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Phytotherapic Potentials of *Xylopia aethiopica* Dried Fruits (Grains of Selim) as Additive in Broiler Production

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Abstract: *Xylopia aethiopica* dried fruits (grains of selim) as an additive in starter broilers production was investigated. For this purpose, a total of 195-day old broiler chicks (Arbor acres) were randomly allocated into five treatments groups with 39 chicks and three replicates of 13 chicks in each. Blended grains of selim was given through drinking water on treatments T2, T3, T4 and T5 at concentrations of 0.4, 0.6, 0.8 and 1.0 g/L, while chicks on treatment T1 (control) received antibiotics (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg) at 0.3 g/L of water. All the experimental chicks were fed *ad libitum* with diet containing 23% crude protein and 2,851.55 kcal/kg metabolizable energy for 28 d. The results revealed that there were similarities ($P > 0.05$) in final body weight, total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio among the treatments. There were significant ($P < 0.05$) differences in the microbial count of faeces before the birds received antibiotics and grains of selim, but count were similar ($P > 0.05$) after grains of selim and antibiotics were administered. Cost of total feed consumed, cost of per kg feed and cost of per kg weight were significantly ($P < 0.05$) higher in treatment T1, but cost differential and relative cost benefit were similar ($P > 0.05$). Results indicate that grains of selim have antimicrobial and anthelminthic properties, and promote growth in broiler chickens.

Key words: Anthelminthic, antibiotics, antimicrobial, broiler chicks, growth promoters, phytotherapic, *Xylopia aethiopica* dried fruits (grains of selim).

1. Introduction

Xylopia aethiopica is a slim, tall, evergreen, aromatic tree, growing up to 20 m high and belonging to the order Magnoliales and family Annonaceae. It is widely cultivated in West, Central and Southern of Africa. In West of Africa, the trees flower twice annually (March-July and October-December), while fruiting occurs in December-March and June-September [1]. The dried fruits of *Xylopia aethiopica* (grains of selim) have long been used as a spice in food and as herbal medicine. Nowadays, poultry scientists are becoming more concern on the residual effect of synthetic antibiotics in broiler products. It has been reported that in modern day consumers are now paying much more attention to the quality and safety of poultry products they eat [2]. As a result of reports on residual effects of antibiotics used in animal production, there is now increased interest in poultry production without using antibiotics and other drugs [3]. It is becoming evident that in raising animals, a more nutrition-based health strategy must now be used in future development of animal production [3]. It has been found that some herbs, spices and extracts stimulate feed intake and endogenous secretions, or possess antimicrobial, coccidiostatic or anthelminthic properties [3, 4]. Many herbal products and their extracts have enhanced broiler performance and resulted in growth-promoting effects [4]. It has been opined that herbes, spices and their extracts could serve as important natural alternatives to the antibiotic growth promoters currently in use [5]. The increasing price of antibiotics and other drugs in addition to the residual effects of their use has made poultry scientist to go into research to find out natural herbal plant, which could serve as cheap and good alternative to synthetic antibiotics. This study is designed to investigate the effect of

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Xylopia aethiopic dried fruits (grains of selim) as an additive in starter broiler production.

2. Materials and Methods

2.1 Experimental Location

This research work was performed in the Poultry Research Unit, Department of Animal Science, Delta State University, Asaba Campus, Nigeria.

2.2 Experimental Birds and Management

A total of 195-day old broiler chicks (Arbor acres strain), weighing from 84 g to 95 g after an adjustment period of 3 d, were used in this study. The experimental treatments were carried out for four weeks (28 d). The birds were managed in a deep litter house of 15 experimental units with dimensions of 2.04 m × 2.03 m per unit. Feed and water were provided *ad libitum*, while necessary vaccinations were given.

2.3 Experimental Design

The broiler chicks were randomly allocated into five treatment groups with three replicates on equal weight basis in a completely randomized design (CRD). Each treatment group was made up of 39 broiler chicks and 13 chicks per replicate.

2.4 Experimental Diets

All the experimental birds were fed on the same isocaloric and isonitrogenous diet, containing 23% crude protein and 2,851.55 kcal/kg metabolisable energy. Finely homogenized powder grains of selim was obtained, which was pulverized with mortar and pestled, milled, homogenized and then passed through a standard 2 mm sieve to remove any fibre material. Graded weights of 0.4, 0.6, 0.8 and 1.0 g grains of selim were dissolved in 1 L of water each for more than 10 h and then given to chicks in treatments T2, T3, T4 and T5 as their drinking water; while chicks in treatment T1 (control) were given antibiotics (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg) in their water (0.3 g/L). Grains of selim and antibiotic were supplied to chicks for 5 d in drinking water. The proximate and phytochemical compositions of *Xylopia aethiopica* dried fruits are presented in Table 1. The composition of the starter broiler chicks diet are presented in Table 2.

2.5 Measurements

The birds were weighed weekly on replicate basis to obtain body weight development and body weight gain; while feed intake and mortality were also recorded on replicate basis weekly. Feed conversion, which is a ratio of feed consumed and the weight gained over a specific period, was also calculated. Faecal samples were collected from each replicate for microbial identification and population count before and after administering grains of selim and antibiotics. Faecal samples were collected on the 6th day after 5 d of administering antibiotics and grains of selim. Fresh faecal droppings were totally collected in each replicate unit early in the morning and homogenized (wet) by mixing. 1 g of the wet faecal samples from each replicates were emulsified in a drop of normal saline on a microscopic slide and covered with a cover slip. The samples were then examined with ×10 objective lens

Table 1 Proximate and phytochemical compositions of *Xylopia aethiopica* dried fruits.

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

+ = slightly present; ++ = moderately present; +++ = present; ++++ = strongly present.

Table 2 Composition of experimental broiler starter diet.

Ingredients	T1* (Control)	T2** 0.4 g/L	T3** 0.6 g/L	T4** 0.8 g/L	T5** 1.0 g/L
Maize	54.50	54.50	54.50	54.50	54.50
Soyabean cake	21.00	21.00	21.00	21.00	21.00
Groundnut cake	12.50	12.50	12.50	12.50	12.50
Fish meal	5.00	5.00	5.00	5.00	5.00
Wheat offal	1.00	1.00	1.00	1.00	1.00
Bone meal	3.40	3.40	3.40	3.40	3.40
Oyster shell	1.50	1.50	1.50	1.50	1.50
Salt	0.30	0.30	0.30	0.30	0.30
Premix[1]	0.50	0.50	0.50	0.50	0.50
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated analysis (%)					
Crude protein	23.10	23.10	23.10	23.10	23.10
Crude fibre	3.64	3.64	3.64	3.64	3.64
Metabolizable energy (kcal/kg)	2,851.55	2,851.55	2,851.55	2,851.55	2,851.55
Determined analysis (%)					
Dry matter	89.92	89.92	89.92	89.92	89.92
Ash	10.73	10.73	10.73	10.73	10.73
Crude fibre	7.74	7.74	7.74	7.74	7.74
Crude protein	23.04	23.04	23.04	23.04	23.04
Ether extract	2.65	2.65	2.65	2.65	2.65
Nitrogen free extract	45.76	45.76	45.76	45.76	45.76

*Antibiotic (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg); **grains of selim.

[1]Each 2.5 kg of starter vitamine-mineral premix (Bio-organic Nutrient Systems Limited, Nigeria) provided the following vitamins and minerals: VA, 10,000,000.00 µg; VD_3, 2,000,000.00 µg; VE, 23,000.00 µg; VK_3, 2,000.00 mg; VB_1, 1,800.00 mg; VB_2, 5,500.00 mg; niacin, 27,500.00 mg; pantothenic acid, 7,500.00 mg; VB_6, 3,000.00 mg; VB_{12}, 15.00 mg; folic acid, 750.00 mg; biotin, 60.00 mg; choline chloride, 300,000.00 mg; cobalt, 200.00 mg; Cu, 3,000.00 mg; I, 1,000.00 mg; Fe, 20 mg; Mn, 40,000.00 mg; Se, 200.00 mg; Zn, 30,000.00 mg; antioxidant, 1,250.00 mg.

and the microbes present were identified with ×40 objective lens. 1 g of the wet faecal samples was made into liquid suspension with 10 mL of normal saline. Serial dilutions ranging from 10^{-1} to 10^{-5} were made for each sample, from which 0.03 mL were taken from each diluent and used in inoculating the media plates of the blood agar (BA) and nutrient agar (NA) by the spreader method [6]. Both aerobic and anaerobic culturing were done for all samples. The inoculated plates were incubated at 37 °C for 24-48 h. The growth of microbial colonies on the plates was enumerated using objective lens of ×10. The counts from each sample were divided by 0.03 mL (the volume of the suspension inoculated into the plates for culturing) and multiplied by the dilution factor to obtain total count/mL of diluent. This was further multiplied by 10 to give the total count of microbes/g of sample.

2.6 Chemical Analysis

The chemical analyses of the proximate compositions of the *Xylopia aethiopica* dried fruit and experimental diet (Tables 1 and 2) were determined according to the procedure of Ref. [7]. The phytochemical analysis was carried out according to the methods of Sofowora [8] and Trease and Evans [9].

2.7 Statistical Analysis

All data generated were subjected to one way analysis of variance (ANOVA) using statistical

package [10], and significant differences among the treatment means were separated using Duncan multiple range test [11].

3. Results

The proximate and phytochemical compositions of *Xylopia aethiopica* dried fruits are presented in Table 1. The results of the phytochemical analysis showed that *Xylopia aethiopica* dried fruits contain the following phytochemicals: tannins, alkaloids, flavonoids, steroids, carbohydrates and saponin. The results of the performance characteristics of the starter chicks given different concentrations of grains of selim in drinking water are presented in Table 3. The final body weight, total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio in all the treatment groups were similar ($P > 0.05$). However, broiler chicks in treatment T5 supplied 1 g/L of grains of selim were numerically (but not significant) better than broiler chicks in treatment T1 given antibiotic in the values of their final body weight, total weight gain, daily weight gain and feed conversion ratio. Microscopy and microbial population count of starter broiler droppings before and after giving different concentrations of grains of selim in drinking water are presented in Tables 4 and 5. The results of microscopy showed that all treatments had normal formed faeces before treatment. Treatment T1 had hookworm; treatments T1, T2 and T5 had roundworms; treatments T1, T2 and T4 had *Candida albicans*; treatment T5 only had *Aspergillus flavus*; while all the treatments have the presence of uric acid crystals and *Staphylococcus* spp. in the droppings. Results revealed a high microbial population before treatment with highly significant ($P > 0.01$) differences in microbial population count among the treatment groups. Microscopy of microbes in starter broiler droppings after being given different concentrations of grains of selim in drinking water shows that all treatments have uric acid crystals. Treatments T1, T3 and T5 had scanty growth of *Staphylococcus*, while treatment T5 alone have *Aspergillus flavus* growth. Further results of microbial population count after treatment showed significant reduction in microbial population and differences were not significant ($P > 0.05$) among all treatment groups. The result of the economic analyses of treatments given different concentrations of grains of selim in drinking water from from 4 d to 28 d is presented in Table 6. Results showed that there were no significant ($P > 0.05$) differences in total feed consumed, cost differential and relative cost benefit. However, result showed that there was significant ($P < 0.05$) difference in the cost of total fed consumed among treatments. Treatment T1 was significantly ($P < 0.05$) higher than treatment T2, but similar ($P > 0.05$) to treatments T3, T4 and T5, respectively; treatments T2, T3, T4 and T5 were all similar ($P > 0.05$). Results also showed a highly significant ($P < 0.01$) difference in cost of per kg feed among treatments; treatment T1

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

Parameters	Treatments					SEM	Significance
	T1* (Control)	T2** 0.4 g/L	T3** 0.6 g/L	T4** 0.8 g/L	T5** 1 g/L		
Initial weight/bird (g)	92.67	95.00	93.33	84.00	92.33	2.04	NS
Final body weight/bird (g)	1,414.00	1,407.33	1,392.00	1,406.00	1,502.67	16.67	NS
Total weight gain/bird (g)	1,321.33	1,312.33	1,298.67	1,322.00	1,410.33	16.86	NS
Daily weight gain/bird (g)	47.19	46.87	46.38	47.21	50.37	0.61	NS
Total feed intake/bird (g)	2,389.33	2,410.33	2,457.67	2,406.33	2,406.33	18.04	NS
Daily feed intake/bird (g)	85.33	86.08	86.08	85.94	86.1	0.64	NS
Feed conversion ratio	1.81	1.84	1.84	1.82	1.73	0.03	NS

*Antibiotics (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg); **grains of selim; SEM = standard error of mean; NS = no significant difference.

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

Treatments	Appearance	Before treatment	After treatment
T1*	Normal formed sample	Hookworm ++, round worms, uric acid crystals +++, growth of *Staphylococcus* spp., *Candida albicans*	Uric acid crystals, scanty growth of *Staphylococcus* spp.
T2**	Normal formed sample	Round worms +, growth of *Staphylococcus* spp., uric acid crystals +, growth of *Candida albicans*	Uric acid crystals, no growth of *Staphylococcus* spp.
T3**	Normal formed sample	Crystals ++, growth of *Staphylococcus* spp.	Uric acid crystals and scanty growth of *Staphylococcus* spp.
T4**	Normal formed sample	Crystals +, growth of *Candida albicans*, scanty growth of *Staphylococcus* spp.	Uric acid crystals, no growth of *Staphylococcus* spp.
T5**	Normal formed sample	Crystals ++, round worms +, growth of *Staphylococcus* spp., visible *Aspergillus flavus*	Crystals, scanty growth of *Staphylococcus* spp., visible *Aspergillus flavus*

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

Microbial counts	Treatments					SEM	Significance
	T1* (Control)	T2** (0.4 g/L)	T3** (0.6 g/L)	T4** (0.8 g/L)	T5** (1 g/L)		
Population before treatment ($\times 10^5$)	17.67^{c}	2.67^{a}	20.00^{c}	5.33^{ab}	15.00^{bc}	2.197	xx
Population after treatment ($\times 10^5$)	4.00	0.00	6.00	0.00	8.00	1.44	NS

*Antibiotics (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg); **grains of selim.
[a, b and c]Treatment means with different superscript within the same row are significantly ($P < 0.01$) different. SEM = standard error of mean; NS = no significant difference. xx = highly significant difference ($P < 0.01$).

Table 6 Economic analyses of starter broilers given different concentrations of *Xylopia aerthiopical* dried fruits (grains of selim) in drinking water.

Parameters	Treatments					SEM	Significance
	T1* (Control)	T2** 0.4 g/L	T3** 0.6 g/L	T4** 0.8 g/L	T5** 1 g/L		
Total feed consumed (kg/bird)	2.39	2.14	2.46	2.41	2.44	0.02	NS
Cost of total feed consumed (₦)	272.70^{a}	244.67^{b}	258.23^{ab}	262.80^{ab}	263.97^{ab}	3.33	x
cost per Kg feed (₦)	144.10^{a}	101.77^{c}	105.00^{bc}	109.00^{ab}	108.37^{ab}	1.31	xx
cost per Kg weight (₦)	192.86^{a}	173.85^{b}	185.51^{ab}	186.91^{ab}	175.67^{ab}	2.77	x
cost differential (₦)	0.00	19.01	7.35	5.95	17.19	3.24	NS
Relative cost benefit (₦)	100.00	111.17	104.23	103.47	109.87	1.84	NS

*Antibiotics (Doxy-gen 20/20 WSP: Doxycycline hyclate 200 mg and Gentamicine sulfate 200 mg); **grains of selim.
[a, b and c]Treatment means with different superscript within the same row are significantly ($P > 0.05$) different. SEM = standard error of mean; NS = no significant difference; x = significantly different; xx = highly significantly different.

was significantly ($P < 0.01$) higher than treatments T2 and T3, but similar ($P > 0.01$) to treatments T4 and T5; while treatments T3, T4 and T5 were similar ($P > 0.01$). Result also showed significant ($P < 0.05$) differences in cost of per kg weight among treatments; treatment T1 was significantly ($P > 0.05$) higher than treatment T2, but similar ($P > 0.05$) to treatments T3, T4 and T5; while treatments T2, T3, T4 and T5 were all similar ($P > 0.05$) in cost of per kg weight.

4. Discussion

The results of the phytochemical analysis showed that *Xylopia aethiopica* dried fruits contain alkaloids, flavonoids, tannins, steroids, carbohydrates and saponins. Alkaloids have been associated with medicinal uses for centuries, and one of their common

biological properties is their cytotoxicity [12]. Alkaloids have been documented to possess analgesic, antispasmodic and bactericidal effects [13]. Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection, and they have been found to be antimicrobial substances against a wide array of microorganisms *in vitro* [12]. Their activity is probably due to their ability to complex with extracellular and soluble proteins and also with bacterial cell wall [12]. They also are effective antioxidant and show strong anticancer activities [12]. They also lower the risk of heart diseases [8]. Tannins bind to proline rich protein and interfere with protein synthesis [12]. This makes tannin an anti-nutritional substance. The extracts also contain saponins, which are known to produce inhibitory effect on inflammation. Saponins have 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. Steroids have been reported to have antibacterial properties and they are very important compounds especially due to their relationship with compounds, such as sex hormones [12]. The results of the phytochemical analysis obtained in this study suggest that these identified phytochemical substances may be the bioactive constituents in grains of selim and thus a valuable reservoir of bioactive compounds of substantial medicinal merit, as earlier stated by Yadav and Munin [12]. This result is similar to the phytochemical screening of *Xylopia aethiopica* oil, which revealled the presence of plant sterols and phenolic compounds, such as flavonoids, tannins and saponin [14-17].

The similarities in the final body weights, total weight gain, daily weight gain, total feed intake, daily feed intake and feed conversion ratio are presented in Table 3. It shows that starter broilers in all treatment groups responded positively in growth to the diet and additives given. The growth pattern in treatment T1 and other treatments indicates that grains of selim have growth promoting potentials just like the antibiotic. Therefore, grains of selim can be used to replace antibiotic as additive in broiler starter production. These results are similar to the improved performance obtained when different concentrations of *Xylopia aethiopica* dried fruits was given in drinking water to finisher broilers, which gave the same results with antibiotic growth promoter (gendox) [5]. Aji et al. [18] and Pourali et al. [19] also stated that garlic (powder or aqueous extract) as an additive in broiler chicken production gave improved body weight gain, daily feed intake and feed conversion ratio. The result is also in line with the results of Refs. [20-24], which obtained improved body weight gain in broilers when ginger (*Zingiber officinale*, a spice) was used at different rates mixed with feed or drinking water as an additive. Refs. [25-30] obtained improved body weight performance when thyme was used as an additive in broiler production, and concluded that thyme oil or powder may be a more environmental friendly alternative to antibiotic growth promoters. The similarities in feed intake and feed conversion ratio, which follows the trend of the growth pattern in this study, is in agreement with the reports of these authors. The growth promoting effect of grains of selim in broiler chickens may be attributed to the presence of phytochemical compounds in the fruits (carbohydrates, flavoniods, alkaloids, steriods, saponins and tannins), which have biological activities, such as antioxidant, antimicrobial and pharmacological effects [5]. However, the final weight of starter broiler chicks given different concentrations of grains of selim in their drinking water in treatments T2, T3, T4 and T5 when compared to control treatment, indicated that broiler chicks can be given all concentrations of grains of selim in drinking water from 0.4 g/L to 1.0 g/L with positive effect on body weight gain.

The absence of roundworms in the droppings of treatments given grains of selim indicated that it

possesses some anthelminthic properties. The decrease in microbial population count as was shown in Tables 4 and 5, indicating that grains of selim has antimicrobial activities. The most dominant microorganisms identified in the population of microbes present were the bacteria *Candida albicans* and *Staphylococcus*. The reduction in the population of *Candida albicans* and *Staphylococcus* in all treatments given grains of selim in drinking water showed that grains of selim has components which possess antibacterial activities, and established the fact that grains of selim is an antimicrobial spice and can effectively replace antibiotics in starter broiler production. This result is in agreement with the similar findings of Sudrashan et al. [31] who obtained significant reduction in the bacterial counts of *Staphylococcus*, *E. coli* and *Salmonella* spp. when essential oil extracted from ginger was used as a decontaminating agent in chicken meat. Significant decrease was also obtained in bacterial count of *E. coli* when grains of selim was administered to finisher broilers at different concentrations in drinking water [5].

Results presented in Table 6 showed that the cost of total fed consumed, cost of per kg feed and cost of per kg weight of treatment T1 was higher significantly than that of treatment T2. Although there were similarities between treatment T1 and the others, treatment T1 was generally higher in cost than all treatments given grains of selim. This implies that it is generally cheaper and economically better to use grains of selim in broiler production than antibiotics. These results could be compared with the work of Minh et al. [32] who reported that supplementation of dried ginger to broiler diets led to improved performance and reduced feed cost.

5. Conclusions

The oral administration of *Xylopia aethiopica* dried fruits (grains of selim) from 0.4 g/L to 1.0 g/L of drinking water in broiler chicks as additive resulted in improved body weight performance. Birds that received grains of selim had a generally better growth performance when compared to those on synthetic antibiotics. The results showed that grains of selim has antimicrobial, anthelminthic, growth promoting and cost reducing potentials in broiler starter production. It is therefore, a possible natural alternative additive that may be used in place of antibiotics growth promoters in broiler chicks for better production of body weight gain and feed conversion ratio.

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