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Performance and Haematological Indices of Broiler Chickens Fed Water Leaf (*Talinum triangulare*) Meal Supplement

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Authors' contributions

This work was carried out in collaboration between all authors. Author GNE designed the study. Author FCN performed the experiment and wrote, while author PCNA wrote the first draft of the manuscript. Author EIO reviewed and edited the report and managed correspondences with the editors. All authors read and approved the final manuscript.

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ABSTRACT

A 56-day experiment involving 150 day-old Anak 2000 broiler chicks was carried out in a completely randomized design to evaluate the performance, haematological parameters and serum metabolites of the broilers fed Water leaf Meal (WLM) supplement for 8 weeks at Ibadan in Oyo state of Nigeria. The birds were allotted to 5 treatments containing 0, 3, 6, 9 and 12% WLM.

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Each treatment was replicated thrice. Broiler starters were fed the same starter diet (21.05-22.75% crude protein (CP)), while the finishers were equally fed the same finisher diet (19.40-19.94%CP). The WLM was found to be rich in protein (19.89%)and ash (10.00%) hence may be a good protein supplement for broilers but low in minerals(Ca, P, Mg and Fe) and phytochemical (phytate, tannin and oxalate). Dietary inclusion of WLM in broiler starter diets depressed feed intake at 12% inclusion levelbut at 9% inclusion total feed intake was elevated, significantly (P<0.05) compared to control and other treatments. Final live weight and weight gain at starter phase decreased significantly (P<0.05) and progressively with the increased concentration of WLM supplements, 3%WLM level was the optimal, replacing soya bean meal with WLM reduced the cost of broiler starter production. Broiler finishers also exhibited a similar pattern. Lymphocytes (%) values in broiler-chicks fed 0 and 3% WLM inclusion diets were significantly (P<0.05) higher than those of broiler-chicks fed 6, 9 and 12% WLM supplementary diet. The PCV and RBC were not affected by the diets.WLM supplements in the diets of broilers had no significant influence on total serum protein, albumin, albumin/globulin ratio, creatinine, urea, alanine-aminotransferase, hydrogen trioxocarbonate IV, phosphate and calcium, unlike cholesterol, globulin, alkaline phosphate, potassium, chloride and aspartate amino transferase which were significantly (P<0.05) affected by the dietary inclusion of WLM supplements. Cholesterol value decreased (102 - I05mg/dl) for the broilers fed 9-12%WLM supplements compared to those placed on 3 and 6% *(*I16-120gm/dl). Serum potassium was highest at 12% WLM inclusion level (4.36mml/L) followed by 9% (3.85mmol/L) while control was the least (3.50mmoI/L). Broiler starters and finishers are recommended to be fed 6 to 12%WLM, respectively for improved feed intake, weight gain and blood formation.

Keywords: Performance; haematology; serum biochemistry; broiler chicken; water leaf meal; supplement.

1. INTRODUCTION

Nutrient levels in the blood and body fluids might not be valid indications of nutrients functions at cellular level as they are considered to be a proximate measure of long term nutritional status [1]. It was noted that blood sampling for the assay of biochemical constituents and haemotological traits are frequently employed in nutritional studies. Changes in the constituent composition of blood when compared to normal values could be used to interpret the metabolic state of the animal as well as the quality of feed offered to the animal [2,3]. Haematological profiles both in human and animal sciences are important indices of the physiological state of the individual [4]. The haematological features have attracted many workers to look at these profiles in order to make clinical predictions of the health status of a specific animal. The blood constituents changes with the advancement of the animal's age and also varies with certain conditions as stress, bacteria/viral infections and intoxication [4]. Blood with its myriad of constituents provides a valuable medium both for clinical investigations and nutritional evaluation of the organism [5]. The result of anti nutrient composition of *T. triangulare* [6], revealed low value of tannins (1.44±0.05 mg/100 g and 1.09±0.26 mg/100 g) which is not high enough to constitute human poison since the lethal value is above 5% while Adebayo et al. [7] revealed that the leaves of *T. triangulare* contain an appreciable amount of flavonoids, alkaloids, saponins, among others and low level of toxicants like tannins and contains substantial amount of bioactive compounds. It can therefore be concluded that *T. triangulare* leaves can contribute significantly to the health management of livestock and man. Waterleaf's crude protein content compares favourably with that of cowpea, peanut, millet, and cashew nuts. Akachukwu and Fawusi [8] investigated the crude protein content of waterleaf leaves and tender stems and found it to be as high as 29.4% and 13.4%, respectively. Sridhar and Lakshminarayana [9] also gave a report on high total lipids, essential oils, alpha-tocopherols and beta-tocopherols in *Talinum triangulare*. This study therefore investigated the beneficial inclusion levels of Water leaf (*Talinum triangulare)* meal as supplementary source of protein in broiler starter and finisher birds focusing on the Performance and haematological implications on the broiler finisher birds.

2. MATERIALS AND METHODS

2.1 Animals and Their Management

One hundred and fifty (150) day-old broiler chicks of Anak 2000 strain were bought from

Zartech Farms Limited, Ibadan. The birds were randomly allotted to five dietary treatments A, B, C, D, and E of 30 chicks per treatment and each treatment was replicated 3 times, with 10 birds per replicate.

The WLM was used in partial replacement of soya bean meal (SBM) and ground nut cake (GNC). Every other ingredient remained constant. The chicks were weighed at the beginning of the experiment and on weekly basis. The starter and finisher phases lasted for 4 weeks each. At the end of the starter phase, the experiment proceeded with the birds from the original treatments without rearrangement. The broiler starters and finishers were fed the same starter and finisher diet (Tables 2 and 3). Feed and water were served *ad-libitum* and data on this intake were recorded on daily basis, while weight gain was determined on weekly basis. Throughout the period of the trial, leftover feed and water were determined on daily basis. Other management practices such as routine vaccination, drug administration and maintenance of cleanliness within and outside the poultry pens/house were observed.

2.2 Experimental Site

The experiment was carried out at the Research Farm of Federal College of Animal Health, Production & Technology, Institute of Agric. Research and Training (IAR&T), Bora, Ibadan, Oyo State, South-West, Nigeria during the early dry season (March-June).

2.2.1 Collection and preparation of water leaf

The water leaf was harvested from around the paddock in IAR&T Ibadan. The leaves were detached from the stems and were air & sun dried on concrete floors for 5 days. The leaves were dried to 12% Moisture content as stipulated by D'Mello [10]. The dried leaves were milled using a hammer mill with a sieve/screen size of 3.36mm to produce leaf meal which was then incorporated into the diet.

2.2.2 Ration formulation

The diets were formulated at Dominion Livestock feed milling industry at Owode estate Ibadan forthnightly. The experimental diets contained 0, 3, 6, 9, 12% WLM. The WLM was used in partial replacement of SBM & GNC while all other ingredients remained constant. The five treatments A, B, C, D, and E contained 0, 30, 60, 90, 120g WLM/Kg of the feed respectively.

2.3 Blood Collection for Analysis

At the end of the feeding trial, a male chick per replicate was randomly selected, weighed and scarified by severing the jugular vein and blood allowed to flow freely into labeled bottles one of which contained EDTA while the other without EDTA was processed for serum. The serum was kept deep frozen prior to analysis. The packed cell volume (PCV%) was estimated by spinning about 75:l of each blood sample in heparinized capillary tubes in an hematocrit micro centrifuge for 5 min while the total red blood cell (RBC) count was determined using normal saline as the diluting fluid. The hemoglobin concentration (Hbc) was estimated using cyanomethaemoglobin method while the mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH) and the mean corpuscular volume (MCV) were calculated.

2.4 Analysis of Blood Samples

Packed Cell Volume (PCV) was determined by microhaematocrit method. Haemoglobin (Hb) concentration was measured spectrophotometrically by cyanomethaemoglobin method [11,12] using SP6-500 UV spectrophotometer (Pye UNICAM ENGLAND). The Red Blood Cell (RBC) and white blood cell counts were estimated using haemocytometer [12]. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH) were calculated from Hb, PVC and RBC [13]. Serum Total Protein (STP) was determined by Kjedahl method [14] while albumin was determined using the BCG (bromocresol green) method [15]. Aspartate amino transaminase (AST) and Alanine amino transaminase (ALT) activities were determined using spectrophotometric method [16,17], respectively. Sodium and potassium were determined by flame photometry [18]. Cholesterol was determined according to Roschlan et al. [19] while urea was determined as described by Kaplan and Szabo [20].

2.5 Proximate and Chemical Analyses

Proximate and chemical composition of the feeds and the WLM were determined according to the Official Method of Analysis [21]. Gross energy values were determined using the bomb calorimeter method [22], while metabolizable energy was estimated by the method outlined by [23].

2.6 Statistical Analysis

Data collected were subjected to Analysis Variance (ANOVA) in SPSS version 10 computer programme (SPSS Inc, Chicago, USA) and errors were calculated as Standard Errors of the Mean (SEM). Significant treatment means were compared using Duncan's Multiple Range Test [24] while Significance was accepted at the 0.5 level of probability.

3. RESULTS AND DISCUSSION

The results of the proximate and chemical compositions of WLM revealed that it is rich in crude protein (19.89%) ash (10.00%) (Table 1). The CP value of WLM in this study agrees with the values reported by Fasuyi [25] (19.90%) but lower than those reported by other authors [26,27,28]. The crude fibre (8.10%) and Ash (10.00%) in this study is lower than the results of many other authors [28,29,26,27,30]. Tables 2 and 3 reveals that the nutrient status of the experimental diets are in line with NRC [31] standards and is adequate for broiler starters and finishers especially during the late dry season of the year, being very rich in Crude Protein (21.05-22.75%) and relatively low in crude fibre (4.0-7.0%).

At broiler starter phase performance indices revealed a depression in growth rate and feed conversion efficiency (FCE). This observation is in agreement with the observation of FAO [32] who revealed that older animals tolerated leguminous leaf meals more than younger ones. Generally, inclusion of WLM in broiler starter diets depressed feed intake most especially at 12% inclusion level (13 74.16g/bird) compared to the control (1426.57g/bird). However, at 9% dietary inclusion of WLM, total feed intake (TFI) was elevated, significantly (P<0.05) compared to control and other treatments. Similar TF1 (1394.30 – 1643.00g/bird and average daily feed intake (ADFI) (49.80 -58.68g/bird) were reported by Nworgu and Fapohunda [33] in which broiler chicks were fed graded level of *Mimosa invisa* leaf meal leaf meal supplements. Nworgu and Fapohunda [33] and Odunsi et al. [34] noted that as the level of forage meal increased in the diets of broiler chicks, feed intake decreased progressively. Esonu et al. [35] reported significant (P<0.05) and progressive increase in feed intake of broiler chicks as the concentration *of Microdesmis pubreula* leaf meal increased from 0 to 5'% and 5 to I0%. Decreased feed intake in starter phase could be attributed to reduction in acceptability which was as a result of anti-nutritional factors in WLM though in low concentrations and D'Mello [10] made similar observations. Nghodigha [36] also made same observation when he fed broiler chickens with *Centrosema pubescens* leaf meal at 0, 5, 10 and 15% and noticed progressive decline in feed consumption as the concentration of the leaf meal increased.

Table 1. Proximate, mineral and phytochemical composition of water leaf meal

Proximate composition (%)	
Dry matter	89.40
Crude protein	19.89
Ether extract	3.85
Crude fibre	8.10
Total ash	10.00
N. free extract	58.16
Met energy(Kcal/kg)	3016.00
Gross energy(Kcal/g)	4307.75
Minerals(mg/100g)	
Calcium	1.39
Phosphorus	0.37
Potassium	1.50
Magnesium	0.47
Sodium	0.39
Zinc	0.05
Iron	0.03
Phytochemical (mg/100g DM)	
Tannin	3.85
Phytate	0.41
Oxalate	0.032

Final live weight (FLW) and weight gain (WG) at starter phase decreased significantly (P<0.05) and progressively with the increased concentration of WLM supplements.

Poor growth observed in the birds fed WLM supplement could be attributed to poor feed utilization as some nutrients were not readily utilized by the broiler chicks [37,35]. Final live weight and WG in this study is slightly higher than those reported by Nworgu and Fapohunda [33]. However, Odunsi et al. [34] reported progressive and significant (P<0.05) depression in final live weight and weight gain of broiler chickens fed wild sunflower leafmeal supplements at 0, 25,50, 75 and I00g/kg. FCE for broiler starters varied from 1.72 to 2.33 while FCE was significantly (P<0.05) depressed with increased concentration of WLM as the birds fed control diet had the best FCE (1.72) as against 2.33 in the birds fed 12%WLM. This result suggests that the nutrients were not properly utilized by the broiler starters placed on WLM dietary supplement (See Table 4). Similar observation was made by other authors [34,33] whose FCE values were higher than in this work. This result reveals that the diets containing WLM were adequately utilized and so resulted in better tissue and muscles formation.

Reports by other authors [38,39] indicated that reduced FCE and poor growth rate of animals could be due to poor feed utilization as a result of poor palatability and nutrient imbalance. Though, the experimental birds were able to tolerate up to 12% WLM with fair results, 3%WLM level was the optimal and replacing soya bean meal with WLM reduced the cost of broiler starter production. This may alleviate nutrition deficiency in poor countries of the tropics and sub tropics. For these reasons, using WLM as a source of protein may serve well for a highly sustainable strategy. Table 5 shows that WLM is a fairly good protein supplement for broiler finishers. Feed intake (FI) weight gain (WG), feed conversion efficiency (FCE) water intake (WI).

Cost of feed per kg live weight gain and final body weight were significantly (P<0.05) affected by the dietary treatments. Average total feed intake (ATFI) varied from 4182.11 to 4504. I5g/bird. Birds placed on 3 to 12% WLM supplements had significantly reduced feed intake of (2.30- 7.15%) compared to control. Final live weight ranged from 2200.00g/bird in 9%, WLM diet to 2460.00g/bird on the birds placed on control diet. Weight gain ranged from 1486.84g/bird in 9% WLM to 1759.44g/bird in 12%WLM (Table 5). It can be observed that as the WLM concentration increased there was an increase in both final live weight and weight gain (Table 5). Mean body weight gain was (1759.44g/bird) for the birds placed on 12% WLM compared to control (1587. 50g/bird).Broiler finishers fed diets containing WLM supplements had a higher degree of elevation in weight gain which was significant (P<0.05). The increase in the weight gain of the broiler finishers fed graded levels of WLM indicated non-hazardous effects of feeding WLM supplements at 3-12% (30 - 120g WLM/kg feed) to broiler finishers and proves that WLM is a very good feedstuff and a very good proteins supplement for broiler finishers. This observation is in harmony with the submission of FAO [32].

Feed conversion efficiency varied from 1.97 to 2.49 with increased concentration of WLM as the birds fed control diet had the best FCE (1.97) as against 2.49 in the birds fed 12% WLM. This result reveals that the diets containing WLM were fairly adequately utilized.

Blood represents a means of assessing clinical and nutritional health status of animals in feeding trial and the haematological parameters (Table 6) most commonly used in nutritional studies include PCV, RBC, HBC, MCHC, MCV and clotting time [40,41,42]. The results of haematological variables in this study suggest that the test diets did not precipitate any severe effects on the health status of the experimental chicks. However; the Lymphocytes (%) values in broiler-chicks fed 0 and 3% WLM inclusion diets were significantly (P<0.05) higher than those of broiler-chicks fed 6, 9 and 12% WLM supplementary diet. The increment in WLM inclusion rates in the diets from diet 3 to diet 5 seemed to enhance neutrophils sedimentation rate. This is supported by previous work that RBC and other parameters such as Hbc and ESR of birds vary among species, breed, sex and the nutrition supplied to the bird [43], The PCV of the control was similar to 6% & 12% WLM level of supplementation while the 3% and 9% were significantly (P<0.05) superior but no particular trend can be deduced and the RBC content followed the same pattern as the PCV. The WBC in the control was significantly (P<0.05) lower than those of the entire treatment which were similar. The PCV values of all birds sampled among dietary treatments indicated that PCV was not affected by diets. The PCV values obtained for all dietary treatments also conformed with values reported [44]. The significant variation in the RBC values across dietary treatments is in agreement with previous reports [45]. It was concluded by most researchers that a degree of variation for RBC is considered normal [43,44,45]. Generally, the haematological values obtained for the experimental birds were analogous with that of the normal ranges mentioned in earlier works stated as follows: PCV = 30.6%; RBC = 2.5 – 3.2 millions/mm^3; Hbc = 6.5 – 9.0g/100ml; WBC = 20-30 thousands/mm^3; MCV = 115-125c.u; MCH = 25-27pg and MCHC = 21-23% [44,46].

Serum metabolites of broilers fed WLM supplements are presented in Table 7. Careful examination of the table reveals that dietary WLM supplements in the diets of broilers had no significant influence on total serum protein (TSP), albumin (AL), albumin/globulin ratio (AGR).

Creatinine (CR), urea (UR) alanine-amino transferase (ALT). hydrogentrioxocarbonate IV, phosphate and calcium, unlike cholesterol (CH), globulin (GL),alkaline phosphate, potassium, chloride and aspartate amino transferase (AST) which were significantly ($P<0.05$) affected by the dietary inclusion of WLM supplements. Cholesterol value decreased (102 - I05mg/dl) for the broilers fed 9-12%WLM supplements compared to those placed on 3 and 6% *(*I16-120gm/dl). Serum potassium was highest at 12% WLM inclusion level (4.36mml/L) followed by 9% (3.85mmol/L) while control was the least (3.50mmoI/L). Alkaline phosphate increased with the increasing levels of WLM which varied from 116.39iu/L in the control to 125.45iu/L at 6% WLM supplement. ASAT was least for broilers in the control (28.70iu/L) and highest in the birds fed 12% WLM supplement (34.40iu/L) (Table 7).

Table 2. Gross composition of experimental diets at the starter phase

Experimental diets					
Ingredients (%)	**Starter phase**				
	A (0%)	**B (3%)**	**C (6%)**	**D (9%)**	**E (12%)**
Maize	47.00	47.00	47.00	47.00	47.00
Corn bran	10.00	10.00	10.00	10.00	10.00
Palm kernel cake	5.00	5.00	5.00	5.00	5.00
Soybean meal	20.00	18.50	17.50	16.50	14.00
Fishmeal	4.00	4.00	4.00	4.00	4.00
Groundnut cake	10.25	9.25	7.25	6.25	5.75
Waterleaf meal	0.00	3.00	6.00	9.00	12.00
Vitamin Premix	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Calculated analysis					
Crude protein (%)	22.31	21.86	21.17	20.75	20.11
Crude fibre (%)	4.59	4.77	4.94	5.03	5.18
Metab energy (Kcal/kg)	2897.73	2881.83	2853.03	2828.88	2799.18
Determined proximate composition of experimental diet (%DM basis)					
Dry matter	87.00	90.00	90.00	88.00	90.00
Crude protein	22.75	21.24	21.25	21.21	21.05
Crude fibre	4.00	7.70	4.50	4.61	6.50
Ash	8.00	11.00	12.00	15.00	14.00
Nitrogen free extract	65.25	60.06	62.25	59.18	58.45
Metab energy (Kcal/Kg)	2984.70	2975.21	2970.65	2971.88	2969.10

Bimba Agro-mix. Vitamins and Mineral premix for Broilers and Chicks (2.5kg/ton) Vitamin A12,500.00iu. Vitamin D3 2, 5000.00iu. Vitamin E= 35,000iu Vitamin K=200g, Thiamine B1=200g, Rlbloflavin B2= 5.00g, Niacin B3 = 40.00g, D-Calpan B5 11.00g, Pyridoxine B6=400g, Biotin=0.10g, Folic acid=I.50g Vitamin B12=0.012g, Manganese= 70.00g, Zinc=50.00g, Copper = 6.00g: lron= 40.00g, lodine = 1.00g: Cobalt = 1I.25g. Selenium = o.15g: Choline chloride = 500.00g

Table 3. Gross composition of experimental diets at the finisher phase

Experimental diets					
Ingredients (%)	**Finisher phase**				
	A	**B**	**C**	**D**	**E**
Maize	49.00	49.00	49.00	49.00	49.00
Corn bran	11.00	11.00	11.00	11.00	11.00
Palm kernel cake	6.00	6.00	6.00	5.00	5.00
Soybean meal	19.00	17.50	16.50	15.50	13.00
Fishmeal	3.00	3.00	3.00	3.00	3.00
Groundnut cake	8.25	7.25	6.25	5.25	4.25
Waterleaf meal	0.00	3.00	6.00	9.00	12.00

Table 3 continued……

Vitamin premix	0.30	0.30	0.30	0.30	0.30
Bone meal	2.50	2.50	2.50	2.50	2.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10
Salt	0.25	0.25	0.25	0.25	0.25
Calculated analysis					
Crude protein (%)	20.83	20.38	20.63	19.61	18.97
Crude fibre (%)	4.78	4.88	4.98	5.07	5.21
Met. energy(Kcal/kg)	2904.60	2888.86	2861.46	2837.31	2807.61
Determined proximate composition of experimental diet (%DM basis)					
Dry matter	91.00	91.00	88.00	91.00	90.00
Crude protein	19.94	19.53	19.46	19.44	19.40
Crude fibre	5.00	6.50	5.50	5.00	4.90
Ash	10.00	13.00	14.00	15.00	14.50
Nitrogen free extract	65.06	60.97	61.04	60.56	61.20
Met energy (Kcal/Kg)	2985.00	2988.12	2975.00	2979.0	2981.05

Bimba Agro-mix. Vitamins and Mineral premix for Broilers and Chicks (2.5kg/ton) Vitamin A12,500.00iu. Vitamin D3 2,5000.00iu. Vitamin E= 35,000iu Vitamin K=200g, Thiamine B1=200g, RIbloflavin B2= 5.00g, Niacin B3 = 40.00g,D-Calpan B5 11.00g, Pyridoxine B6=400g,Biotin=0.10g, Folic acid=I.50g Vitamin B12=0.012g, Manganese= 70.00g, Zinc=50.00g, Copper = 6.00g: lron= 40.00g, lodine = 1.00g: Cobalt = 1I.25g. Selenium = o.15g: Choline chloride = 500.00g

Table 4. Performance of broiler chicks fed experimental diets at the starter phase

Parameter	Starter phase					
	***A (0%)**	**B (3.00%)**	**C (6.00%)**	**D (9.00%)**	**E (12.0%)**	**SEM**
Initial live wgt (g/bird)	41.91	42.86	41.00	41.00	40.00	
Final body wgt (g/bird)	872.50a	794.74b	742.11c	713.16C	630.56d	0.92
Mean BWG (g/bird)	830.59a	751.88b	701.11c	672.16d	590.56e	0.73
Average DWG (g/bird	29.65a	26.85b	25.04c	24.01c	21.09d	0.12
Average TFI (g/bird)	1426.57b	1455.44b	1375.25c	1529.59a	1374.16c	0.73
Average DFI (g/bird)	50.95c	51.98b	49.12d	54.63a	49.08d	0.08
FCE	1.72c	1.94b	1.96b	2.28a	2.33a	0.72
Average TWI(ml/bird)`	2861.32d	3014.75c	3062.17b	3005.04c	3137.57a	0.89
Mortality (%)	5.00	5.00	5.00	5.00	5.00	

abc : Means with different superscripts on the same row differ significantly (P< 0.05)), DWI- Daily Water intake, FCE-Feed Conversion Efficiency, TWI-total water intake, BWG- body weight gain, DWG-daily weight gain, TFI-total feed intake, DFI- daily feed intake, wgt- weight

Table 5. Performance of broiler finisher fed experimental diets at the finisher phase

Parameter	Finisher phase					
	***A (0%)**	**B (3.00%)**	**C (6.00%)**	**D (9.00%)**	**E (12.0%)**	**SEM**
Initial live wgt (g/bird)	872.50a	794.74b	742.11c	713.16c	630.56d	0.92
Final body wgt (g/bird)	2460.00a	2360.00a	2380.00a	2200.00b	2390.00a	0.88
Mean BWG (g/bird)	1587.50c	1565.26c	1637.89b	1486.84d	1759.44a	0.81
Average DWG (g/bird)	56.70b	55.90b	53.50c	53.10c	62.84a	0.03
Average TFI (g/bird)	4504.15a	4182.11d	4396.88ab	4379.36b	4327.45b	0.73
Average DFI (g/bird)	160-86a	149.36d	157.03b	156.41b	154.55c	-
FCE	1.97	2.08	2.03	2.49	2.15	-
Average TWI (ml/bird)	8867.80c	8679.28d	8922.85b	8999.89b	9303.92a	
Average DWI (ml/bird)	316.71c	309.98d	318.67c	321.43b	332.28a	0.12
Feed: Water intake ratio	1:1.97	1:2.08	1:2.03	1:2.49	1:2.15	-
Mortality (%)	3.45	3.45	3.45	3.45	3.45	

*a b cd : Means with different superscripts on the same row differ significantly (P< 0.05) *A (%WLM), DWI- Daily Water intake, FCE – Feed Conversion Efficiency, TWI-total water intake, BWG- body weight gain, DWG-daily weight gain, TFI-total feed intake, DFI- daily feed intake, wgt-weight*

Table 6. Haematological parameters of broilers fed water leaf meal supplements at the finisher phase

Experimental diets						
Parameters	**Finisher phase**					
	***A**	**B**	**C**	**D**	**E**	**SEM**
Haemoglobin (%)	10.70b	11.70a	11.0ab	11.60a	11.30a	0.02
Packed cell vol. (%)	32.11c	35.41a	33.12b	34.00a	33.01b	0.11
Red blood cells(x1012L)	2.91b	3.23a	2.94b	3.06a	2.87b	0.10
White blood cells(x1012L)	15.11b	21.20a	19.40a	20.90a	18.70a	0.54
Mean cell volume (Fl)	110.34	109.63	112.65	111.11	115.02	1.10
MCH (Pg/cell)	36.77	36.22	37.41	37.94	39.37	0.20
MCHC. (%)	33.32	33.04	33.21	34.15	34.32	0.06
Lymphocytes (%)	68.00a	71.00a	63.13b	58.00c	61.00b	0.34
Neutrophils (%)	32.00c	29.10c	37.11b	42.14a	39.25a	0.45

*abc: Means with different superscripts on the same horizontal row differ significantly (P<0.05). MCH-Mean Cell Haemoglobin, MCHC-Mean Cell Haemoglobin Concentration, *A =0% Water leaf meal (WLM) B=3%, C = 6%, D = 9% E = 12% WLM*

Table 7. Serum metabolites of broilers fed water leaf meal supplements at the finisher phase

Experimental diets						
Parameter	**Finisher phase**					
	***A**	**B**	**C**	**D**	**E**	**SEM**
Total serum protein (g/dl)	3.50	3.45	3.20	3.30	3.40	0.02
Albumin (g/dl)	1.40	1.45	1.50	1.45	1.50	0.03
Globulin (g/dl)	2.10a	2.00a	1.70b	1.75b	1.90a	0.02
Albumin Globulin ratio	0.69	0.73	0.88	0.83	0.79	0.03
Cholesterol (mg/dl)	119.00a	116.00a	120.00a	102.00b	105.00b	1.05
Creatinine (mg/dl)	0.90	0.87	0.80	0.82	0.80	0.01
Urea (mg/dl)	23.00	23.30	22.85	22.88	22.59	0.02
ASAT+(IU/L)	28.70b	29.00b	30.80b	33.65a	34.40a	0.65
ALT* (IU/L)	24.00	24.50	26.01	23.00	25.14	0.20
Alkaline phosphate (IU/L)	116.39b	121.00a	125.45a	124.14a	122.05a	1.10
Sodium (mmol/L)	145.00	144.24	143.01	146.15	148.00	0.22
Calcium (mmol/L)	7.00	6.88	6.40	6.69	6.80	0.03
Potassium (mmol/L)	3.50b	3.55b	3.65b	3.85a	4.36a	0.11
Phosphate (mmol/L)	7.00	7.25	8.00	7.50	8.12	0.25
Chloride (mmol/L)	109.00b	110.01b	118.00a	114.58a	115.00a	0.23
HCO3-(mmol/L)	20.00	19.68	20.00	19.54	19.00	0.17

*a. b .c: Means with different superscripts on the same horizontal row differ significantly (P<0.05) *A =0% Water leaf meal (WLM) B=3%, C = 6%, D = 9% E = 12% WLM, ASAT+ = Aspartate Amino Transferase formally known as SGOT (Serum glutamate oxalate transaminase) HCO3-Hydrogen trioxocarbonate IV' ALT* =Alanine amino Transferase formally known as SGPT (Serum glutamate-pyruvate transaminase)*

4. CONCLUSION

The WLM was found to be fairly rich in protein low in fibre and ash hence a fairly good protein supplement for broilers but low in minerals and phytochemical. Dietary inclusion of WLM in broiler starter diets depressed feed intake. Final live weight and weight gain at starter phase decreased progressively with the increased concentration of WLM supplements but 3%WLM level was the optimal. Broiler finishers had a reduced feed intake compared to the control. Broiler finishers fed diets containing WLM supplements had a higher degree of elevation in weight gain indicating non-hazardous effects of feeding WLM supplements at 3-12% and proves that WLM is a fairly good feedstuff and protein supplement for broiler finishers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kerr GR, Lee ES, Lam E.K Lorimor RJ, Randall E, Forthofer RN, Davis MA,

Magnettism A. Relationships between dietary and biochemical measures of nutritional status. The American Journal of Clinical Nutrition.1982;35:294-308.
2. Church JP, Judd JT, Young CW, Kelsag JL, Djum WW. Relationship among dietary constituent and specific serum clinical components of subjects eating self-selected diets. Animal Journal of Clinical Nutrition.1984;40:1338-1340.
3. Babatunde GM, Fajimi AO, Oyejide AO. Rubber seed oil versus palm oil in broiler chickens diet. Effect of performance, nutrient digestibility, haematology and carcass characteristics. Animal Feed Science and Technology. 1992;35:133-146.
4. Khan TA, Zafar F. Haematological study in response to varying doses of estrogen in broiler chicken. International Journal of Poultry Science. 2005;4(10):748-751.
5. Aderemi FA. Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biochemistry of pullet chicks. Trop J Anim Sci. 2004;7(1):147-153.
6. Aja PM, Okaka ANC, Onu PN, Ibiam U, Urako AJ. Phytochemical Composition of *Talinum triangulare* (Water Leaf) Leaves. Pakistan Journal of Nutrition. 2010;9(6):527-530.
7. Adebayo AS, Gbadamosi IA, Adewunmi CO. Formations of antimicrobial dried powdered herbs in soap bases. In phyto medicines in malaria and sexually transmitted diseases; Challenges for the new millennium. Adewunmi CO, Adesina SK. (Eds.). Obafemi Awolowo University, Ile Ife. 2000;97.
8. Akachuku CO, Fawusi MAO. Growth characteristics, yield and nutritional value of waterleaf, *Talinum triangulare* (Jacq) Wild in a Semi-Wild Environment. Discovery and Innovation. 1995;7:163-172.
9. Sridhar R, Lakshminarayana G. Lipid Classes, Fatty Acids, and Tocopherols of Leaves of Six Edible Plant Species. J Agric Food Chem. 1993;41:61-63.
10. D'Mello JPF. Leguminous leaf meals in non – ruminants nutrition. In: *Tropical legumes in Anim. Nutrition* 1st ed. A.B. Int. Wallingford, Oxon, U.K. 1995;247-280.
11. Swenson MT. Effects of vitamin B12 and liver meal on the hematology of chicks fed on low protein ration. Anim Vet Res. 1951;12:147-151.
12. Schalm JW, Jain NC, Carol EJ. Veterinary Haematology. 3 Edn. Lea and Febriger. Philadelphia USA. 1975;15-81.
13. Jain NC, Schalm's Veterinary Haematology. 4th Edn. Lea and Febrigen, Philadelphia, USA. 1986;34-50.
14. Kohn RA, Allen MS. Enrichment of proteolysis activity relative to nitrogen in preparations from the rumen for *in vitro* studies. Animal Feed Science and Technology. 1995;52:1-4.
15. Peters T, Biamonte GT, Doumas BT. Protein (total protein) in serum. In: Selected methods applications to livestock management and of clinical chemistry. Faulkner GWR, Mcites S. (Eds.). Amercian Association of Clinical Chemistry. 1982;100-115.
16. Rej R, Holder M. Aspratate aminotransferase. In: Methods of enzymatic analysis. 3 Edn. Bergmeyer HU, Bergmeyer J, Grassl M. (Eds.). Weinhein Velagchemie.1983;416-433.
17. Holder M, Rej R. Alanine transaminase. In: Methods of enzymatics analysis 3rd Edn; 1983.
18. Mouldin RE, Goldale OA, Engeman RM, Goodall MJ, Craves RK, Johnston JJ. Determination of zinc phoshide residue in the 2 Rev. Edn. 1996;140-153.
19. Roschlan P, Bernet E, Guber W. Enzymatischebestimmung of gesantcholesterium in serum. J Clin Biochem. 1974;12:403-407.
20. Kaplan A, Szabo II. Clinical chemistry interpretation and technique. 1st Edn. Henry Kumpton Publishers, London. 1979;109-110.
21. Association of Official Analytical Chemists (AOAC). Washington DC. 15th Edition; 1990.
22. Miller DS, Payne PR. A ballistic bomb calorimeter. Br J Nutr. 1959;13:501-508.
23. Panzenga U. Feeding parent stock. Zootecncia International. 1985;22-24.
24. Obi IU. Statistical methods of detecting differences between treatment means. 2nd Edition. Snaap Press, Enugu, Nigeria. 1990;25-85.
25. Fasuyi AO. Nutritional Potentials of some Tropical vegetable leaf meals: Chemical characterization and Functional Properties. African Journal of Biotechnology. 2006;5(1):049-053.
26. Sonaiya EB. Backyard poultry production for socioeconomic advancement of the Nigerian family: Requirements for research

and development. Nig Poult Sci J. 2000;1:88-108.
27. FAO. Food composition table for use in Africa. FAO and US Department of Health Education and Welfare Bethesda, Maryland .1968;24-31.
28. Rice P, Rice IW, Tindall HD. Fruit and vegetable production in warm climates, 2nd edition, McMillan Ed. Ltd. 1991;25-48.
29. Taiwo AA. Proximate and chemical composition of some Nigerian underutilized non-conventional feed resources. Annual in house review of IAR&T, held on 10th-12th Feb. 1998;10-11.
30. Oyenuga VA. Nigeria foods and feeding stuffs, their chemistry and nutritive value 3rd Edition. IUP. University of Ibadan, Ibadan, Nigeria. 1968;35-40.
31. NRC. Nutrient Requirements of Poultry. Ninth revised edition. National Academy Press. Washington, D.C; 1994.
32. FAO. Legume trees and other fodder trees as protein sources for livestock. Anim. Prod and Health Paper. 1992;102:14-18.
33. Nworgu FC, Fapohunda JB. Performance of broiler chicks fed mimosa (*Mimosa invisa*) leaf meal supplements. Aletor VA, Onibi GE (eds.). Proc. of 27th Ann. Conf. NSAP, held at FUTA Nigeria on the 17th -21st March. 2002;128-131.
34. Odunsi AA, Farinu GO, Akinola JO. Togun VA. Growth, Carcass characteristics and body composition of broilers fed wild sunflower (*Tithonia diversifolia*) forage meal. Trop Anim Prod Invest. 1999;2:205-211.
35. Esonu BO, Iheukwumere F, Iwuji TC, Akanu N, Nwugo OH. Evaluation of micronutrients of puberula leaf as feed ingredient in broiler starter diets. Nig J Anim Prod. 2003;30(1):3-8.
36. Nghodigha LM. Incorporation of *Centrosema pubescens* in broiler diets. Effects on performance characteristics. Bulletin of Animal Health and Production in Africa. 1994;42:159-161.
37. Udedibie ABI, Igwe FO. Dry matter yield and chemical composition of pigeon pea leaf meal and the nutritive value of pigeon pea leaf meal and grain meal for laying hens. Animal Feed Science and Technology. 1989;24:111-119.
38. Oluyemi JA, Roberts FA. Poultry production in warm wet climates. Macmillan Tropical Agriculture, Horticulture and Applied Ecology Series; 1979.
39. McDonalds P, Edwards RA, Greenhalgh JFD. Evaluation of food. In: Animal Nutrition 4th Edition. Longman scientific and Technical Publications, England. 1994;260-283.
40. Aletor VA, Adeogun OA. Nutrients and anti-nutrient components of some tropical leafy vegetables. Food Chemistry. 1995;54(4):375-379.
41. Olorede BR, Longe OG. Effects of replacing palm kernel cake with shear butter cake on quality characteristics, haematology and serum chemistry of laying hens. Nigerian Journal of Animal Production. 2000;27:19-23.
42. Adeyemi OA, Fasina OE, Balogun MO. Utilization of full fat *Jatropha* seeds in broiler diet: Effect on hematological parameters and blood chemistry. Proceedings of the 25th conference of Nigerian Society for Animal Production held at Michael Okpara University of Agriculture, Umudike, Nigeria. 2000;108-109.
43. Bell DJ, Sturkie PD. Chemical constituents of blood. Avian Physiology (2nd Edition). Comstock Publishing Associates, Cornel University Press, N.Y; 1965.
44. Maxwell MH, Robertson W, Spencer S, Maclorquodale CC. Comparison of haematological parameters in restricted and ad libitum fed domestic fowls. Br Poult Sci. 1990;31:407-413.
45. Chubb LG, Rowell JG. Counting blood cells of chickens. J Agri Sci Camb. 1959;42:263-271.
46. Gilbert AB. Sedimentation rate of erythrocytes in the domesticated cork. Poult Sci. 1962;41:784-788.

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