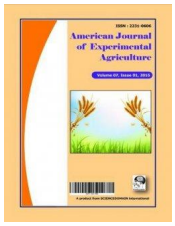

American Journal of Experimental Agriculture
8(6): 350-360, 2015, Article no.AJEA.2015.179
ISSN: 2231-0606

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Effect of *Xylopia aethiopica* Dried Fruits (Grains of Selim) as Additive on Performance, Microbial Response and Blood Parameters in Finisher Broilers

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Authors' contributions

This work was carried out by authors JOI and JEU. Author JOI designed the study and supervised the work while author JEU generated the data and did the literature search. Author JOI managed the analyses of the study. Both authors drafted, corrected and approved the final manuscript.

Article Information

DOI: 10.9734/AJEA/2015/17083
Editor(s):
(1) Hugo Daniel Solana, Department of Biological Science, National University of Central Buenos Aires, Argentina.
Reviewers:
(1) Anonymous, Slovak University of Agriculture in Nitra, Slovakia.
(2) Anonymous, Ataturk University, Turkey.
(3) Adela Marcu, Department Animal Production Engineering, Banat´s University of Agricultural Sciences and Veterinary Medicine, Romania.
(4) Anonymous, Universidade Federal do Parana, Brazil.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=1080&id=2&aid=9633

Original Research Article

Received 25th February 2015
Accepted 30th April 2015
Published 6th June 2015

ABSTRACT

The effect of grains of selim (*Xylopia aethiopica*) as additive on the performance, gut microbes and blood parameters of finisher broilers was investigated. One hundred and ninety five (195) 28 days old broilers (Arbor acres strain) were randomly assigned to five treatment groups with each treatment having three replicates in a completely randomized design. Each treatment group had 39 chicks and 13chicks per replicate. The experiment was done in the Poultry Research Unit of the Department of Animal Science, Delta State University, Asaba Campus, Nigeria between November 2013 and January 2014. Well homogenized powdered grains of selim was dissolved and given through drinking water in treatments 2, 3, 4 and 5 at concentrations of 0.4, 0.6, 0.8 and 1.0 g per litre but chicks on treatment 1 (control) received 0.3 g/litre of antibiotics (doxygen). Chicks were fed with isoproteinous and isocaloric diets with 20% crude protein and 2905.95 Kcal/kg metabolizable energy *ad libitum* for four weeks. Results showed no significant differences among treatments in the final body weight, total weight gain, daily weight gain, total feed intake, daily feed intake and feed

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conversion ratio. There were no significant differences in the microbial population count of the faeces before and after the birds received treatment of antibiotics and grains of selim in drinking water. There were no significant differences in hematological parameters. However there were significant differences in serological parameters with creatinine, cholesterol and urea values highest in the control but progressively decreased with increased concentration of grains of selim whereas albumin, total protein and globulin values were similar. Results showed that grains of selim has antimicrobial and anthelminthic properties, and have growth promoting potentials in broiler chickens with no adverse health implications.

Keywords: Anthelminthic; antibiotics; antimicrobial; biochemistry; Xylopia aethiopica dried fruits (grains of selim); growth promoter; serum.

1. INTRODUCTION

Xylopia aethiopica is an aromatic tree growing up to a height of 20 meters and of the order Magnoliales and family Annonaceae. It grows widely in the tropical zones of west, central and southern Africa [1]. The dried fruits of *Xylopia aethiopica* (Grains of Selim) are used as a spice for food and as a herbal medicine by man. There is more concern on the residual effect of synthetic antibiotic use in broiler production. The consumers of poultry products are now paying more attention to quality and safety of poultry products that they consume [2]. Reports on residual effects of antibiotics have generated renewed interest in the none use of antibiotics and other drugs in poultry production [3]. It has become imperative that in raising animals for food, a more nutrition-based health strategy must be adopted in the development of animal agriculture [3]. It has been found that some herbs, spices and their extracts can stimulate feed intake and encourage endogenous secretions which enhance antimicrobial, coccidiostatic or anthelminthic activities [3,4]. Many of these herbal products and their extracts have improved broiler performance, indicating that they have growth-promoting potentials [4]. Herbal products could serve as an environmental friendly alternatives to the antibiotic growth promoters still being used in some developing countries [5,6]. The high cost of antibiotics and other drugs which have residual effects has necessitated the need to research into natural herbal plants that could serve as cheap and good alternative in place of commercial (synthetic) antibiotics [6]. This study is designed to investigate the effects of grains of selim (*Xylopia aethiopica* dried fruits) on performance, microbial response and blood parameters in finisher broilers.

2. MATERIALS AND METHODS

2.1 Experimental Site

This investigation was done in the Poultry Research Unit of the Department of Animal Science, Delta State University, Asaba Campus, Nigeria. All experimental procedures used in this study were approved by the Department of Animal Science and Faculty of Agriculture Boards of Study of the Delta State University, Abraka, Asaba Campus, Nigeria.

2.2 Experimental Birds and Management

One hundred and ninety five (195) finisher broilers (Arbor acres strain) weighing from 1377-1454.67 g were used in this study. The birds were managed in a deep litter house of fifteen pens with dimensions of 2.04m x 2.03m and given feed and water *ad libitum* for four weeks (29-56 days).

2.3 Experimental Design

The finisher broilers were randomly assigned into five treatment groups with three replicates on equal weight basis in a completely randomized design. Every treatment group was made up of 39 broiler chicks and 13 in each replicate.

2.4 Experimental Diets

Broiler birds were fed the same isoproteinous and isocaloric diet with 20% crude protein and 2905.95 Kcal/kg metabolizable energy A well homogenized powdered grains of selim was obtained by pulverizing with mortar and pestle, milled and passed through a standard sieve (2 mm) to remove all fibre. Weights of 0.4, 0.6, 0.8 and 1.0g of grains of selim were weighed and dissolved in a litre of water each for more than 10 hours and given to broilers in treatments 2, 3, 4

and 5 as their drinking water, but broilers in treatment 1 (Control) were given 0.3 g of antibiotics (Doxy-gen 20/20 WSP) per litre in their drinking water. A well homogenized powdered grains of selim dissolves in water without sediments. Grains of selim were used to replace antibiotics in the drinking water of finisher broilers in treatments 2, 3, 4 and 5 whenever birds in treatment 1 were given antibiotics. Grains of selim and antibiotics were given in drinking water for five days. The proximate and phytochemical compositions of *Xylopia aethiopica* dried fruits are presented in Table 1. The composition of the finisher broilers diet is presented in Table 2.

2.5 Performance Evaluation

The measurements of body weight development were done weekly on replicate basis to obtain weekly body weight and body weight gain. Feed intake and mortality were also recorded on replicate basis weekly while feed conversion ratio which is a ratio of feed consumed and the weight gained over a specific period was calculated. Faecal samples were collected from each replicate for microbial identification and population count before and after grains of selim and antibiotics were administered. Fresh faecal droppings were totally collected from each replicate pen before dawn and thoroughly mixed wet on the 6^{th} day after 5 days of giving grains of selim and antibiotics. One gram of the wet faecal samples collected from each replicates were emulsified in a drop of normal saline on a microscopic slide and covered with a slip. The samples were carefully examined with X10 objective lens and the organisms present were identified with X40 objective lens. 1.0 g of the wet faecal samples were made into liquid suspension with 10 ml of normal saline. Serial dilutions ranging from 10^{-1} to 10^{-5} were made for each faecal sample. From these serial diluents, 0.03 ml each were inoculated into the media plates of the Blood Agar (BA) and Nutrient Agar (NA) using the spreader method [7]. Both aerobic and anaerobic culturing was respectively carried out. Inoculated plates were incubated at 37°C for 24-48 hours. The growth of microbial colonies on the plates were counted and the average count from each sample was divided by 0.03 ml (the volume of suspension dispensed into the plates for culturing) and multiplied by the dilution factor to obtain the total count per ml. This value was further multiplied by 10 to give the total count of microbes per gram of the faecal sample. Blood samples approximately 10ml per bird were collected from replicates in each treatment into specimen bottles with and without ethylene diamine tetra-acetic acid (EDTA). The haematological parameters such as pack cell volume (PCV) was determined using Winthrobes micro-haematocrit technique, haemoglobin (Hb) was determined with a digital photo colorimeter (Model 312E by Digital Photo Instruments, Germany) at a wavelength of 540 nm, after blood had been mixed with Drabkin's solution in a ratio of 1:200 and expressed in g/dl unit. Red blood cell count (RBC) was determined using a coulter electronic counter (Model ZF by Coulter Electronics Ltd, London) and white blood cell count (WBC) was evaluated. Other haematological indices such as mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC) were computed as outlined [8].

The serum obtained was analyzed for creatinine and urea by deproteinization and Urease-Berthelot Colorimetric methods using Randox test kit (Randox Laboratories Ltd., UK.). Total protein was determined by the Biurette method using Randox test kit while albumin value was obtained by Bromocresol green method. The globulin was obtained by the method of Coles [9]. Cholesterol was determined by Enzymatic endpoint and glucose by Colorimetric method.

2.6 Chemical Analysis

The proximate composition of the experimental spice was determined [10]. The phytochemical analysis was carried out to determine the presence of saponins, steroids, tannins, flavonoids and alkaloids [11,12], Table 1.

2.7 Statistical Analysis

All data generated were subjected to one way analysis of variance (ANOVA) for completely randomized design using statistical package and significant differences found among the treatments means were separated using Duncan Multiple Range Test [13,14].

3. RESULTS

The results of the phytochemical analysis showed that *Xylopia aethiopica* dried fruits contain the following phytochemicals: alkaloids, tannins, flavonoids, steroids, saponin and carbohydrates.

The results of the performance characteristics of the finisher broilers given different concentrations of *Xylopia aethiopica* dried fruits in drinking water are presented in Table 3. There were no significant (P>0.05) differences in final body weight, total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio in all the treatment groups. However, finisher broilers in treatments given *Xylopia aethiopica* dried fruits though not significantly better than broiler chicks in treatment 1 given antibiotic, they had higher values in final body weight, total weight gain, daily weight gain and feed conversion ratio in this study.

Results of the microscopy of finisher broiler droppings before and after treatment are presented in Table 4. The results showed that before treatment all treatment groups were highly infected with *Uric acid crystals, Staphylococcus spp, E. coli , Candida albicans*, hookworm, round worm and their ova while treatments 2 and 4 had *Aspergillus flavus*. The results of microscopy after treatment showed a total absence or highly reduced presence of microbes in all treatment groups.

Results of the microbial population count of finisher broilers droppings before and after treatment are presented in Table 5. The colony count of microbes showed that all treatment groups were highly infected with the colony count ranging from 23.33 to 41.00 $x10^5$ cfu/ml before treatment. The values dropped significantly in all treatment groups after the administration of the antibiotics and *Xylopia aethiopica* dried fruits. There were no significant (P>0.05) differences in colony count before or after treatment in all treatment groups.

The results of hematology of finisher broilers given different concentrations of *Xylopia aethiopica* dried fruits in drinking water are presented in Table 6. Results showed no significant (P>0.05) differences in Hemoglobin (HB), Packed cell volume (PCV), Red blood cell count (RBC), White blood cell count (WBC), Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH) and Mean corpuscular hemoglobin concentration (MCHC) in all treatment groups. The results of serum biochemistry of finisher broilers given different concentrations of *Xylopia aethiopioca* dried fruits in drinking water are presented in Table 7. There were no significant (P>0.05) differences in total protein, albumin and globulin of their serum. Significant (P<0.05) differences were found in creatinine and glucose while highly significant (P<0.01) differences occurred in cholesterol and urea content of the treatment groups. The creatinine content of treatment 1 (control) was significantly (P<0.05) higher than that of treatment 5 but similar (P>0.05) to those of treatments 2, 3 and 4 while treatments 2, 3, 4 and 5 given *Xylopia aethiopical* dried fruits were similar (P>0.05). The cholesterol values of treatments 1 and 2 were highly significantly (P<0.01) higher than those of treatments 3, 4 and 5. Treatment 1 was highly significantly (P<0.01) higher than treatments 4 and 5 but similar (P>0.01) to treatments 2 and 3 in urea, while treatments 2, 3 and 4 were also similar (P>0.01). The glucose content of treatment 2 was significantly (P<0.05) different from all other treatments but others were similar (P>0.05).

4. DISCUSSION

The results of the phytochemical analysis showed that *Xylopia aethiopica* dried fruits has alkaloids, flavonoids, tannins, steroids and carbohydrates present in it while saponin is marginally present. Alkaloids have been documented to possess analgesic, antispasmodic and bactericidal effects [15]. Flavonoids are hydroxylated phenolic substances synthesized by plants in response to microbial infection and they have been known to be antimicrobial substances against a wide range of microorganisms *in vitro*. Their activity is probably due to their capability to complex with extracellular and soluble proteins and to complex with bacterial cell wall [16]. They are also good antioxidant and show strong anticancer activities [16]. They lower the risk of heart diseases [11]. Tannins bind to proline rich protein and interfere with protein synthesis and this make tannin an anti-nutritional substance [16]. Steroids have been found to have antibacterial properties and are very important compounds in relationship with sex hormones [16]. The saponins found in grains of selim are also known to produce inhibitory effect on inflammation and has the property of precipitating and coagulating red blood cells. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness [16]. The results obtained in this study thus suggest the identified phytochemical compounds may be the bioactive constituents in grains of selim, and this could make this spice to be an increasingly valuable reservoir of bioactive compounds of substantial

medicinal merit [16]. This result is similar to the findings of several authors who carried out Phytochemical screening of *Xylopia aethiopica* oil and reported the presence of plant sterols and phenolic compounds such as flavonoids, tannins and the saponins [17-20].

Table 1. Proximate and phytochemical compositions of *Xylopia aethiopica* dried fruits (Grains of Selim)

Parameters %		Phytochemical Test	Results
Dry matter	87.95	Flavonoid	+++
Ash(%)	5.84	Tannin	++++
Crude fibre	10.51	Alkaloid	++
Crude protein	2.73	Steroid	++
Ether extract	9.9	Saponin	+
Nitrogen free extract	58.97	Carbohydrate	+

+ = slightly present, ++= moderately present, +++= present, ++++= strongly present
(Source: [21,22])

Table 2. Composition of experimental finisher broilers diet

	Treatments				
	T1*	**T2****	**T3****	**T4****	**T5****
Ingredients	**0.3 g/litre (antibiotic)**	**0.4 g/litre**	**0.6 g/litre**	**0.8 g/litre**	**1.0 g/litre**
Maize	58.00	58.00	58.00	58.00	58.00
Soyabean cake	17.00	17.00	17.00	17.00	17.00
Groundnut cake	9.00	9.00	9.00	9.00	9.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Weath offal	5.00	5.00	5.00	5.00	5.00
Palm oil	1.20	1.20	1.20	1.20	1.20
Bone meal	3.20	3.20	3.20	3.20	3.20
Limestone	1.55	1.55	1.55	1.55	1.55
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.50	0.50	0.50	0.50	0.50
Methionine	0.15	0.15	0.15	0.15	0.15
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis:					
Crude protein(%)	20.07	20.07	20.07	20.07	20.07
Crude fibre(%)	3.57	3.57	3.57	3.57	3.57
M E kcal/kg	2905.95	2905.95	2905.95	2905.95	2905.95
Determined analysis					
Dry matter(%)	87.84	87.84	87.84	87.84	87,84
Ash(%)	9.22	9.22	9.22	9.22	9.22
Crude fibre(%)	11.33	11.33	11.33	11.33	11.33
Crude protein(%)	20.86	20.86	20.86	20.86	20.86
Ether extract(%)	3.09	3.09	3.09	3.09	3.09
Nitrogen free extract(%)	43.34	43.34	43.34	43.34	43.34

*Each 2.5 kg of finisher vitamine-mineral premix (Bio Organic nutrient systems LTD Nigeria) provided the following vitamins and minerals. Vit A, 8,500,000.00 I.U; Vit D3,1,500,000.00 I.U; Vit E, 10,000.00 I.U; Vit K3,1,500.00 mg; Vit B1,1,600.00 mg; Vit B2,4000.00 mg; Niacin, 20,000.00 mg; Pantothenic acid; 5000.00 mg; Vit. B6, 1,500.00 mg; Vit B12, 10.00 mg; Folic acid,500.00 mg; Biotin 750.00 mg, Choline chloride175,000.00 mg, Cobalt 200.00 mg; Copper 3,000.00 mg;liodine 1,000.00 mg; Iron, 20 mg,Manganise,40,000.00; Selenium200.00; Zinc30.000.00; Antioxidant, 1,250.00 *Antibiotics (Doxy-gen 20/20 WSP : Doxycycline d hyclate 200 mg and Gentamicine de sulfate 200 mg)*
***Grain of selim. ME: Metabolizable energy*
(Source: [21,22])

Table 3. Performance characteristics of finisher broilers given different concentrations of *Xylopia aethiopica* dried fruits (grains of selim) in drinking water

	Treatments						
Parameters	**T1* 0.3g/litre**	**T2** 0.4g/litre**	**T3** 0.6g/litre**	**T4** 0.8g/litr**	**T5** 1g/litre**	**SEM**	**SIG**
Initial weight (g)	1431.00	1454.67	1421.00	1377.00	1431.33	16.85	NS
Final body weight (g)	3186.00	3274.33	3181.33	3415.33	3394.00	45.12	NS
Total weight gain (g)	1754.00	1867.67	1789.33	2009.33	1891.33	47.72	NS
Daily weight gain (g)	62.64	66.70	63.90	71.76	67.55	170.46	NS
Total feed intake (g)	4786.00	4888.67	4751.67	4727.67	4543.00	76.20	NS
Daily feed intake (g)	170.93	174.60	169.70	168.84	162.25	27.22	NS
Feed conversion ratio	2.74	2.65	2.67	2.34	2.42	0.071	NS

**Antibiotics (Doxy-gen 20/20 WSP : Doxycycline d'hyclate 200 mg and Gentamicine de sulfate 200 mg)*
***Grains of selim; NS: Not significant*
(Source: [21,22])

Table 4. Microscopic analysis of finisher broiler droppings before and after giving different concentrations of *Xylopia aethiopica* dried fruits (grains of selim) in drinking water

Treatments	**Appearance**	**Observations Before Treatment**	**Observations After Treatment**
Treatment 1*	Normal formed sample	*Hookworm* ++*, Uric acid crystals* +++, growth of S*taphylococcus* spp*,* Ova of *round worms* and *E. coli*	*Crystals* ++ and *Candida albicans* and *E. coli* but no growth
Treatment 2**	Normal formed sample	*Cyst of E. coli* +,mature *worms*, growth of E. coli, *Candida albicans*, growth of *Staphylococcus* spp and *Aspergillus flavus*	Ova of *round worm,* growth of *E. coli* and *Staphylococcus* spp
Treatment 3**	Normal formed sample	Ova of *Isosprabelli* ++ and growth of *Staphylococcus spp*, *Crystals* ++, growth of *E. coli* and *Candida albicans* and Ova of *round worm* +	*Crystals* +,and growth of *E. coli* and *Isosporabelli*
Treatment 4**	Normal formed sample	*Cryst of E. coli* + , *Candida albicans* and growth of *Staphylococcus* spp*, Aspegillus flavus,* Mature *round worm* + and *Crystals* +++,	*E. coli* and *Staphylococcus* spp
Treatment 5**	Normal formed sample	*Crystals* +*, E. coli*, growth of *Staphylococcus* spp *and Candida albicans*	*Crystal* ++,growth of *Candida albicans* and *E. coli*

Table 5. Microbial population count of finisher broiler droppings given different concentrations of *aethiopica Xylopia* dried fruits (grains of selim) in drinking water

	Treatments						
Microbial counts	**T1* 0.3 g/litre**	**T2** 0.4 g/litre**	**T3** 0.6 g/litre**	**T4** 0.8 g/litre**	**T5** 1 g/litre**	**SEM**	SIG
Population before Treatment ($_x10^5$)	37.00	33.33	41.00	35.33	23.33	2.53	NS
Population after treatment ($_x10^5$)	0.00	11.33	3.33	12.67	4.67	1.71	NS

**Antibiotics (Doxy-gen 20/20 WSP : Doxycycline d'hyclate 200mg and Gentamicine de sulfate 200mg **Grains of selim NS: Not significant*

Table 6. Haematology parameters of broilers given different concentrations of *Xylopia aethiopica* dried fruits (grains of selim) in drinking water

	Treatment						
Parameters	**T1*** **0.3 g/litre**	**T2**** **0.4 g/litre**	**T3**** **0.6 g/litre**	**T4**** **0.8 g/litre**	**T5**** **1 g/litre**	**SEM**	**SIG**
PCV%	27.67	24.67	26.00	27.33	28.67	0.78	NS
HB(g/dl)	9.23	7.57	8.10	8.57	8.87	0.36	NS
RBC($X10^6$/µl)	4.33	3.67	4.00	4.33	4.67	0.20	NS
WBC	5.40	6.53	6.33	6.17	5.67	0.30	NS
MCV(FL)	643.33	694.44	700.00	662.22	623.33	42.68	NS
MCH(pg)	214.67	215.00	220.11	208.22	172.83	16.90	NS
MCHC(g/dl)	33.37	29.26	30.99	31.35	30.92	0.65	NS

**Antibiotics (Doxy-gen 20/20 WSP : Doxycycline d'hyclate 200 mg and Gentamicine de sulfate 200 mg)*
***Grains of selim*

Table 7. Serology parameter of broiler given different concentrations of *Xylopia aethiopica* dried fruits (grains of selim) in drinking water

	Treatments						
Parameters	**T1*** **0.3 g/litre**	**T2**** **0.4 g/litre**	**T3**** **0.6 g/litre**	**T4**** **0.8 g/litre**	**T5**** **1 g/litre**	**SEM**	**SIG**
Creatinine(mg/dl)	0.77^{a}	0.57^{ab}	0.53^{ab}	0.50^{ab}	0.43^{b}	0.04	*
Cholesterol(mg/dl)	82.00^{a}	72.33^{a}	48.33^{b}	44.67^{b}	35.33^{b}	5.4	**
Glucose(mg/dl)	98.00^{b}	110.00^{a}	101.67^{b}	101.67^{b}	101.67^{b}	1.26	*
Urea(mg/dl)	9.67^{a}	9.33^{ab}	8.00^{abc}	7.67^{bc}	7.33^{c}	0.32	**
Albumin(g/dl)	2.10	2.37	2.23	2.13	2.1	0.07	NS
Total Protein(g/dl)	5.13	5.1	5.13	5.17	5.00	0.17	NS
Globulin(g/dl)	3.03	2.73	2.90	3.03	2.90	0.15	NS

Antibiotics (Doxy-gen 20/20 WSP : Doxycycline d'hyclate 200 mg and Gentamicine de sulfate 200 mg) **Grains of selim a, b, c means with different superscripts in the same row are significantly (P<0.05)*, (P<0.01) different. NS: Not significant*

The final body weights, total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio which were similar (Table 3) shows that finisher broilers in all treatment groups responded positively in weight preformance to the diet and additives provided. The weight improvement pattern in treatment 1 given antibiotic (Doxy-gen 20/20 WSP: Doxycycline d'hyclate 200 mg and Gentamicine de sulfate 200 mg) and that of other treatments given *Xylopia aethiopica* dried fruits indicate that *Xylopia aethiopica* dried fruits has growth promoting potential just like the antibiotic and, therefore, *Xylopia aethiopica* dried fruits can be used to replace antibiotic as additive in broiler finisher production. These results are similar to the improved performance obtained in a similar study when different concentrations of *Xylopia aethiopica* dried fruits was given in drinking water to broiler chicks just like that of antibiotic growth promoter [5,6]. [23-25] also reported that garlic (powder or aqueous extract) given as an additive to broilers gave improved body weight gain, daily feed intake and feed conversion ratio. The result of this study is also in agreement with the improved body weight gain obtained in broilers when ginger (*Zingiber officinale*, a spice) was administered at different amounts in feed or drinking water as an additive [26-30]. [23,31-35] also used thyme as an additive in broiler production and had improved body weight and suggested that thyme oil or powder may be a promising alternative to antibiotic growth promoters. The similarities in feed intake and feed conversion ratio which is in line with the growth pattern obtained in this study, also agree with the findings of cited authors. The improved performance of *Xylopia aethiopica* dried fruits may be attributed to the presence of several phytochemical compounds in the fruits such as alkaloids, flavoniods, sterols, saponins and tannins which have biological activities as antioxidant, antimicrobial and pharmacological effects [5,6]. However the final weight in the finisher phase of this experiment of broiler birds given different concentration of *Xylopia aethiopica* dried fruits in their drinking water which are treatments 2 to 5 when compared to the control treatment indicate that broiler birds can be given all concentrations of *Xylopia*

aethiopica dried fruits in drinking water from 0.4 g/litre to 1.0 g/litre with positive effect on body weight performance.

The elimination of mature worms in the treatments 2, 3, 4 and 5 given grains of selim shows that the spice possesses some anthelminthic activities. The decrease of microbial population count of treatments given grains of selim also indicates that grains of selim has antimicrobial properties. The most prominent microorganisms identified in the population were the bacteria *Candida albicans, E. coli* and *Staphylococcus* spp. The decrease in bacteria population in all treatments given grains of selim in drinking water showed that it has bioactive compounds that possess antibacterial activities and establish the fact that grains of selim is an antimicrobial spice for finisher broilers and could effectively replace antibiotics in their production. This result is similar to the findings that reported a continuous reduction in the population of *E. coli* with increased concentrations of grains of selim [5,6]. The result is also similar to the findings that reported significant reduction in the bacterial counts of *Staphylococcus* spp, *E. coli* and *Salmonella* spp when essential oil isolated from ginger effectively acted as a decontaminating agent in chicken meat [36].

The hematological parameters investigated were not significantly affected by giving different concentrations of grains of selim in drinking water of broilers compared to those given antibiotic. Red blood cells (RBC) are responsible for the transportation of oxygen and carbon dioxide in the blood as well as manufacture of hemoglobin hence higher value indicate a greater potential for this function and a better state of health [31,37]. White blood cells are involve in protecting the body from infection and consist of lymphocytes, monocytes, neutrophils, eosinophils and basophils [31,37]. They help to eliminate virus-infected cells, enhance the production of antibodies and engulf foreign materials (antigens) that enter the body [31,37]. The general none significance of the white blood cell count (WBC) shows that whatever antibiotic can do to impair or enhance the broiler ability to wade off infection, grain of selim can equally do the same at the concentrations of 0.4 g/litre to 1.0 g/litre of water. These results are in agreement with the report that garlic mobilized the immune system and empowers the defense ability of the body against infectious organisms [37]. These results are also supported by earlier reports that these plants improve the health status and performance of broilers, in addition to improve antibody titre against Newcastle Disease virus [38,39].

The none significant differences in total protein, albumin and globulin among treatments given grains of selim compared to control treatment indicate that grains of selim have the same effect as antibiotic on albumin, total protein and globulin content in the birds. The total protein values in this study agree with the report that ginger supplementation didn't affect the total blood protein and the none significant differences in albumin and globulin shows that grains of selim is as good as antibiotics and can effectively replace antibiotics [40]. Result showed that grains of selim has bioactive compounds with anti-cholesterol properties and that the higher the concentrations of grains of selim given to broilers the lesser their cholesterol levels. This result is similar to the significant decreased in blood cholesterol obtained when broiler chicks were fed diets containing garlic [24,41,42]. Significant decrease in blood cholesterol in response to thyme oil administration was also reported in broiler birds [24,33,41,43]. These findings are similar to the significant decrease in blood cholesterol obtained when chicks were fed up to 6% ginger powder [44,45]. However the results on serum glucose is in agreement with the report that thyme supplementation in broiler diets significantly increased glucose level compared to those of the control group [38]. The possible reason for increase serum glucose may be due to the abdominal lipids catabolism of gluconeogenesis process in the birds with the administration of grains of selim, just as crushed thyme consumption by broiler chickens was reported to have increased the serum glucose [43]. Results showed significance decrease in blood serum creatinine and urea in treatments 4 and 5 compared to control. These results showed that the higher the concentrations of grains of selim given to broilers the lesser their blood serum creatinine and urea. This implies that the kidney of broilers given grains of selim functioned better than that of the control, since elevated creatinine level signifies impaired kidney function or kidney disease. As the kidneys become impaired for any reason, the creatinine level in the blood will rise due to poor clearance of creatinine by the kidney [43]. Blood urea level is another indicator of kidney function, urea is also a metabolic by-product which can build up if kidney functioning is impaired [43]. It can, therefore, be concluded that grains of selim

administration in broilers has no adverse health implications on the birds.

5. CONCLUSION

The similarity of the weight performance, the reduction effect on microbial population, the similarity in haematological parameters, the better serum chemistry values of broilers given grains of selim in this study indicate that *Xylopia aethiopica* dried fruits (grains of selim) has growth promoting potentials and can serve as a natural alternative to antibiotics in broiler production with no adverse health implications on birds or consumers of the products. The elimination of mature worms also indicate that grains of selim possess some anthelminthic activities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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The peer review history for this paper can be accessed here:
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