was determined by the Buiret technique and albumin and globulin by the colorimetric technique. The Berthelot (colorimetric) method was used to determine its urea content, while glucose and cholesterol were analyzed through the enzymatic colorimetric method. Creatinine was determined by the kinetic method using alkaline purate.

The experimental design and data analysis: The experiment was a two-factor factorial experiment with the dietary treatments (at 5 levels) and weeks (at 4 levels) as factors and with the following model:

$$X_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{ijk}$$

Where:

- X_{ijk} = The observed value of each of the response variables (haematological or serological characteristics)
- μ = The overall population mean
- α_i = Observed effect of the ith dietary treatment (level of dietary DESM)
- β_j = Effect of the jth week of semen or blood collection
- $\alpha\beta_{ij}$ = Effect of the interaction between dietary treatments and time in weeks
- e_{ijk} = Random residual error due to the experimentation

All data collected were analyzed using the two–way analysis of variance procedure (Steel and Torrie, 1980). Means showing significant differences were separated using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

Haematological and serological indices of the broilers: Table 1 is a summary of the Analysis of Variance (ANOVA) on the haematological and serological characteristics of the broilers for the last four weeks (finisher phase) of feeding the experimental diets

Table 1: Summary of ANOVA of the haematological and serological indices of the broilers fed *Dacryodes edulis* Seed Meal (DESM)

		Mean squares												
Source of variation	df	PCV	WBC	RBC	Hb	Chol.	Gluc.	Urea	Creat.	Alb.	Glob.	MCHC	MCH	MCV	TP
Total	59														
Treatment	4	1.79^{ns}	14.45^{ns}	0.55^{ns}	0.44^{ns}	1493.77*	3.86^{ns}	2.04^{ns}	0.02^{ns}	0.06ns	0.16^{ns}	0.04^{ns}	618.49^{ns}	5956.81^{ns}	0.23^{ns}
Weeks	3	17.30*	146.60**	70.75^{ns}	5.76*	6757.62**	149.35**	3.96*	0.14**	0.28**	1.28**	1.13^{ns}	20986.59**	192582.14**	2.44**
Treatment x time	12	6.72*	16.22*	0.62^{ns}	2.16*	5710.31*	3.36^{ns}	0.94^{ns}	0.02^{ns}	0.09^{ns}	0.17^{ns}	1.04^{ns}	888.82^{ns}	8158.61^{ns}	0.12^{ns}
Error	40	3.24	7.42	0.82	1.05	253.38	2.51	0.84	0.01	0.04	0.12	1.05	565.24	5132.66	0.18

df = degrees of freedom; ns = not significant (p>0.05); * = Significant (p<0.05); ** = Highly significant (p<0.01). PCV = Packed Cell Volume; WBC = White Blood Cells Count; RBC = Red Blood Cells Count; Hb = Haemoglobin; Chol. = Cholesterol; Gluc. = Glucose; Creat. = Creatinine; Alb. = Albumins; Glob. = Globulins; MCHC = Mean Corpuscular Haemoglobin Concentration; MHC = Mean Corpuscular Haemoglobin; MCV = Mean Corpuscular Volume. TP = Total Protein

Table 2: Effect of dietary treatment on the haematological indices of the broilers*

	Levels of dietary DESM inclusion					
Indices	0%	15%	30%	45%	60%	Overall
PCV (%)	29.52±1.02	28.75±1.00	27.83±1.24	28.83±1.28	29.42±0.63	28.87±0.30
WBC (x 10^{10}/l)	2.13±0.24	2.26±0.33	3.61±1.64	4.34±1.24	4.38±1.63	3.34±0.49
RBC (10^{12}/l)	2.39±0.63	2.04±0.56	1.90±0.49	2.34±0.71	2.33±0.68	2.20±0.27
Hb (g/dl)	9.80±0.34	9.59±0.34	9.28±0.42	9.60±0.43	9.68±0.25	9.59±0.90
MCHC (g/dl)	33.32±0.04	33.36±0.03	33.35±0.03	33.21±0.09	33.34±0.65	33.32±0.03
MCH (pg)	62.67±8.64	78.86±13.64	73.64±11.32	80.64±14.34	77.50±11.61	74.66±3.21
MCV (fl)	188.72±28.06	234.13±40.74	220.59±33.84	242.20±43.0	241.49±36.54	225.43±9.96

*Values are Means ± Standard Errors. PCV = Packed Cell Volume; WBC = White Blood Cells Count; RBC = Red Blood Cell Count; Hb = Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration; MCH = Mean Corpuscular Haemoglobin; MCV = Mean Corpuscular Volume. Within each row, means with different superscripts differ significantly (p<0.05)

Table 3: Effect of dietary treatment on the serological indices of the broilers*

	Levels of dietary DESM inclusion					
Indices	0%	15%	30%	45%	60%	Overall
Cholesterol (mg/dl)	129.92±9.28^{b}	152.92±5.93^{a}	131.33±6.95^{b}	124.50±8.58^{b}	128.83±5.02^{b}	133.50±4.99
Glucose (mmol/l)	10.93±0.97	11.66±0.97	11.50±0.63	11.38±0.98	12.48±1.10	11.59±0.25
Urea (mg/dl)	8.44±0.36	7.77±0.33	7.93±0.22	7.53±0.29	7.38±0.24	7.81±0.18
Creatinine (mg/dl)	0.46±0.00	0.48±0.05	0.54±0.06	0.44±0.01	0.46±0.01	0.48±0.02
Albumins (g/dl)	1.96±0.07	1.96±0.08	1.83±0.08	1.81±0.07	1.88±0.06	1.89±0.03
Globulins (g/dl)	2.11±0.16	2.33±0.11	2.30±0.10	2.14±0.10	2.08±0.15	2.19±0.05
Protein (g/l)	4.07±0.17	4.29±0.15	4.13±0.14	3.96±0.15	3.97±0.17	4.08±0.06

*Values are Means ± Standard Errors. Within each row, means with different superscripts differ significantly (p<0.05)

to the broilers. Variations in the experimental diets (treatments) had no significant effect (p>0.05) on all the haematological and serological indices measured except blood cholesterol, which showed highly significant (p<0.01) differences with changes in the levels of dietary DESM. Weekly variations were, however, significant (p<0.05) for mean Packed Cell Volume (PCV), Haemoglobin (Hb) and urea and highly significant (p<0.01) for mean Red Blood Cell (RBC) count, Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and mean blood cholesterol, glucose, creatinine, albumins, globulins and total proteins. Significant (p<0.05) treatment x time (weeks) interaction effects occurred in mean PCV, WBC, Hb and in blood cholesterol.

Variations in the mean (±SE) values of the haematological and serological parameters associated with the dietary treatments are presented in Table 2 and 3 respectively. PCV, RBC and Hb were highest in broilers on the control treatment (29.52±1.02%, 2.39±0.63 x 10^{10}/l and 9.80±0.34g/dl respectively) and lowest in broilers fed the 30% maize replacement diet (27.83±1.24%, 1.90±0.49 x 10^{10}/l and 9.28±0.42g/dl respectively). These variables gradually declined from 0-30% maize replacement and increased gradually with increasing levels of dietary DESM. WBC, MCH and MCV generally increased steadily, though not significantly (p>0.05), as the level of DESM in the diet was increased, while serum levels of urea and albumins generally declined with increasing levels of dietary DESM. Blood cholesterol was significantly (p<0.05) higher in birds on the 15% maize replacement diet than those on all the other dietary treatments, which had similar levels of cholesterol (Table 3). Some of the variables (blood glucose, creatinine, globulins MCHC and proteins) showed marked, though non-significant (p>0.05) increases as DESM was increased from 0-15% of the dietary maize and declined gradually as more of the test ingredient was incorporated into the diets. Weekly variations in the mean (±SE) values of the haematological and serological variables measured during the finisher phase are presented in Table 4. Mean RBC count was significantly (p<0.01) higher during the first week of the finishing phase (5.45 x 10^{12}/l)

Table 4: Haematological and serological indices with significant time effects (Mean±SEM)

	Time (Weeks)			
Indices	1	2	3	4
RBC	5.46±0.43^{a}	1.15±0.80^{b}	1.14±0.08^{b}	1.05±0.05^{b}
Glucose	12.03±0.19^{b}	14.99±0.34^{a}	12.35±0.66^{b}	7.40±0.39^{c}
Creatinin	0.36±0.02^{b}	0.57±0.04^{a}	0.43±0.03^{b}	0.54±0.02^{a}
Albumins	1.73±0.06^{c}	2.06±0.05^{a}	1.92±0.06^{ab}	1.84±0.07^{bc}
Globulins	1.81±0.10^{c}	2.28±0.07^{ab}	2.51±0.10^{a}	2.18±0.11^{b}
MCH	19.05±2.33^{b}	97.81±8.20^{a}	86.29±8.13^{a}	95.50±5.60^{a}
MCV	57.66±6.92^{b}	300.62±25.16^{a}	257.02±24.45^{a}	286.41±16.68^{a}
Protein	3.54±0.10^{c}	4.34±0.08^{a}	4.43±0.09^{a}	4.01±0.01^{b}
Urea	7.53±0.39^{bc}	8.39±0.18^{a}	7.25±0.16^{c}	8.07±0.20^{ab}

SEM = Standard Error of the Mean. RBC = Red Blood Cell Count; MCH = Mean Corpuscular Haemoglobin; MCV = Mean Corpuscular Volume. ^{a,b,c}Within each column, means with different superscripts differ significantly ($p<0.05$)

Table 5: Haematological and serological indices with significant treatment x week interaction effect (Mean±SEM)

		Indices			
Weeks	Levels of DESM (%)	PCV (%)	WBC	Hb	Cholesterol
1	0	29.67±1.20	2.76±0.88	9.90±0.42	102.67±5.84
	15	28.33±1.20	3.76±0.51	9.47±0.39	156.33±6.39
	30	28.00±0.00	9.57±5.91	9.30±0.00	126.33±11.41
	45	24.33±4.26	11.16±1.22	8.10±1.43	102.00±7.51
	60	28.33±1.67	12.84±3.88	8.97±0.67	120.67±6.69
2	0	32.33±1.67	2.18±0.24	10.77±0.29	178.33±10.27
	15	32.00±0.58	1.11±0.19	10.67±0.20	168.67±4.91
	30	31.00±1.00	2.24±0.45	10.37±0.33	157.00±1.00
	45	31.00±0.00	2.96±0.82	10.30±0.00	161.67±7.75
	60	30.33±0.67	1.66±0.07	10.10±0.20	154.33±4.84
3	0	25.67±2.85	2.06±0.37	8.56±0.94	127.67±4.18
	15	27.00±1.15	2.47±0.32	9.00±0.40	144.33±20.85
	30	22.00±2.65	1.27±0.18	7.33±0.88	105.33±14.52
	45	31.67±0.88	1.79±0.16	10.57±0.30	102.00±15.63
	60	30.33±1.76	1.85±0.08	10.10±0.59	123.67±3.53
4	0	30.00±1.00	1.51±0.06	9.97±0.33	110.67±2.73
	15	27.67±3.38	1.69±0.07	9.23±1.13	142.33±7.22
	30	30.33±0.88	1.37±0.07	10.13±0.30	136.67±5.21
	45	28.33±0.88	1.48±0.21	9.43±0.30	132.33±11.57
	60	28.67±0.88	1.19±0.28	9.56±0.30	116.67±5.36

SEM = Standard Error of the Mean. PCV = Packed Cell Volume; WBC = White Blood Cell Count; Hb = Haemoglobin.
^{a,b,c}Within the same column, means with different superscripts are significantly different ($p<0.05$)

than in subsequent weeks ($\leq$1.15 x 10^{12}/l). Besides blood globulins and protein which increased steadily up to the third week and declined in the fourth week, the other blood parameters (albumins, glucose, urea, MCH, MCV and creatinine) generally increased significantly after the first week and declined gradually thereafter.

The mean (± SE) values of the blood characteristics with significant Treatment x Week interaction effects are presented in Table 5. Generally, PCV (%) was higher during the second week of the finisher phase than in the other weeks. Variations in % PCV did not appear to be influenced by the level of DESM inclusion in the diet. WBC declined significantly after the first week. The first week WBC values (Table 5) increased significantly ($p<0.01$) as more of the test ingredient (DESM) was incorporated into the broiler diets. The highest value (12.84±3.88 x 10^{10} cells/l) was obtained in the first week in broilers fed diets in which 60% of the maize was replaced with DESM. WBC values obtained thereafter were much lower ($\leq$2.96 x 10^{10} cells/l) and did not appear to be influenced by the level of inclusion of DESM.

The Haemoglobin (Hb) content of the blood was generally higher during the second week of the finisher phase than in the other weeks (Table 5) with the highest values occurring in broilers which received 0% (10.77±0.29 g/dl) and 15% (10.67±0.20 g/dl) dietary maize replacement with DESM. The lowest Hb value (7.33±0.88 g/dl) (Table 5) was recorded during the third week of the finisher phase in broilers fed diets with 30% maize replacement. Blood cholesterol was highest (178.33±10.27 mg/dl) during the second week in broilers that received the control diet (0% DESM). The level of inclusion of DESM in the diet did not appear to have a definite influence on the blood cholesterol levels of the broilers.

DISCUSSION

Variations in the level of maize replacement with *Dacryodes edulis* Seed Meal (DESM) from 0-60% in the broiler diets had no significant ($p>0.05$) effect on the haematological indices (PCV, WBC, RBC, Hb, MCHC, MCH and MCV) of the broilers. This is an indication that *Dacryodes edulis* seed meal does not contain factors that are deleterious to normal blood formation and does not impact negatively on the physiology, pathology and nutritional status of the broilers. Several workers (Akinola and Abiola, 1999; Akinwutimi, 2000; Adejumo and Anyanwu, 2001) have reported similar results with the use of some other non-conventional feed ingredients with broilers. The values of the haematological indices obtained in this study fall within normal ranges reported by several other workers for broilers (McDonald, 1998; Akinwutimi, 2000; Ikhimioya *et al*., 2000; Akpodiete and Okagbare, 2000; Obasoyo *et al*., 2005). The similarity in the haematological indices between the control diet and the other dietary treatments is an indication that *Dacryodes edulis* Seed Meal can safely be used as a feed ingredient, to replace even up to 60% of the maize in commercial broiler diets without deleterious effects on broilers.

Differences in the mean serological indices (glucose, urea, creatinine, albumins, globulins and total proteins) among the dietary treatments were not significant ($p>0.05$). The similarity in blood glucose among the dietary treatments indicates that the inclusion of DESM in the diets of broilers does not significantly alter blood glucose levels. High serum glucose is an indication of pancreatic or liver disease (Cheesebrough, 1999). Serum urea, creatinine and total proteins depend on the quality and quantity of protein supplied in the diet (Eggum, 1970; Iyayi and Tewe, 1998; Awosanya *et al*., 1999). The absence of significant differences among the dietary treatments for these indices indicates that replacement of up to 60% of the dietary maize with DESM in broiler diets does not significantly diminish the quality of protein in the diets. Values obtained for serum urea in this study (7.38±0.24 mg/dl to 8.44±0.36 mg/dl) (Table 3) are higher than those reported for broilers by Sogunle *et al*. (2005) (1.80-2.16 mg/dl) with cashew nut reject meal and lower than those obtained by Akpodiete and Okagbare (2000) (12.78-13.08 mg/dl) with maggot meal. Blood urea is inversely related to the quality of dietary protein (Eggum, 1970) and high serum urea indicates poor dietary protein utilization (Awosanya *et al*., 1999). The serum creatinine levels observed in this study (Table 3) were lower than those reported by of some other workers, notably Adeyemi *et al*. (2000) (1.70 mg/dl) and Sogunle *et al*. (2005) (1.2-1.5 mg/dl). High serum creatinine levels in birds are indicative of muscle wastage (Mafimidiwo *et al*., 1998) due to catabolism of creatinine phosphate (Bell *et al*., 1992). The inclusion of DESM in broiler diets does not therefore lead to a breakdown of muscle tissue in broilers. The fact that variations in dietary DESM did not bring about significant differences in serum albumins, globulins and total proteins between the dietary treatments shows that the use of DESM as a feed ingredient in broilers does not diminish the immune status of the broilers, or appreciably alter the disease-fighting ability of the body systems of the birds. Values obtained (Table 3) agree with the findings of Akpodiete and Okagbare (2000) for broilers and layers fed graded levels of maggot meal. Blood cholesterol, though significantly higher in the 15% dietary DESM treatment than in the other treatments (Table 3), presented a significant treatment x week interaction (Table 5).

The effect of time (weeks) of blood collection on the haematological and serological indices was significant in RBC, MCH, MCV, glucose, urea creatinine, albumins, globulins and proteins (Table 4). The significantly low MCH and MCV values obtained in the first week of blood collection may have stimulated an increase in the production of erythrocytes thus leading to the significantly elevated RBC level during the first week of collection (which also corresponded with the first week of the finisher phase). This may have been triggered by the introduction of a new diet, the finisher diet. This was also manifest in the high WBC (which is an indication of stress) recorded in the first week. In the subsequent weeks, however, stability was restored as the broilers adjusted to the finisher diets.

Treatment x time (weeks) interaction effects were manifest in %PCV, WBC, Hb and in serum cholesterol (Table 5). Although the highest PCV values were associated with 0-45% DESM for maize diets during the second week and the 45% DESM for maize diet during the third week of blood examination, the values obtained were consistent with values published for broilers by Mitruka and Rawnsley (1977) and Ross *et al*. (1978). The lowest value occurred in broilers on the 30% DESM for maize diet in the third week. The haemoglobin and cholesterol contents of the blood followed the same general pattern as the PCV. The highest WBC values occurred in the first week and increased progressively and significantly as the level of DESM in the diet was increased (Table 5). Elevated levels of WBC (luecocytosis) are indicative of stress (McDonald, 1998) and may have arisen, in this study, from the change in diet from the starter to the finisher diets in the first week of the finisher phase.

It can be concluded, on basis of the similarity in the haematological and serological indices between the control diet and the other dietary treatments, that *Dacryodes edulis* seed meal safely be used as a feed ingredient to replace as much as 60% of maize in conventional broiler diets without impacting negatively on normal blood formation, physiology, pathology and nutritional status of broilers in the tropics.

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