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HAEMATOLOGICAL PARAMETERS OF THE NIGERIAN LOCAL GROWER CHICKENS FED VARYING DIETARY LEVELS OF PALM KERNEL CAKE

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SUMMARY

The effect of feeding varying dietary levels of Palm Kernel Cake (PKC) on the haematological parameters of the Nigerian local grower chicken was investigated. Sixty (60) nine-week old local chickens were randomly allotted to five experimental diets at four birds per three replicates. Five isonitrogenous (17% CP) grower diets containing 2,813 to 3,070 Kcal ME/kg with varying levels of 10, 15, 20 and 25% PKC used to replace maize and soybean in diets 2, 3, 4 and 5 were formulated respectively. Diet 1 without PKC (0% PKC) was the control. Feed and water were supplied ad libitum for ten weeks. Packed cell volume, haemoglobin, red blood cell, platelets, heterophil and eosinophil were similar ($p>0.05$) among birds across diets whereas variations in white blood cell (15.95 to 19.53 x $10^6/mm^3$), lymphocytes (60.00 to 67.00%) and monocytes (0.67 to 2.00%) were significant ($p<0.05$). The haematological parameters obtained were within the normal range of values documented for healthy chicken. PKC added up to 25% in the diet of the Nigerian local grower chicken elicited no adverse effect on the hematology.

Key-words: hematological parameters, local chickens, palm kernel cake

INTRODUCTION

The Nigerian indigenous or local chicken is a light strain or breed possessing a small body size with extremely variable plumage colour, early maturing of rather nervous disposition and produces white-shelled eggs (Oluyemi and Robert, 2003). Local chickens are abundant in Nigeria, about 123,900,000 in 1978 (Akinwumi et al., 1979), 115,880,864 in 2003 (FMARD, 2006) and about 84 million in 2006 (Poultry International, 2006). Just as the local fowl or chickens are abundant and well adapted to the Nigerian climate, Palm Kernel Cake (PKC) a product of palm oil mill industry is also abundant in the southwestern part of Nigeria with no alternative use but in feeding livestock.

Analysis of normal haematological parameters of chickens is very much essential in diagnosing the various pathological and metabolic disorders and can be used as a tool to assess the health

status of an individual or a flock. Changes in the haematological parameters are often used to determine various status of the body and stresses due to environmental, nutritional and/or pathological factors. Haematological values of poultry are influenced by age, sex, breed, climate, geographical location, season, day length, time of day, nutritional status, life habit of species, present status of individual and their factors (Islam et al., 2004). There is scanty information on the haematological values of the Nigerian local chicken. The little information available were derived from those scavenging on the free range whose management in term of feeding, housing, health/medication etc. were neither standardized nor documented.

The present study was carried out to evaluate the effects of feeding varying dietary levels (0 – 25%) of PKC on the haematological parameters of the Nigerian local grower chicken (*Gallus domesticus*) of Oyo state ecotype reared under intensive system of management.

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MATERIAL AND METHODS

Local hens and cocks with similar or peculiar morphological traits (Oluyemi, 1974; Nwosu et al., 1985; Oluyemi and Roberts, 2003; Adebambo, 2005) were purchased from markets in Oyo state of Nigeria. They were either multicoloured, black brown or off white in plumage colour with thin, scaled, feathered or unfeathered, black, yellow or white coloured shank. Their body weight ranged from 600 g to 1200 g. The local hens and cocks were given anti-stress, long acting antibiotics, coccidiostat and dewormed in addition to vaccine against Newcastle disease to stabilize them. Water and commercial layers mash were given *ad libitum*. The hens were bred with local cocks and allowed to lay fertile eggs which were hatched in the hatchery to chicks. The emerging chicks were reared under a deep litter system of management to 9 weeks of age with chick mash containing 3,000 Kcal Metabolizable Energy (ME) per kg and 22% Crude Protein (CP) to cater for the starter phase. Normal prophylactic medication and vaccination were administered as at when due.

Sixty (60) nine-week old local chicken were randomly alloted to five experimental diets at four birds per replicate of three in a completely randomised design. Fifteen partitions of the deep litter house were used and each partition represented a replicate that housed four birds. Five grower mash which were isonitrogenous (17% CP) with 2,812.95 to 3079.26 Kcal ME per kg diet were formulated with varying levels of 10, 15, 20 and 25% dietary PKC which were used to replace maize and soybean meal in diets 2, 3, 4 and 5 respectively. Diet 1 without PKC (0% PKC) was served as the control one. The PKC used contained CP (16.60%), Crude Fibre - CF (25.30%), Ether Extract - EE (12.50%), ash (10.10%), Nitrogen Free Extract - NFE (35.5%), Neutral Detergent Fibre – NDF (48.60%), Acid Detergent Fibre – ADF (39.90%) and 8.5% lignin (Afolabi, 2009). The proximate composition and detergent fibre fractions of the experimental diets were determined according to the procedures of AOAC (1990) and Van Soest et al. (1991) respectively. The gross and chemical composition of experimental diets is as shown in Table 1. All birds were given access to feed and water *ad libitum* for 10 weeks.

Table 1. Composition of experimental diets with varying levels of PKC fed to the Nigerian local grower chicken

Tablica 1. Sastav pokusnih obroka s različitim količinama pogače palminoga sjemena u tovu nigerijskih domaćih pilića

Diets Levels of PKC (%)	1 0	2 10	3 15	4 20	5 25
Ingredients: Maize	54	46	43.30	39.50	35.60
Soybean meal	22.90	20.90	18.60	17.40	16.30
Palm Kernel Cake (PKC)	-	10	15	20	25
Wheat Offal	2.0	2.0	2.0	2.0	2.0
Cassava Meal	16	16	16	16	16
Fish Meal (72% PKC)	2.0	2.0	2.0	2.0	2.0
Bone Meal	2.11	2.11	2.11	2.11	2.11
Oyster Shell	0.5	0.5	0.5	0.5	0.5
*Premix (Grower)	0.25	0.25	0.25	0.25	0.25
Salt (NaCl)	0.18	0.18	0.18	0.18	0.18
Lysine	0.01	0.01	0.01	0.01	0.01
Methionine	0.05	0.05	0.05	0.05	0.05
Total	100	100	100	100	100
Calculated analyses: ME (Kcal/kg)	3,079.26	2,930.64	2,921.90	2,867.83	2,812.95
Methionine (%)	0.33	0.34	0.34	0.35	0.36
Lysine (%)	0.90	0.89	0.85	0.75	0.83
Feed Cost (₦/kg)	54.70	52.25	49.13	47.33	45.55
Determined analyses Crude Protein	16.80	17.30	17.00	17.40	17.10
Crude fibre	7.90	9.00	9.60	10.30	11.20
Ether extract	8.40	8.60	8.30	8.60	8.60
Ash	9.00	8.40	8.30	8.00	8.60
Nitrogen Free Extract (NFE)	57.90	56.70	56.80	55.70	54.60
Neutral Detergent Fibre (NDF)	17.00	17.50	17.40	17.60	17.40
Acid Detergent Fibre (ADF)	14.10	14.40	14.00	13.90	14.30
Acid Detergent Lignin (ADL)	2.60	3.65	4.30	4.89	5.35

*Supplied per kg diet: Vit. A, 10 x 10^6 ; Vit. D_3, 2 x 10^6 I.U; Vit. E, 2 x 10^4mg; Vit. K_3, 2 x 10^3mg; Vit. B, 3000 mg; Vit. B_2,5,000 mg; Niacin, 45,000 mg; Calcium pentothenate, 10 g; Vit. B_6, 4g; Vit. B_{12}, 20 mg; Choline chloride, 300 g; Folic acid, 1 g; Biotin, 50 mg; Manganese, 300 g; Iron, 120 g; zinc, 80 g; Copper, 8.5 g; Iodine, 1.5g; Cobalt, 300 mg; Selenium, 120 mg; Anti-oxidant 120 g

At the end of week 10, blood samples were collected aseptically with sterile syringes and needles from the jugular vein of each of the experimental birds into a bottle per bird with ethylene diamine tetracetic acid (EDTA) to prevent clotting. All blood samples collected were subjected to haematological analysis of Packed Cell Volume (PCV), haemoglobin, Red Blood Cell (RBC), White Blood Cell (WBC), platelets, lymphocytes, heterophils, monocytes and eosinophil in the laboratory according to the procedure of MAFF (1984). Data (values) obtained were subjected to Analysis Of Variance (ANOVA) and descriptive statistics using the General Linear Model (GLM) of SAS Software (SAS, 1999). Treatment means were compared by Duncan option of the software.

RESULTS

The proximate composition and fibre fractions of the five experimental diets revealed that the CP content varied from 16.8 to 17.4%, while the CF content varied from 7.9 to 11.20%. The values of NFE, NDF and ADF were similar (Table 1).

The haematological parameters of the Nigerian local grower chickens (week 10 – 19 old) fed varying levels (0 – 25%) of PKC are shown in Table 2. Variations in the blood PCV, haemoglobin, RBC, platelets, heterophil, and eosinophil were not significant ($p>0.05$). However, there were differences in the WBC (x 10^6/mm^3) of birds on diet 2 (10% PKC) which were significantly lower than the WBC measured or counted for grower birds fed diets 1, 3, 4 and 5. There were significant ($p < 0.05$) differences in the lymphocytes and the monocytes of the Nigerian local grower birds fed varying levels of PKC.

Table 2. Haematological parameters of the Nigerian local grower/finisher chicken (weeks 10 – 19 old) fed varying dietary levels of PKC

Table 2. Hematološki parametri nigerijskih domaćih pilića u tovu (u dobi 10-19 tjedana), hranjenih različitim količinama pogače palminoga sjemena

Parameters	Diet 1 0% PKC	Diet 2 10%PKC	Diet 3 15% PKC	Diet 4 20%PKC	Diet 5 25%PKC	SEM
PCV (%)	37.0±1.0	34.50±0.5	39.0±1.0	36.5±2.5	38.5±6.5	1.06
Haemoglobin (g/dl)	12.1±0.3	11.5±0.3__	13.1±0.5	12.1±0.7	12.25±2.25	0.40
Red Blood Cell (x 10^6/mm^3)	3.3±0.04	2.82±0.34	3.37±0.02	2.94±0.43	2.9±0.51	0.19
White Blood Cell (x 10^6/mm^3)	19.5^a±0.3	15.95^b±0.1	18.18^a±1.28	17.68^a±0.23	17.95^a±1.65	0.32
Platelet (X10^6/mm^3)	13.0±5.4	17.35±0.55	13.65±0.45	12.7±5.8	12.4±7.0	1.58
Lymphocytes (%)	63.5^b±2.5	67.0^a±2.0	60.0^c±1.0	65.5^{ab}±1.5	64.0^{ab}±1.0	0.57
Heterophil (%)	32.33±1.67	30.0±1.0	31.33±4.67	30.00±1.0	33.0±1.0	0.76
Monocytes (%)	1.00^{ab}±0.00	1.00^{ab}±0.5	1.50^{ab}±0.5	2.00^a±0.00	0.67^b±0.33	0.19
Eosinophil (%)	3.0±1.0	2.00±0.00	2.00±1.0	1.83±1.17	2.33±0.67	0.33

abc*Means along the same row with any identical superscripts are not significantly (*p>0.05*) different

DISCUSSION

Variations in PCV values (34.5 ± 0.5 to 39.0 ± 1.0%) observed in the present study were not significant (*p>0.05)* and ranging from 24.9 to 45.2% for healthy chicken (Mitruka and Rawnsley, 1977; Nworgu et al., 2007; Riddell, 2011). Ikhimioya et al. (2000) reported 26.1 to 29.5% PCV for the Nigerian indigenous chicken while 27.38 ± 0.46 to 34.60 ± 0.64% PCV were obtained in Fayoumi, Assil and local chickens in Sylhet region of Bangladesh (Islam et al., 2004). Pampori and Iqbal (2007) had also reported 35.21 to 40.70% PCV values for the native chicken of Kashmir. The PCV values so obtained in the present study were lower than those reported (26.38 ± 0.49%) for 5week old broilers (Khan et al., 2002).

The haemoglobin values of local grower chicken on all diets (11.5 ± 0.3 to 13.5 ± 0.5 g/dl) were within the range established as normal values (7.4 to 13.1 g/dl) for chickens (Mitruka and Rawnsley, 1977). Haemoglobin values from 6.3 to 7.8 g/dl (Mmereole, 1996), and 8.7 to 9.3 g/dl (Ikhimioya et al., 2000) have been reported for the Nigerian indigenous chicken. Islam et al. (2004) also reported 7.06 ± 0.6 to 9.54 ± 0.05 g/dl haemoglobin for Fayoumi, Assil and local chickens of Bangladesh. Pampori and Iqbal (2007) obtained 11.32 to 13.21% haemoglobin values for the native chicken of Kashmir.

The RBC of local grower chicken fed PKC based diets (2.82 ± 0.34 to 3.37 ± 0.02 x 10^6/mm^3) were within the range of established values of 2.8 x 10^6/mm^3 (Banks, 1974) and 1.58 to 4.1 x 10^6/mm^3 (Mitruka and Rawnsley, 1977) for healthy domestic chickens. The RBC values of 2.35 x 10^6/mm^3 (Nworgu et al., 2007), 2.84 x 10^6/mm^3 (Khan, 2005) and 3.0 x 10^6/mm^3 (Riddell, 2011) had been reported for exotic chickens while Pampori and Iqbal (2007) reported 2.98 to 3.2 x 10^6/mm^3 RBC for the native chicken of Kashmir. The results are in accordance with 1.5 to 2.8 x 10^6/mm^3 (Mmereole, 1996) and 2.39 to 2.94 x 10^6/mm^3 (Ikhimioya et al., 2000) reported for local chicken. Islam et al. (2004) had reported 2.69 ± 0.08 x 10^6/m^3 RBC for 9 month old local chickens of Bangladesh. The PCV, hemoglobin and RBC values obtained in this study indicated that the birds were healthy with normal

metabolic rate and not anemic. Since the RBC carries the respiratory pigments – the haemoglobin, the normal and higher quantity of circulating RBC indicated that the birds could withstand respiratory stress. This accounted for the "hardiness" or strength of the local chicken.

The platelets responsible for hemostasis, trephocytosis and phagocytosis in birds were lower in the blood of local grower chicken except for birds on diet that contained 10% PKC that had 17.35 ± 0.55 x 10^6/mm^3 platelet, which was also similar ($p>0.05$) to those of birds on other diets. Mitruka and Rawnsley (1997) reported normal range of platelet in healthy chicken to be 60.4 x 10^6/mm^3.

The WBC of local grower chicken fed 10% PKC-based diets (15.95 ± 0.1 x 10^6/mm^3) was significantly ($p<0.05$) lower than that obtained in the control and other PKC-based diets (i.e. 17.68 ± 0.23 to 19.5 ± 0.3 x 10^6/mm^3). Although these values were within the normal range of 9.20 to 31.0 x 10^6/mm^3 reported (Riddell, 2011; Mitruka and Rawnsley, 1977; Banks, 1974) for healthy domestic chickens and 6.95 to 18.65 x 10^6/mm^3 of blood reported (Mmereole, 1996; Ikhimioya et al., 2000) for healthy Nigerian local chicken. Pampori and Iqbal (2007) had reported 16.8 to 22.29 x 10^6/mm^3 WBC values for the native chicken of Kashmir. The WBC play prominent role in disease resistance, especially with respect to the generation of antibodies and the process of phagocytosis. This could explain the reason of high degree resistance to disease reported (Nwosu, 1979; Anyanwu and Adikuru, 1993) for the Nigerian local chicken. Palm kernel cake has been estimated to have 30-35% B-mannan (Chemgen Corp, 2002) yielding mannan-oligosaccharide (MOS) or mannose through physical digestion in the gizzard. Mannose has been indicated to act as prebiotics by increasing the immunity of birds (Sundu et al., 2006). Sundu et al. (2006) also speculated that soluble β-mannan from PKC acts like a food allergen to induce an immune response from broilers, which becomes particularly evident when broilers have necrotic enteritis. Such phenomena could also have occurred in local grower chicken used in this study.

The lymphocytes were the most numerous and frequent WBC type followed by heterophils, eosinophils and the monocytes. Bounous et al. (2000) observed the same trend and described the lymphocytes as the most numerous WBC in chickens and turkeys. The lymphocytes (60.00 ± 1.0 to 67.00 ± 2.0%) and monocytes (0.67 ± 0.33 to 2.00%), which were agranulocytes of WBC, were within the normal range from 47.2 to 85.0% and 0.06 to 5.0% respectively for a healthy chicken (Riddell, 2011; Mitruka and Rawnsley, 1977). Islam et al. (2004) reported 71.25 ± 0.85% lymphocytes and 3.42±0.50% monocytes for local chicken of Bangladesh. Banks (1974) reported 6% monocytes for domestic chickens while 10.85 to 10.90% were obtained for normal native chicken of Khashmir (Pampori and Iqbal, 2007). Lymphocytes are implicated in antibody production, as they are reactive cells in inflammation and delayed hypersensitivity (Banks, 1974). Small lymphocytes may be responsible for the development of clones of plasma cells while monocytes are phagocytic cells. Higher Lymphocytes and Heterophils count in this study is consistent with the findings of Sturkie (1965) who also observed higher lymphocytes and heterophils in chicken. This is in contrast to the findings of Oyewale (1987) who observed higher WBC count and lowered lymphocyte counts in Nigerian fowls.

The heterophils (30.00 to 33.00%) and the eosinophils (1.83 ± 1.17 to 3.0 ± 1.0%) that are granulocytes of WBC were within normal range from 10 to 53.6% and 0.00 to 15% respectively for a healthy chicken (Riddell, 2011; Pampori and Iqbal, 2007; Mitruka and Rawnsley, 1977). However the heterophil count was higher than 19.75 ± 0.85% and the eosinophils lowered than 4.50 ± 0.51% reported for local chicken of Bangladesh (Islam et al., 2004). The basophils are responsible for the elaboration of histamines and heparin in circulating blood while eosinophil functions in phagocytosis.

CONCLUSION

The haematological parameters showed that palm kernel cake could be safely included in the diets of Nigerian local grower chicken up to 25% without any adverse effect on the health status.

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HEMATOLOŠKI PARAMETRI U TOVU NIGERIJSKIH DOMAĆIH PILIĆA HRANJENIH RAZLIČITIM UDJELIMA POGAČE PALMINOGA SJEMENA

SAŽETAK

U ovome radu istraživan je utjecaj hranidbe različitim količinama pogače palminoga sjemena na hematološke parametre u tovu nigerijskih domaćih pilića. Šezdeset pilića u dobi od 9 tjedana nasumce je raspodijeljeno u 5 hranidbenih skupina po četiri pileta u tri ponavljanja. Sastavljeno je pet izoproteinskih (17% sir. bjelančevina) grover smjera koje su sadržavale 2813-3070 Kcal ME/kg s različitim udjelima pogače (od 10, 15, 20 i 25%) kao zamjenom za kukuruz i soju u smjesama 2, 3, 4 i 5. Smjesa 1, bez udjela pogače (0%), bila je kontrola. Pilići su dobivali hranu i vodu ad libitum deset tjedana. Hematokriti, hemoglobin, crvene krvne stanice, trombociti, heterofil i eozinofil imali su slične vrijednosti ($p>0.05$) u svim skupinama pilića, ali su promjene u bijelim krvnim stanicama (15.95 do 19.53 x 10^6 /mm^3), limfocitima (60.00 do 67.00%) i monocitima (0.67 do 2.00%) bile signifikantne ($p<0.05$). Hematološki parametri bili su u granicama normale za zdrave piliće. Dodatak pogače palminoga sjemena do 25% u hranu nigerijskih domaćih pilića nije negativno utjecao na hematologiju.

Ključne riječi: hematološki parametri, domaći pilići, pogača palminoga sjemena

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