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Haematological and Serum Biochemical Indices of Finisher Broiler Chicken Fed Untreated and NaOH Treated Palm Press Fibre Meal-Based Diets

***Ikpe, J.N., **Ahaotu, E.O., ***Vining-Ogu, I.C. *Abdullahi, J., ****Mbachu, M.U. *Njoku, J. U. and *****Simeon-Ahaotu, V.C.**

Department of Animal Health and Production Technology, Akanu Ibiam Federal Polytechnic, Unwana, EbonyiState. Department of Animal Science, University of Agriculture and Environmental Sciences, Umuagwo, Imo State.*

****Department of Science Laboratory Technology, Akanu Ibiam Federal Polytechnic, Unwana, aEbonyi State.*

*****Department of Agriculture, Alvan Ikoku Federal University of Education, Owerri, Imo, State.*

******Department of Microbiology, Gregory University, Uturu, Abia State, Nigeria.*

Corresponding Author: * julianankpe@gmail.com +234 803 492 8358

Target Audience: Livestock farmers, Extension agents, Nutritionists, Feed millers

Abstract

The soaring cost of maize that constitutes about 60% of broiler feed has led to the quest for discovery and use of alternative feed ingredients, which could impact on blood parameters. Research was therefore conducted to investigate the blood parameters of finisher broiler chickens fed untreated and NaOH treated Palm Press Fibre meal (PPFM). Four hundred and twenty finishing broilers were randomly assigned to 7 treatment diets. T (control) contained only maize. In A1, A2, A3 untreated PPFM substituted maize at 16.67, 33.33 and 50% rates (10, 20 and 30% inclusion rates) while for B1, B2 and B3 NaOH treated PPFM substituted maize at the same rate. The broilers were managed under deep litter system for 28days after which blood was collected for haematological and serum biochemical parameters analysis. Data were analyzed for variance (ANOVA) at 0.05 significance level. The total protein and haemoglobin concentration (Hb) had ($P<0.05$) highest value in B3 group while the control had the least value. In the same vein, there were variations in other parameters but the results were within the normal range. It was concluded that though 50% substitution of maize with NaOH treated PPFM gave highest values but both untreated and NaOH treated PPFM can substitute maize at up to 50% without causing a deleterious effect on blood parameters of broiler chickens.

Keywords: Diet; NaOH treatment; Palm Press Fibre; Haematology; Serum biochemistry; finisher broilers

Description of Problem

The current climate changing has threatened productivity of both animal and crop agriculture (1). The productivity of Maize which make-up 55 - 65% of the finished feed for poultry (2) is among the sector facing the threat (3; 4). The outcome of which has contributed immensely to the current exorbitant rise in the cost of feeding broilers. This challenge has necessitated the interest in the sourcing for inexpensive agro industrial waste as an alternate feed ingredient to replace maize in broiler feed formulation. An agro industrial waste of interest is Palm oil Press fibre (PPF), which is the fibrous material that remains after decanting the palm oil mill effluent. Nigeria is ranked fourth largest producer of palm oil in the world, accounting for 3% of global production (5). This means that PPF is abundant in Nigeria. Presently, heaps of PPF are seen around most mills within the areas where palm fruit is processed and could become an environmental problem since the delayed use of PPF has been reported to result in bioconversion to methane, which directly contributes to greenhouse gas emissions (6). The chemical composition of PPF ranges from 6.50- 8.35 % moisture content, 93.91-91.23 % dry matter, 3.6 – 7.5 % crude protein, 33.18-35.73 % carbohydrate, 5.56 - 40.13 % of fat and about 14.6 % crude fiber depending on the method of the oil extraction from the oil palm fruit (7). The performance indications of an animal as a result of feed ingredient consumed, is not the only indicator for determining the efficiency of the feed ingredient, as some feed ingredient even though good in performance indicators but can impact negatively on other valuable parameters of the animal including blood. This research therefore investigated the effect of substituting different graded levels of untreated and NaOH treated PPF for maize, on the hematological and serum biochemical profiles of finisher broiler chickens.

Materials and Methods

The research was conducted at the Teaching and Research Farm, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo North, Local Government Area, Ebonyi State. Unwana is in tropical rain forest zone of Nigeria. It is located at latitude 5° 53' 22.0416" N and longitude 7° 57' 13.8168" E with a temperature range of between 27 and 38°C. Rainfall is high with maximum during June/July and September/October with a short August break (8).

Collection preparation and treatment of Palm Press Fiber (PPF)

The PPF was collected from a local palm oil mill at Afikpo South, Local Government Area, Ebonyi State, sun dried to crispiness and was taken to a hammer mill for milling to obtain the Palm Press fiber Meal (PPFM). Degradation of the PPFM was carried out using the method of (9). The PPFM was soaked in a 2 % w/v solution of 97 % sodium hydroxide (NaOH) inside a tightly covered container and maintained at room temperature for 24 hours. After the alkali treatment, the PPFM was dried in an oven to a moisture level of about 10 %. Sample of the 2 %NaOH treated (TPPFM) and untreated PPFM were analyzed for proximate composition as described by (10).

Experimental Design

The design of the experiment was a Completely Randomized Design (CRD) of 7 treatment groups (T_1, A_1, A_2, A_3, B_1, B_2 and B_3) replicated 3 times to give a total of 21 groups. Each group constitutes the experimental unit. A total of 420 finisher broilers of 28 days post hatch, was used for the experiment. The broilers were randomly assigned to the 7 treatment groups giving a total of 60 broilers per treatment group, replicated 3 times to give 20 broilers in a group. The broilers was raised in a deep litter system of management. Feed and water were given *ad-libitum* and proper routine management practices and medication adopted. The feeding trial lasted for 28 days.

Experimental Diets

A total of 7 experimental diets was formulated for the research. T_1 which is the control contained no PPFM. The A groups (A_1, A_2 and A_3) contained untreated PPFM while the B groups (B_1, B_2 and B_3) contained 2 %NaOH treated PPFM. The PPFM substituted maize in the finisher diets of the different groups at 16.67 %, 33.33 % and 50 % substitutions (10, 20 and 30 % inclusion) levels for 1, 2 and 3 respectively on weight to weight basis.

Data collection and analysis

Blood samples were collected at the end of 28th day of the experiment from the wing web vein of the broilers into ethylene diamine tetra-acetic acid (EDTA) bottle for hematological parameters analyses and in to plain bottles for serum biochemical

Table 1. Ingredient and calculated nutrient composition of the experimental diets

Ingredients	Dietary levels (% of Untreated and treated PPFM)						
	T_1(control)	A(untreated PPFM)			B(2%NaOH treated PPFM)		
		A_1(10)	A_2(20)	A_3(30)	B_1(10)	B_2(20)	B_3(30)
Maize (9%CP)	60.00	50.00	40.00	30.00	50.00	40.00	30.00
PPFM (12.60%CP)	0.00	10.00	20.00	30.00	0.00	0.00	0.00
TPPFM (12.42%CP)	0.00	0.00	0.00	0.00	10.00	20.00	30.00
SBM (44%CP)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
GNC (45%CP)	8.00	8.00	8.00	8.00	8.00	8.00	8.00
BDG (25%CP)	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Fish Meal (65%CP)	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Blood Meal (83%CP)	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone Meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
LLysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
** Vit/MinPremix	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrient composition of the diets							
Crude Protein (%)	20.29	20.35	21.01	21.34	20.63	20.93	21.32
Crude Fibre (%)	4.22	4.36	5.12	5.57	4.40	4.59	4.78
*Met. Energy (Kcal/Kg)	2985.31	2931.23	2877.15	2823.07	2949.82	2914.33	2878.84

*Note. ** To provide the following per kilogram of feed: vit A 10,000IU; vit. D3 1,500 IU; vit. E 2 mg; riboflavin 3 mg; pantothenic acid 10 mg; nicotinic acid, 2.5 mg; choline 3.5 mg; folic acid 1mg; magnesium 56 mg; lysine 1 mg; iron*

analyses. The following hematological parameters were analysed using Sysmex Auto Analyzer; Haemoglobin concentration (Hb), Packed cell volume (PCV), Total white blood cell ($TWBC_{(t)}$), Red blood cell (RBC), Mean cell volume (MCV), Mean cell Haemoglobin (MCH), Mean cell Haemoglobin Concentration (MCHC) and White blood differential. The serum biochemical analyses were carried out using Randox commercial test kit specific for each biochemical parameter in accordance with standard procedures prescribed by the producer - Randox Laboratories (UK).

Data collected were subjected to statistical analyses using analysis of variance (ANOVA) procedure at 0.05 significance level. Means that had significant difference were separated using Duncan multiple range test. The data analysis was done using Statistical Analysis System (SAS) analytical software version (12).

Results and Discussion

Haematological indices

The haematological indices of the finisher broilers as presented in table 2 showed that the RBC, the PCV and Hb of the broilers fed diets containing NaOH treated Palm Press Fibre meal had significantly higher values than the broilers in the control group and those fed diet containing untreated PPFM. Essentially all the oxygen supplied to tissues is carried by Hb, while the PCV is the percentage of RBC in blood (13). The increased values obtained from broilers fed diet containing NaOH treated Palm Press Fibre meal for the RBC, PCV and HB is an indication that the ingredient impacted on these parameters better than the control and the untreated Palm Press Fibre meal. However, all the values were within the normal range for broilers within the geographical location as opined by (14). The TWBC and its differentials were similar ($P>0.05$) among the treatment groups except B_3 in which the value obtained in TWBC was significantly ($P<0.05$) higher than the value obtained in control. The result is an indication that at 50% substitution of maize with NaOH treated PPFM, the broiler birds had a better improved TWBC than the birds in the other treatment groups. The values obtained in the TWBC and its differentials for all the treatment groups were however within the normal range stipulated by (14). The MCH which is the expression of the average haemoglobin content of a single RBC and the MCHC which is the expression of the volume within the RBC occupied by the hemoglobin (15) had the highest value for broilers in the control group than values obtained in the other groups. The MCH value was highest for the broilers in the control group while B_3 had the least value. Also, the broilers in the control had the highest value for MCHC while treatment B_3 also had the least value. The higher values for the MCH and MCHC obtained from the control groups could have compensated for the lower values obtained in the RBC, PCV and Hb. These values however, were also within the normal range as reported by (14). The result obtained from the research is an indication that at up to 50 % substitution level of maize with both the NaOH treated and untreated Palm Press Fibre Meal, the substitution did not cause deviation from the normal range of the hematological parameters of the broiler chicken

Table 2. Hematological indices of finisher broilers fed different levels of NaOH treated and untreated PPFM

Parameters	Dietary levels (% of Untreated and treated PPFM)							SEM
	Control	A (Untreated PPFM)			B (Treated PPFM)			
	T_1(0.00)	A_1(10.00)	A_2(20.00)	A_3(30.00)	B_1(10.00)	B_2(20.00)	B_3(30.00)	
RBC ($x10^6/mm^3$)	2.85^c	3.07^c	3.09^c	3.12^c	3.46^b	3.89^a	3.92^a	0.13
PCV (%)	25.5^f	28.33^b	29.67^b	30.00^b	33.33^a	34.5^a	35.67^a	1.12
Hb (g/dl)	10.83^b	11.10^b	11.13^b	11.37^b	12.07^a	12.35^a	12.6^a	0.24
TWBC ($x10^3/mm^3$)	20.27^b	20.50^{ab}	21.13^{ab}	20.63^{ab}	21.67^{ab}	21.55^{ab}	22.03^a	3.39
Neutrophils (%)	29.50^{abc}	28.33^{bc}	32.33^a	33.00^a	29.33^{abc}	30.50^{ab}	26.33^c	1.66
Lymphocytes (%)	61.75	64.00	59.33	58.67	61.67	61.00	62.33	2.13
Monocytes (%)	5.50	5.33	5.00	5.33	5.33	5.50	5.00	4.78
Eosinophils (%)	3.00	2.33	3.00	2.67	2.67	3.00	3.00	4.36
MCV (fl)	89.58^{cb}	92.17^{abc}	96.11^{ab}	95.99^{ab}	96.89^b	88.80^c	91.06^{abc}	2.76
MCH (pg)	38.09^a	36.11^{abc}	36.07^{ab}	36.39^{ab}	35.11^b	31.79^c	32.17^c	0.91
MCHC (g/dl)	42.54^a	39.22^b	37.55^{bc}	37.95^{bc}	36.21^{cd}	35.78^{cd}	35.33^d	0.88

Without superscript = not significant. Means with different superscript in the same row differ significantly ($P < 0.05$). SEM = Standard Error Mean

Serum biochemical indices

The serum biochemical indices of the finisher broilers as presented in table 3 showed that the total protein (TP) of broilers fed NaOH treated Palm Press Fibre meal had highest values for B_3 and least for broilers in the control group. The TP of the control group however was similar ($P>0.05$) with A_1, A_2 and A_3 but significantly different ($P<0.05$) from B_1, B_2 and B_3. The liver function enzymes (Asparate {AST}, Alanine phosphatase {ALP} and Alanine aminotranspherase {ALT}) and bilirubin of the broilers had no difference ($P>0.05$) among the control and the rest of the treatment groups. The liver function enzymes diagnose and monitor proper functioning or damage of liver (16). An increase in the concentration of these enzymes may be suggestive of damaged liver cells. The non-significant result obtained on these parameters in the present research is an indication that the diets did not impact negatively on the liver of the broilers. The creatinine which is a by-product excreted by the kidney as a result of energy production by the skeletal muscle (17), had the highest value for broilers in the control group and least for broilers in B_3 group. Also, the total cholesterol was highest for broilers in the control group which was similar ($P>0.05$) with the values obtained in A_1, A_2 and A_3 treatment groups but significantly ($P<0.05$) higher than values obtained for B_1, B_2 and B_3. Glucose was highest for broilers in the control group and significantly ($P<0.05$) lower for broilers whose diet contained NaOH treated PPFM. Despite the variations among the treatment groups for these serum biochemical parameters, the values obtained from all the treatment groups were within the normal range (14).

Conclusion and Application

From the findings of this research, the following conclusions were derived:

1. The substitution of maize with 2 % NaOH treated PPFM at 50 % substitution gave the highest value for Hb and TP of the broiler

Table 3. Serum biochemical indices of finisher broilers fed different levels of NaOH treated and untreated PPFM

Parameters	Dietary levels (% of Untreated and treated PPFM)							SEM
	Control	A (Untreated PPFM)			B (NaOH Treated PPFM)			
	T_1(0.00)	A_1(10.00)	A_2(20.00)	A_3(30.00)	B_1(10.00)	B_2(20.00)	B_3(30.00)	
Total protein (g/dl)	3.08^{d}	3.30^{dcb}	3.23^{dcb}	3.17^{cd}	3.51^{b}	3.49^{bc}	3.91^{a}	1.32
AST (u/l)	35.50	31.33	32.00	33.50	34.00	31.50	33.97	2.04
ALT (u/l)	30.50^{ab}	31.67^{a}	31.33^{a}	29.33^{ab}	28.67^{b}	30.00^{ab}	28.33^{b}	1.08
ALP (u/l)	61.50^{ab}	61.17^{ab}	60.97^{ab}	63.60^{a}	60.27^{b}	59.95^{b}	62.8^{ab}	1.27
Bilirubin (mg/dl)	0.64	0.58	0.57	0.56	0.58	0.59	0.57	0.03
Total Cholesterol (mg/dl)	103.11^{a}	101.25^{a}	100.77^{a}	97.49^{ab}	94.50^{bc}	91.62^{cd}	88.67^{d}	1.37
Urea (mg/dl)	11.53^{ab}	11.46^{ab}	11.46^{ab}	10.48^{bc}	9.99^{bc}	9.47^{c}	12.20^{a}	0.65
Creatinine (mg/dl)	0.91^{a}	0.93^{a}	0.87^{ab}	0.89^{ab}	0.86^{ab}	0.87^{ab}	0.79^{b}	0.05
Glucose (mg/dl)	167.75^{a}	120.33^{b}	135.33^{ab}	136.00^{ab}	134.67^{ab}	126.00^{b}	100.00^{b}	16.92

Without superscript = not significant. Means with different superscript in the same row differ significantly ($P < 0.05$). SEM = Standard Error Mean.

chickens.

2. Though there were variations in the values obtained among the different treatment groups for both the hematological and serum biochemistry parameters analyzed, but these values were within the normal range.
3. Both untreated and 2 %NaOH treated PPFM can be a part of ingredients for the diet of finisher broiler chickens.

References

[1]. Cheng, M., McCarl, B. and Fei, C. (2022). Climate change and livestock Production: A Review of Literature. *Atmosphere, 13*(1), 140; https://doi.org/10.3390/atmos13010140

[2]. Agriculture.Institute, (2023). Poultry feeds and Feedings Optimal Inclusion Levels of Feed Ingredients for Broilers and Layers. https://agriculture.institute/poultry-feeds-and-feeding/optimal-feed-ingredients-broilers-layers/

[3]. Mulungu, K. and N. Ng'ombe, J. (2020). Climate Change Impacts on Sustainable Maize Production in Sub-Saharan Africa: A Review. IntechOpen. doi: 10.5772/intechopen.90033

[4]. Aroyehun, A. R. (2023). Impacts of Climate Change on Maize Production: An Approach to Food Production Sustainability in Nigeria. *International Journal of Research in Applied Sciences, Innovations and Technology (IJORIASIT)* Volume 2 Issue 1.

[5]. Shahbandeh, M. (2025). Palm oil

top global producers 2024/25 https://www.statista.com/statistics/856231/palm-oil-top-global-producers/

[6]. Hafis, S. M., Ridzuana, M. J. M., Rahayu, A., Mohamed, B., Farahanac, R. N., Fatina, B. N. and Syahrullaild S. (2013). *Properties of palm pressed fibre for metal forming lubricant applications.* Procedia The Malaysian International Tribology Conference, MITC Engineering 68; 130 – 137.

[7]. Heuzé, V., Tran, G. and Sauvant, D. (2015). Palm Press Fibre. Feedipedia, a program by INRA, CIRAD, AFZ and FAO. .https://www.feedipedia.org/node/15392. *Last updated on May 11, 2015, 14:35*

[8]. Enwikipedia, (2025). https://en.wikipedia.org/wiki/Unwana

[9]. Ikpe, J. N., Oko, E. C. and Vining-Ogu, I. C. (2019). Potentials of Bio-Fermented Rice Husk Meal as a replacement to Brewers Dried Grain in Finisher Broilers Diet. *Journal of Agricultural Science.* 11(2): 533-540.

[10]. A.O.A.C. (2016). Association of Official Analytical Chemists. Official methods of analysis (18th ed.). A.O.A.C International Virginia, USA.

[11]. Pauzenga, U. (1985). Feeding parent stock. *Zootecnia International* Pp 22-25.

[12]. SAS Institute Inc. (2008). SAS/STAT User's guide version 9.2 for windows, NC: SAS Institute Inc.[13]. Purves, W. K., Sadava, D., Orians, G. H. and Heller, H. C. (2003). Life: The science of biology (7th ed.) p.954. Sinaeur Association and W. H. Freeman U. S. A.

[14]. Onunkwo, D. N.; Amajuruonye, W. and Daniel-igwe, G. (2018). Hematological and serological response of broiler chickens fed varying levels of direct microbes as food additive. *Nigeria Journal of Agriculture*, 49 (1): 164-167.

[15]. Jaime, S. (2005). Diagnostic value of hematology. In Gregg J. Harrison and Theresa Lightfoot (eds) Clinical Avian Medicine. vol. II Spix publishing Pp 588-609. Palm Beach.

[16]. Ambrosy, A. P., Dunn, T. P. and Heidenreich, P. A. (2015). Effect of minor liver function test abnormalities and values within the normal range of survival in heart failure. *The American Journal of Cardiology*, 115(7): 938-941.

[17]. Esubonteng, O.K. A. (2011). An assessment of the effect of Moringa olifera leaf powder as a nutritional supplement in the diet. A thesis submitted to the Department of Molecular Medicine, School of Medical Sciences Kumasi Kwame Nkrumah University of Science and Technology, in partial fulfillment of the requirements for the degree of Master of Science.