Paper ISSN 0189-0514
Online ISSN 1427-4410
J. Anim. Prod. Res. (2021) 33(1):26-39

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EFFICACY OF AQUEOUS FRESH NEEM (*Azadirachta indica*) BARK EXTRACT AS NATURAL GROWTH PROMOTER: EFFECT ON GROWTH PERFORMANCE, BLOOD PROFILE AND ECONOMICS OF PRODUCTION IN BROILER CHICKENS

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ABSTRACT

Effect of aqueous fresh neem *(Azadirachta indica)* bark extract (AFABE) was evaluated in a 42-day feeding trial. One hundred and ninety-five (195), 7 day-old mixed sex, broiler chicks were weighed and allotted to 5 groups of 39 birds each and replicated thrice with 13 birds each. Experimental groups were designated as T_1, T_2, T_3, T_4 and T_5 and administered Water, Collimycin$^{(R)}$, 3, 6 and 9ml of AFABE per litre of drinking water, respectively in a CRD. Test ingredients were administered thrice a week. Broiler starter feed containing 24%CP and finisher feed containing 20%CP diets were offered *ad libitum.* Results revealed that growth performance parameters were not significantly (P>0.05) influenced. Gross profit was highest for birds on control group followed by birds on T3 (273.25 ₦/bird), while birds on T2 had the least value (86.46 ₦/bird). Packed cell volume (PCV), red blood cell (RBC), haemoglobin, mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), neutrophil, albumin, creatinine, aspartate amino transferase (AST) and alkaline phosphatase (ALP) were significantly (p<0.05) influenced. Dressing percentage, head, liver, empty gizzard, empty crop, proventriculus, empty intestine and empty caecum differed (P<0.05) significantly. It may be concluded that administration of AFABE had no adverse effect on growth performance however, increased profit margin compared only to antibiotic, increased relative liver weight and offal, haemoglobin, MCV and MCH of broiler chickens while it decreased dressing percent.

Key words: Serum indices, Gross-profit, Haematology, Neem, Broiler and growth

INTRODUCTION

In recent time, attention of livestock researchers have been refocused on the use of medicinal herbs as natural antibiotic growth promoter in an attempt to boost performance of food animal in the livestock sector. This impetus arises due to a ban on the use of synthetic antibiotic growth promoters among livestock keepers especially in European Union (EU) in 2006 and other countries of the world (Miller, 2015). Synthetic antibiotics have been administered to food animals, for example, broiler chickens were served these synthetic antibiotics in order to control diseases such as necrotic enteritis caused by *Clostridium perfringes*, enhance growth and improve feed conversion ratio (Castanon, 2007; Fasina *et al*., 2016).

Studies have proven that synthetic antibiotics used widely as growth promoter to improve the general performance of food animals have recently raised concerns regarding emergence of antibiotic resistant strain of bacteria that spread to humans among other harmful effects (Maron *et al*., 2013). USFDA (2013) reported increasing levels of resistance in bacteria isolated from food-producing animals and retail meat sources via a study conducted by the National Antimicrobial Resistance Monitoring System

(NARMS). However, it is pertinent at this moment to re-consider the global practice of herbal medicine that has dated back to the very earliest period of known human history. There is substantial evidence of herbs having been used in the treatment of many diseases and vitalization of body system in almost all ancient civilizations, the Egyptians, the Chinese, the Greek and the Romans civilizations (Tipu *et al*., 2006).

Azadirachta indica A. Juss is one of the most versatile, multifarious evergreen trees of the tropic with great medicinal relevance in both livestock and humans (Girish and Shankara, 2008). It has been playing very vital role in Ayurvedic medicine as a result of the possession of these phyto-chemical contents namely; flavonoids, saponnins, phenols among others in the leaves, (Uza *et al*., 2020) fruits, seeds and bark which make the plant possess antifungal, anti-inflammatory (Girish and Shankara, 2008), antiviral, antiseptic and medicinal properties.

Neem leaves powder has been reported by Alam *et al*. (2015) to increase live body weight, body weight gains and feed efficiency of broiler chickens due to the synergistic action of various bio-molecules in neem which stimulated growth of beneficial bacteria and prevented proliferation of harmful bacteria as well as improve the function of the digestive enzymes. Kharde and Soyjanya (2014) also reported that antimicrobial and immune stimulatory properties of neem played a good role in reducing microbial load of birds thus, enhancing growth of broiler chickens. The need to also consider blood profile evaluation as a valuable tool for monitoring the toxicity of any feed ingredient that has the possibility of affecting the health status of any farm animals was also indispensable (Oyawole and Ogunkunle, 2004). This study however, evaluated the growth performance, blood profile and economics of production of broiler chickens orally served aqueous fresh *Azadirachta indica* (neem) bark extract and Collimycin $^{(R)}$

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Poultry Unit of Livestock Teaching and Research Farm, Federal University of Agriculture, Makurdi, Benue State- Nigeria. Makurdi lies on the geological coordinates of latitude 7°44' North and longitude 8°22' East with an ambient temperature range of 17.3– 35.6°C and the relative humidity of 47-48% (TAC, 2009) from guinea savannah.

Collection and Preparation of Aqueous Fresh *Azadirachta indica* (neem) Bark Extract

Fresh *Azadirachta indica* bark was collected from an *Azadirachta indica* tree around the environment of Federal University of Agriculture, Makurdi. The bark was crushed into smaller particles using mortar and pestle. Thereafter, one litre of drinking water was boiled (100° C) and one kilogrammme (1 Kg) of the preparation was put in the boiling water and allowed to boil for 15 minutes. It was then allowed to cool, filtered and stored in a refrigerator (4° C) for subsequent use.

Experimental Diets

Two experimental diets namely; starter (24%CP) and finisher (20%CP) diets were formulated using maize, full fat soya bean, rice offal, methionine, lysine, vitamin premix, bone meal and salt were purchased from local market and livestock shops within Makurdi, as presented in Table 1.

Table 1: Ingredients and Nutrient Composition of Experimental Diets

Ingredients (Kg)	Starter diet	Finisher diet
Maize	35.54	43.63
Full fat soya beans	55.54	42.22
Rice offal	6.00	9.00
Bone meal	3.00	4.00
Lysine	0.25	0.25
Methionine	0.25	0.25
Vitamin minerals	0.25	0.25
Salt	0.40	0.40
Analysed nutrient proximate composition (%)		
Crude protein	24.09	20.13
Crude fibre	4.51	4.32
Ether extract	12.15	10.47
ME (Kcal/Kg)	3215.92	3142.64

ME= Metabolisable energy, Kcal=Kilocalories, Kg=Kilogramme

**I kg of* *Vitamin minerals contained vitamin B1, 1g; vitamin B2,6g; vitamin B12,0.02g; vitamin K3,3g; vitamin E,3g;Biotin,0.05g;Folicacid,1.5g;cholinechloride,250g;Nicotineacid,30g;Capantothenate,15g;Co,0.4g;Cu,8g; Fe,32g;I0.8g;Zn,40g;Mn,64g ;Se,0.16g,BHT,5g*.

Analyses of Proximate Composition of Feed Samples and Phytochemical Content of Aqueous fresh *Azadirachta indica* Bark Extract.

The feed samples were oven (65°C) dried to a constant weight, milled and analysed for nutrient proximate compositions according to standard procedures described by A.O.A.C. (2000). Phyto-chemical content of aqueous fresh *Azadirachta indica* bark extract was carried out according to the method described by Dash *et al.* (2017).

Experimental Animals and Design

One hundred and ninety-five (195) 7-day-old mixed sex, Ross strain broiler chicks were purchased from Amo Hatchery in Ibadan, Nigeria. The birds were allowed a week adjustment period prior to the commencement of the study. Thereafter, these birds were weighed and allotted to five (5) groups of thirty-nine (39) birds each and replicated three times with thirteen (13) birds per replicate. Experimental groups were designated as T_1, T_2, T_3, T_4 and T_5 and administered ordinary drinking water, antibiotic (Collimycin$^{(R)}$) at 1g per 4litres, 3, 6 and 9ml of aqueous fresh

Azadirachta indica bark extract per litre of drinking water, respectively in a completely randomized design. Test ingredients were administered to the experimental birds thrice a week. Formulated broiler chick starter (24%CP) and finisher chicken (20%CP) diets were fed to these birds' *ad libitum* at starter and finisher phases, respectively. The experimental birds were kept in a pen (2.5x1.2M) throughout the period of the study which lasted 8 weeks.

These birds were raised on deep litter system. Vitalyte and vaccines were administered to birds via drinking water and all other routine practices were duly followed.

Data collection

Growth performance indices considered include; initial weight which was recorded prior to commencement of the study. Feed intake was calculated by subtracting leftover feed from feed offered on daily basis. Water intake was calculated by subtracting leftover water from water offered on daily basis. Daily weight gain was calculated by subtracting previous weight from the present weight. Feed conversion ratio was calculated by dividing feed intake by weight gain and feed to water intake ratio was determined by dividing water intake by feed intake.

Haematological Indices of Finisher Broiler Chickens (8-week)

Haematological indices evaluations were carried out at the end of the feeding trial. The blood collection site was sterilized with methylated spirit prior to collection. Five (5) ml sterilized, disposable syringe fitted with 24-guage sterilized hypodermic needle was used to collect blood from jugular vein of one broiler chicken per replicate between 7.00 am to 9.00 am. Two (2) ml of the blood sample collected from each bird was put in a well labeled blood sample bottle containing ethylene diamine tetra-acetic acid (EDTA) and sample bottle without EDTA for haematological indices and serum biochemical assay, respectively. The following haematological indices; packed cell volume (PCV), red blood cell (RBC) count, haemoglobin (Hb) concentration and white blood cells (WBC) count were determined according to procedure of Coles (1986) while Lymphocyte, Heterophil, Eosinophil, Basophil and Monocyte were determined using the procedures outlined by Jain (1986). Mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and Mean corpuscular haemoglobin concentration (MCHC) were calculated as follows. MCV=PCVx10/RBC, MCH= Hbx10/RBC and MCHC=Hbx100/PCV.

Serum Biochemical Constituents of Finisher Broiler Chickens (8-week)

Blood in the sample bottles without EDTA were used to determine the serum biochemical indices. Total serum protein, albumin and globulin were determined using Buiret method as described by Reinhold (1953). Creatinine, uric acid, and Alkaline phosphatase (ALP) were determined using the method described by Coles (1986). Serum glucose was determined by O-Tluioline method using acetic acids (Cooper and McDonald, 1970). Alanine amino transferase (ALT) and Aspartate amino transferase (AST) were determined as reported by Lindsley (1977). Serum cholesterol was determined through spectrophotometer using commercial diagnostic kit (fortress Diagnostic Ltd UK) according to Gowenlock *et al.* (1988).

Carcass Evaluation

At the end of the finisher phase, a bird was randomly selected from each replicate representing the average live body weight of the treatment group. The selected birds were fasted of feed for 11 hours to avoid faecal contamination during evisceration (Rosa *et al*., 2012). The selected birds were slaughtered by severing the neck at the first vertebrae with a sharp knife and bled. They were dipped in hot water (60-70˚C) for one to two minutes and their feathers were manually plucked. Each bird was eviscerated and the weight taken. The following parameters were measured; live weight, bled weight, de-feather weight,

eviscerated weight, carcass weight and dressing percentage was calculated.

Dressing percentage was calculated as carcass weight/live weight x 100

Relative weight of offal and organs were expressed as percentage of offal or organ weight/live weight x 100.

Economic Analysis

Economic analysis was determined at the end of the study by difference of all the expenses and the income earned at completion of the experiment. The following indices were considered; cost of broiler chicks, cost of feed, cost of vaccines/medicines, and other operational costs.

Statistical Analysis

Data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS (2015) and means were separated ($P<0.05$) using Duncan Multiple Range Test (DMRT) (1955).

RESULTS AND DISCUSSION

Phytochemical Analysis of Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE)

Results on phytochemical analysis of aqueous fresh *Azadirachta indica* bark extract (AFABE). The results revealed the presence of flavonoids, alkaloids, phytate, tannin, saponin, phenol and glycosides. This confirmed the work of Uza *et al.* (2020) that aqueous neem leaf extracts contain alkaloids, flavonoids, saponins, glycosides, phytate, phenol and tannins. Dash *et al.* (2017) reported that these metabolites are of great medicinal value and have been extensively used in drug and pharmaceutical industries due largely to their inherent numerous biological and therapeutic properties.

Effect of administering aqueous fresh *Azadirachta indica* bark extract (AFABE) on growth performance of broiler chicken is presented in Table 2. Results revealed that all growth parameters considered were not significantly ($P>0.05$) influenced across the treatment groups. Final body weight, daily feed intake, daily weight gain, daily water intake and FCR ranged from 1333.33 to 1516.67 g/bird, 122.93 to 139.61 g/bird, 28.53 to 32.67 g/bird, 275.56 to 342.46 ml/bird and 3.78 to 4.84, respectively across the treatment groups. These results were in consonance with findings of Shaahu *et al*. (2020) who reported non-significant ($P>0.05$) effect on all growth performance indices of broiler chickens offered 0.2, 0.4 and 0.6% aqueous fresh neem leaf extract.

Similarly, Nnena and Okey (2013) also reported non-significant ($P>0.05$) effect on all growth performance parameters of broiler chicks served aqueous neem leaf extract at 20, 40 and 60ml per litre of drinking water. This implied that AFABE served to these birds at various concentrations had no detrimental effects on growth performance. This could be due to the fact that phyto-chemical contents of this extract did not negatively interfere with the metabolic processes in the body system of the experimental birds. Thus, the quantity of these phytochemicals present in AFABE offered to the experimental birds via drinking water were within tolerable levels. In contrast, Durrani *et al.* (2008) reported higher body weight gain, water intake and better feed conversion ratio for broiler chicks offered water containing neem leaf infusion compared to other treatments. The difference in results of these studies could be imputed to variation in test materials used, methods of preparation of the test ingredients, durations of administration of test ingredients as well as strains of broiler chickens used.

Table 2: Effect of Administering Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE) on Growth Performance of Finisher Broiler Chickens

Parameters	T1	T2	T3	T4	T5	SEM
Initial body weight (g/bird)	133.00	137.00	136.00	137.00	135.00	0.40
Final body weight (g/bird)	1500.00	1350.00	1516.67	1416.67	1333.33	54.69
Daily feed intake (g/bird)	122.93	139.61	138.81	133.58	130.79	4.40
Daily weight gain (g/bird)	32.55	28.84	32.67	30.47	28.53	1.29
Daily water intake (ml/bird)	333.23	275.56	342.46	326.79	325.58	12.55
Feed: water	1:2	1:2	1:2	1:2	1:2	0.00
FCR	3.78	4.84	4.25	4.38	4.58	0.25

FCR= Feed conversion ratio
T1= Birds were offered ordinary drinking water
T2= Birds were offered Collimycin$^{(R)}$ (antibiotic) at 1g per 4litre of drinking water
T3=Birds were offered 3ml of AFABE per a litre of drinking water
T4=Birds were offered 6ml of AFABE per a litre of drinking water
T5=Birds were offered 9ml of AFABE per a litre of drinking water
SEM= Standard Error of Mean

Effect of Administering Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE) of Haematological Indices of Broiler Chicken

Results on effect of administering aqueous fresh *Azadirachta indica* bark extract (AFABE) on haematological indices of broiler chicken is presented in Table 3. Results revealed that PCV, RBC, haemoglobin, MCV, MCH and Neutrophil were significantly ($P<0.05$) influenced across the treatment groups. Birds on T3 had the highest PCV value (39.33%) while birds on T2 and T4 had the least and similar values (36.33%) for PCV. PCV values of birds in this study fell within the range of reference PCV values (26.00-45.20%) for a clinically normal chicken reported by Mitruka and Rawnsley (1981). Birds on T1 and T3 had the highest and similar values (2.33 - 2.43x$10^{12}/L$) for RBC while birds on T2 had the least RBC (2.03x$10^{12}/L$) value. This implied that synthetic antibiotic (Collimycin$^{(R)}$) used in this study negatively interfered with normal blood production in the body system of the experimental birds. These RBC values fell within the range (1.58-3.82 x$10^{12}/L$) of reference RBC values for a clinically normal chicken as reported by Mitruka and Rawnsley (1981).

Haemoglobin values were highest (13.10g/dL) for birds on T3 while birds on T1 and T2 had the least and similar haemoglobin values (12.10g/dL). Birds offered AFABE generally had higher haemoglobin values than a range (7.40-12.20 g/dL) of reference haemoglobin values for a clinically normal chicken reported by Mitruka and Rawnsley (1981). This showed that phytochemical contents of AFABE potentially elevate haemoglobin component of the blood in broiler chicken. These results corroborated the findings of Nagalakshmi *et al.* (1996) who opined that neem possessed strong influence on haematological indices of broiler chickens particularly haemoglobin. Similarly, Sarker *et al. (*2014) work on aqueous neem leaf extract unveiled the propensity of herbal plants to alter some haematological indices of broiler chickens.

MCV (178.73fL) and MCH (59.53pg) values were highest for birds on T2 while birds on T3 had the least MCV (161.73fL) and the least and similar MCH values (53.57pg) were recorded for

birds on T3 and T4. MCV and MCH values in this study were higher than a range (90.00-140.00 fL) of reference MCV and MCH (33.00-47.00 pg) values for clinically normal chickens (Mitruka and Rawnsley, 1981). Birds on T1 and T4 had the highest and similar neutrophil values (48.00 %) while birds on T3 had the least value (44.00 %) for neutrophil. Results of this study contrasted the findings of Odoh and Bratte (2015) who reported no significant (P>0.05) effect on all haematological indices considered when broiler chickens were fed diets containing 0, 2.5, 5.0, 7.5 and 10% neem leaf meal.

Table 3: Effect of Administration of Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE) on Haematological Indices of Broiler Chickens

Parameters	T1	T2	T3	T4	T5	SEM
Packed cell volume (%)	38.33^{ab}	36.33^{c}	39.33^{a}	36.33^{c}	37.67^{bc}	0. 36
RBC ($x10^{12}/L$)	2.33^{a}	2.03^{b}	2.43^{a}	2.27^{ab}	2.23^{ab}	0.05
WBC ($x10^{9}/L$)	6.00	6.27	6.13	6.40	6.33	0.15
Haemoglobin (g/dL)	12.10^{c}	12.10^{c}	13.10^{a}	12.80^{ab}	12.57^{bc}	0.12
MCV (fL)	174.23^{ab}	178.73^{a}	161.73^{c}	170.47^{b}	169.07^{b}	1.73
MCH (pg)	54.97^{ab}	59.53^{a}	53.87^{b}	53.57^{b}	56.33^{ab}	0. 83
MCHC (g/dL)	33.37	33.27	33.47	33.27	33.33	0.39
Lymphocytes (%)	44.33	46.67	46.67	44.33	45.33	0.55
Neutrophil (%)	48.00^{a}	45.67^{ab}	44.00^{b}	48.33^{a}	45.67^{ab}	0.56
Eosinophil (%)	2.67	2.67	3.67	2.67	3.67	0.21
Basophil (%)	0.33	0.67	0.67	0.67	1.00	0.13
Monocytes (%)	4.67	4.33	4.67	4.00	4.33	0.25

a,b,c= Means in the same row with different superscripts are significantly different (p<0.05).
MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Haemoglobin and MCHC = Mean Corpuscular Haemoglobin. T1= Birds were offered ordinary drinking water
T2= Birds were offered Collimycin$^{(R)}$ (antibiotic) at 1g per 4 litre of drinking water
T3=Birds were offered 3ml of AFABE per a litre of drinking water
T4=Birds were offered 6ml of AFABE per a litre of drinking water
T5=Birds were offered 9ml of AFABE per a litre of drinking water
SEM= Standard Error of Mean

Effect of Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE) on Serum Biochemical Indices of Broiler Chickens

Results on effect of administering aqueous fresh *Azadirachta indica*bark extract (AFABE) on serum biochemical indices of broiler chickens is presented in Table 4. Results revealed that albumin, creatinine, AST and ALP were significantly (p<0.05) influenced among all serum biochemical indices considered. Birds on T5 had the highest (1.99g/dL) and T4 had the least (1.49g/dL) values for albumin, while birds on other treatment groups had similar values for albumin. Creatinine values were highest and similar (0.52mg/dL) for birds on T2 and T4 while birds on other treatment groups had the least and similar values (0.48mg/dL) for creatinine. This variation in creatinine values

could occur as a results of various activities or exercise carried out by these birds prior to blood collection for the study. AST values were highest and similar (48.33U/L) for birds on T4 and T5, birds on T2 and T3 had similar values (40.70 U/L) for AST while birds on T1 (control) had the least value (38.23U/L). This agree with the findings of Uza *et al*. (2020) who reported significant difference in creatinine and AST values of broiler chickens served aqueous fresh neem leaf extract via drinking water.

Birds on T4 and T5 had the highest and similar ALP values (42.90 U/L) while birds on T1 and T2 had the least and similar (36.20 U/L) ALP value across the treatment groups. AST and ALP values increased proportionately with concentration of AFABE in this study. This was an indication of tissue damage, stress or presence of certain anti-nutritional factors which led to the release of such enzymes into the blood system. Total protein and cholesterol values in this study were not significantly different ($p>0.05$). These results were in line with findings of Odoh and Bratte (2015) who reported no significant difference in these parameters when laying birds were fed diets containing dietary level of 0.0, 2.5, 5.0, 7.5 and 10.0%) neem leaf meal.

Table 4: Effect of Administration of Aqueous Fresh *Azadirachta indica* Bark on Serum Biochemical Indices of Finisher Broiler Chickens

Parameters	T1	T2	T3	T4	T5	SEM
Total protein (g/dL)	2.97	3.37	3.23	3.10	3.60	0.11
Albumin (g/dL)	1.59^{ab}	1.76^{ab}	1.68^{ab}	1.49^{b}	1.99^{a}	0.06
Globulin (g/dL)	1.57	1.61	1.56	1.61	1.61	0.08
Glucose (mg/dL)	65.03	61.33	61.33	60.47	67.50	3.41
Cholesterol (mg/dL)	61.23	60.50	59.33	59.97	61.40	1.16
Creatinine (mg/dL)	0.46^{b}	0.52^{a}	0.48^{b}	0.53^{a}	0.47^{b}	0.01
AST (U/L)	38.23^{b}	41.20^{ab}	40.70^{ab}	48.33^{a}	49.00^{a}	1.55
ALT (U/L)	19.80	19.87	21.77	22.57	21.20	0.45
ALP (U/L)	37.20^{b}	36.20^{b}	37.77^{ab}	42.90^{a}	44.40^{a}	1.34

a,b,c= Means in the same row with different superscripts are significantly different ($p<0.05$).
AST= Aspartate Amino Transferase, ALT= Alanine Amino Transferase, ALP= Alkaline Phosphatase.
T1= Birds were offered ordinary drinking water
T2= Birds were offered Collimycin$^{(R)}$ (antibiotic) at 1g per 4 litre of drinking water
T3=Birds were offered 3ml of AFABE per a litre of drinking water
T4=Birds were offered 6ml of AFABE per a litre of drinking water
T5=Birds were offered 9ml of AFABE per a litre of drinking water
SEM= Standard Error of Mean

Effect of Administering Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE) on Carcass Characteristics

Effect of administering aqueous fresh *Azadirachta indica* bark extract (AFABE) on carcass, characteristics of broiler chickens is presented in Table 5. Results revealed that dressing percentage, head, liver, empty gizzard, empty crop, proventriculus, empty small intestine and empty caecum differed ($P<0.05$) significantly among the parameters measured. Birds on T1 and T2 had the highest and same dressing percentage (70.33 %), birds on T3 and T5 had similar values (68.67 %) for dressing

percentage and birds on T4 had the least dressing percentage (66.00 %). Relative head weight was highest for birds on T2 (2.73 %) while birds on T4 and T5 had the least and similar weight for head (2.29 %). Birds on T5 had the highest relative liver weight (3.07 %) while birds on T1, T2 and T3 had the least and similar liver weight (1.95, 2.22 and 2.13 % respectively). This implied that as the concentration of AFABE increased across the treatment groups, the weight of liver also increased. This increment could be as a result of an attempt by the liver to cope with its enormous detoxification task which is its primary function in the body system. This could possibly cause inflammation of the liver due to excessive work-load as seen in the liver weight of birds on high concentration of AFABE in this study. These results corroborates the findings of Nodu *et al.* (2016) who reported significant ($p<0.05$) effect on liver weight of broiler chickens administered varied levels (3,4 and 5g/litre of water) of mashed fresh neem leaf .

Birds on T1 and T5 had the highest and similar relative empty gizzard weight (2.12 and 2.15 %) while birds on T3 had the least weight (1.59 %) for relative gizzard weight. These results were at variance with the findings of Khatun *et al*. (2013) who reported non- significant ($P>0.05$) effect on dressing percentage, relative weight of liver and gizzard of broiler chickens served different levels (1-3ml/ litre of water) tulsi and neem leaves extract. Similarly, Karde and Sansiya *et al.* (2014) also reported non-significant ($P>0.05$) effect on dressing percentage, relative weight of liver and gizzard of broiler chickens fed diets supplemented with varied levels of garlic and neem leaf meal which contradicted the findings of this study. These variations in results obtained from the studies could be as a result of difference in neem products used, method of preparation and breeds of broiler chicken used.

Birds on T4 recorded the highest empty crop (0.69 %) and proventriculus relative weight (0.72 %) while birds on T5, T2 and T1 recorded the least and similar weight (0,47, 0.48 and 0.48 %) for empty crop and least proventriculus weight (0.53 %) was also recorded for birds on T2 and T5 across the treatment groups. The highest empty small intestine weight (4.75 %) was recorded for birds on T5 while birds on other treatment groups had the least and similar relative weights. Birds on T5 also had the highest empty caecum weight (0.82 %), birds on T4 had the least weight (0.54 %) for empty caecum while birds on other treatment groups had similar values for relative empty caecum weight.

Table 5: Effect of Administration of Aqueous Fresh *Azadirachta indica* Bark Extract on Carcass Evaluation and Organ Weight of Finisher Broiler Chicken

Parameters	T1	T2	T3	T4	T5	SEM
Live body weight (Kg)	1.60	1.40	1.55	1.44	1.44	0.04
Bled weight (Kg)	1.53	1.31	1.43	1.31	1.34	0.04
Plucked weight (Kg)	1.46	1.25	1.37	1.26	1.28	0.04
Evisc. Weight (Kg)	1.25	1.08	1.17	1.05	1.08	0.04
Carcass weight (Kg)	1.12	0.98	1.06	0.95	0.99	0.03
Dressing percentage (%)	70.33^{a}	70.33^{a}	68.67^{ab}	66.00^{b}	69.00^{ab}	0.59
Offal and organ weight (% Live body weight)						
Head	2.57^{ab}	2.73^{a}	2.53^{ab}	2.40^{b}	2.29^{b}	0.05
Legs	4.15	4.21	3.88	3.84	3.64	0.10
Heart	0.43	0.46	0.45	0.43	0.48	0.06
Liver	1.95^{b}	2.22^{b}	2.13^{b}	2.44^{ab}	3.07^{a}	0.13
Empty Gizzard	2.12^{a}	2.01^{ab}	1.59^{c}	1.70^{bc}	2.15^{a}	0.07
Empty crop	0.48^{b}	0.48^{b}	0.56^{ab}	0.69^{a}	0.47^{b}	0.03
Proventriculus	0.57^{ab}	0.51^{b}	0.58^{ab}	0.72^{a}	0.53^{b}	0.03
Lungs	0.43	0.38	0.43	0.54	0. 49	0.02
Empty Small intestine	4.38^{b}	4.43^{b}	4.50^{b}	4.42^{b}	4.75^{a}	0.11
Empty Large intestine	0.28	0.38	0.30	0.37	0.37	0. 02
Empty caecum	0.64^{ab}	0.66^{ab}	0.75^{ab}	0.54^{b}	0.82^{a}	0.03
Pancreas	0.24	0. 28	0.28	0. 23	0. 25	0.01

a,b,c= Means in the same row with different superscripts are significantly different ($p<0.05$). Evisc= Evisceration.
T1= Birds were offered ordinary drinking water
T2= Birds were offered Collimycin$^{(R)}$ (antibiotic) at 1g per 4 litre of drinking water
T3= Birds were offered 3ml of AFABE per a litre of drinking water
T4= Birds were offered 6ml of AFABE per a litre of drinking water
T5= Birds were offered 9ml of AFABE per a litre of drinking water
SEM= Standard Error of Mean

Effect of Aqueous Fresh *Azadirachta indica* Bark extract (AFABE) on Economics of Production of Broiler Chickens

Effect of aqueous fresh *Azadirachta indica* bark extract (AFABE) on economics of production of broiler chickens is presented in Table 6. Results revealed that the cost of feed consumed (₦779.26/ bird), Cost/Kg weight gain (₦1044.25) and Total cost of production (₦1130.56/ bird) were numerically highest for birds on T2 (antibiotic) while birds on T1 (control) had the least value for cost of feed consumed (₦691.50/ bird), Cost/kg weight gain (₦848.89) and total cost of production

(₦1030.00/ bird) across the treatment groups. Gross profit was highest for birds on T1 (₦470.00/ bird) that is, control group, followed by birds on T3 (₦406.23/ bird) while birds on T2 (antibiotic) had the least value (₦219.44/ bird). Profit margin decreased as the concentration of AFABE increased across the treatment groups. This implied that birds on groups served AFABE gave the highest profit margin compared only to birds served antibiotic. These results were in line with the findings of You and Silbergeld (2014) who reported that extensive use of antibiotics in livestock obviously increased the cost of production thereby, reducing the profit margin of the livestock keeper. Similarly, Graham *et al*. (2007) reported no justification for persistent administration of synthetic antibiotics as growth promoter to broiler chickens as this increased the cost of production.

According to Ansari *et al*. (2008) administration of herbal plants especially *Withania somnifera, Nigella sativa* and *Azadirachta indica* maximized profit per broiler chicken which agreed with the findings of this study, further buttress results of findings of Shaahu *et al.* (2020) that aqueous fresh neem leaf extract improves profit margin of farmers (that chose broiler chickens production as an option) have boost their financial status especially, in developing countries like Nigeria. Therefore, farmers are advised to avoid incurring unnecessary cost and increase profit margin by using medicinal plants as natural growth promoters in broiler chicken production.

Table 6: Economics of Production of Broiler Chickens Served Aqueous Fresh *Azadirachta indica* Bark Extract (AFABE)

Economic parameters	T1	T2	T3	T4	T5
Cost of feed (₦/Kg)	132.98	132.98	132.98	132.98	132.98
Cost of DOC (₦/ bird)	300.00	300.00	300.00	300.00	300.00
Cost of medication/vaccine (₦/ bird)	38.50	51.30	38.50	38.50	38.50
Total feed consumed (Kg/ bird)	5.20	5.86	5.83	5.61	5.49
Cost of feed consumed (₦/ bird)	691.50	779.26	775.27	746.02	730.06
Total weight gain (g/ bird)	1.37	1.21	1.37	1.28	1.20
Cost/Kg weight gain (₦)	848.89	1044.25	910.04	951.17	1001.28
Total cost of production (₦/ bird)	1030.00	1130.56	1113.77	1084.52	1068.56
Revenue (₦/ bird)	1,500.00	1350.00	1520.00	1420.00	1330.00
Gross profit (₦/ bird)	470.00	219.44	406.23	335.48	261.44

DOC= Day-old chick.
T1= Birds were offered ordinary drinking water
T2= Birds were offered Collimycin$^{(R)}$ (antibiotic) at 1g per 4 litre of drinking water
T3=Birds were offered 3ml of AFABE per a litre of drinking water
T4=Birds were offered 6ml of AFABE per a litre of drinking water
T5=Birds were offered 9ml of AFABE per a litre of drinking water

CONCLUSIONS

It can be concluded that AFABE had significant effect on relative liver weight, haemoglobin, MCV, MCH, AST, ALP values. However, AFABE decreased dressing percentage and improved profit margin of broiler chickens when compared with the use of synthetic antibiotics. AFABE could therefore, be administered to broiler chickens as natural growth promoter at 3ml per litre of drinking water for better performance and improved profit margin. Hence, 3ml per litre of drinking water gave the best numerical value for growth.

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