International Journal of Clinical & Medical Informatics

ISSN: 2582-2268 Research Article | Vol 4 Iss 1

Daniellia oliveri Leaf Extracts as an Alternative to Antibiotic Feed Additives in Broiler Chicken Diets: Meat Quality and Fatty Acid Composition

Alagbe JO

Department of Animal Science, University of Abuja, Nigeria

Correspondence should be made to Alagbe JO, demsonfarms@yahoo.com; Orcid number: 0000-0003-0853-6144

Received Date: January 28, 2021; Accepted Date: March 10, 2021; Published Date: March 17, 2021

ABSTRACT

The objective of the study was to examine the effect of feeding different levels of Daniellia oliveri leaf extract (DOFE) on the meat quality and fatty acid composition of broiler chicks. A total of 375 one-day old broiler chicks were randomly assigned into five dietary treatments of seventy-five birds per group; each group was further divided into 5 replicates consisting of 15 chicks each. The dietary treatments include a control diet fed 1.25 g/litre Oxytetracycline (T1), T2, T3, T4 and T5 were fed. DOFE at 20 ml, 40ml, 60ml and 80 ml/litre respectively. Basal diet was formulated to meet the nutritional requirements of birds according to NRC (1994), feed and water were given ad libitum and the experiment lasted for 56 days. Result obtained showed that Daniellia oliveri leaf contained Dry matter (89.11 %), crude protein (18.95 %), crude fibre (13.11 %), ether extract (4.78 %), ash (6.10 %), neutral detergent fibre (28.10 %), and acid detergent fibre (47.50 %). Significant differences ($P<0.05$) were observed in the proximate composition of the breast meat. Total saturated fatty acid (TSFA), total unsaturated fatty acid (TUFA) and omega-6/omega -3 ratio (n-6: n-3) values were significantly influenced ($P<0.05$) by DOFE. Birds in T5 had the highest TUFA value of 77.87 % followed by T4 (72.45 %), T3 (66.43 %), T2 (61.94 %) and T1 (41.47 %) respectively. While T1 (44.71 %) had the highest value of TSFA ($P<0.05$) relative to other treatments. Antherogenic index were significantly ($P<0.05$) different among the treatments, the value increases as the level of DOFE increased. It was concluded that feeding DOFE to birds at 80 ml/litre highly influenced the composition of fatty acid and meat quality of animals without any negative effect on their general performance.

KEYWORDS

Super Absordent; Water hyacinth; Biodegradable, Microwave; Chemical activation; Medical

INTRODUCTION

The huge increase in poultry production to meet growing demand in the world has led to the rise in antibiotic use, leading to a worrying increase in cases in antibiotic resistance diagnosed in animal and humans via direct contact, environmental contamination and feed consumption causing high cases in various ailments including cancer [1]. Poultry meat is an excellent source of high protein, essential vitamins, minerals and fatty acid especially polyunsaturated fatty acids [2-4]. Consumption of antibiotics contaminated animal products is injurious to health while multiplications of antibiotic resistance pose a great threat and danger to livestock industry, particularly poultry production and venture in Nigeria [5-7]. It thus

Citation: Alagbe JO, *Daniellia oliveri* Leaf Extracts as an Alternative to Antibiotic Feed Additives in Broiler Chicken Diets: Meat Quality and Fatty Acid Composition. Int J Clin Med Info 4(1): 15-24.

becomes imperative to find cheap, readily available alternatives to antibiotics feed additives in poultry diets. Among the potential alternative is the use of medicinal plants.

Daniellia oliveri (Rolfe) is an evergreen uncultivated copiously available tree, particularly in the savannah zone of Nigeria [8,9]. The plant belongs to the family *Caesal piniaceae* and the tree can grow up to 48 meters with leaves deciduous to torch [10]. Scientific studies have revealed that the roots, stems and leaves demonstrated a considerable antimicrobial [11], anti-inflammatory [12,13], cytotoxic [14,15], antihyperglycaemic [16], antioxidant [17], anti-diarrheal [18], immunostimulatory [19], hepatoprotective [20,21] and miracicidal activities [22,23]. The plant parts contains various phytochemicals (tannins, flavonoids, saponins, phenols, alkaloids, terpenoids, glycosides), minerals, amino acids and vitamins and it can be traditionally used for the treatment of malaria, typhoid, skin diseases, gastro intestinal infections, urinary infections and tooth ache [24,25].

In view of these abundant potentials, the use of *Daniellia oliveri* leaf extract will promote food safety. Therefore, this study was carried out to examine the effects of *Daniellia oliveri* leaf extracts as an alternative to antibiotic feed additives in broiler chicken diets: meat quality and fatty acid composition.

MATERIALS AND METHOD

Study Area

The experiment was carried out at the University of Abuja Teaching and Research Farm, Gwagwalada, Nigeria.

Sources, Collection and Preparation of Daniellia oliveri Leaf Extract

Mature leaves of *Daniellia oliveri* leaves were collected from different plants within the University premises; it was authenticated at the herbarium of Department of Crop Science, University of Abuja, Nigeria, with a voucher number CS - 012 D. The leaves were washed and allowed to dry under shade until a constant weight was obtained and made into a powder using a Panasonic electric blender Model (AA-7301A) and stored in a well labeled air-tight container. 200 g of the sample was soaked in 1000 ml of ethyl alcohol (80% BDH), the mixture was agitated using an electric blender, poured in a container and then kept in the refrigerator at 4°**C** for 48 hours, sieved with What Man No. 1 filter paper to obtain *Daniellia oliveri* leaf extracts (DOFE).

Animals and their Management

Three hundred and seventy-five one day old (Ross 308) broiler chicks with mixed sex were used for the experiment. The birds were purchased from a commercial hatchery in Ibadan, Oyo State, Nigeria and weighed on arrival on the farm to obtain their initial body weight and thereafter weekly. A deep litter housing system was used, it was fumigated two weeks prior to the commencement of the study, and the surrounding environment was also cleaned daily to ensure proper hygiene. Birds were divided to five treatments with five replicates of fifteen (15) birds in a completely randomized design. Electric brooders were used and wood shavings serve as the litter material. Vaccines were administered according to the prevailing disease condition in the environment and all other management practices were strictly adhered to throughout the experiment which lasted for 56 days.

Ration Formulation

Three (3) basal diets were formulated at different stages of production to meet up with the requirements of birds according to NRC (1994). Broiler starter's mash (0 day - 21 days), growers mash (22 days - 35 days) and finishers mash (36 days - 56 days).

Treatment 1: Basal diet + Oxytetracycline 2.5 g/l.
Treatment 2: Basal diet + 20 milli/litre DOFE/litre of water.
Treatment 3: Basal diet + 40 milli/litre DOFE/litre of water.
Treatment 4: Basal diet + 60 milli/litre DOFE/litre of water.
Treatment 5: Basal diet + 80 milli/litre DOFE/litre of water.

Measurements

Proximate compositions of experiment diet and meat (breast and thigh) were determined by using official method of analysis by AOAC (2000).

Weight gain (g) = final weight (FW) - initial weight (IW).

Feed intake (g) = Amount of feed consumed - remaining feed.

Fatty Acid Analysis

At the end of the experiment, five birds were randomly selected from each treatment for fatty acid analysis (FA). Meat lipids (breast) from freeze dried; grounded samples were extracted with chloroform-methanol (2:1 v/v; [52] with slight modification as described by [26]. After extraction, FAs in the residual fat were esterified, using acid and base catalyzed methods as described by [26]. Fatty acid methyl esters (FAMEs) analysis was performed by gas chromatography mass spectrometry (GC - MS; Mussek - QM - 2010 plus, China) equipped with electron impact (EI) detector. Separations of Fas were carried out on capillary column Model 7009 A, Punjab Technologies, India (30 m × 0.32 mm × 0.25 µm) using helium as carrier gas. Column temperature was held at 50°C for 1 minute, and then the temperature was raised up to 150°C at the rate of 15°C per minute. Temperature was later increased to 175°C at the rate of 2.50°C and hold for 5 minutes and finally increased to 220°C at the rate of 2.50°C per minute and kept for 5 minutes. The identification of the peaks was made by comparison of the equivalent chain length with those of authentic fatty acid methyl esters. Peak areas were determined automatically using the agilent gas chromatography ChemStation software. The fatty acid concentrations were expressed in percentage of the sum of total identified peaks measured in each sample.

Statistical Analysis

All data were subjected to one - way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using Duncan multiple range tests [53]. Significant was declared if $P \leq 0.05$ (Table 1).

Parameters	% Composition
Dry Matter	89.11
Crude Protein	18.95
Crude Fibre	13.11
Ether Extract	4.78
Ash	6.10
Neutral Detergent Fibre (NDF)	28.10
Acid Detergent Fibre (ADF)	47.50
Nitrogen Free Extract (NFE)	46.17

Table 1: Proximate composition of *Daniellia oliveri* leaf meal.

RESULT AND DISCUSSION

The Proximate Composition of Experimental Diet and Daniellia oliveri Leaf Meal

The proximate composition of experimental diet (Table 2) revealed that it contains crude protein, crude fibre, ether extract, calcium, phosphorus and metabolizable energy which ranged between 19.33% - 23.08%, 3.06% - 3.95%, 4.28% - 5.03%, 0.98% - 1.10 %, 0.40% - 0.51% and 2936 kcal/kg – 3100.2 kcal/kg respectively. The experimental diet was in three (3) phases with starter mash fed between (0 day - 21 days), growers mash (22 days - 35 days) and finishers mash (36 days - 56 days). The crude protein and ether extract values obtained in this study are in conformity with the values obtained by [27,28,15] when phytogenic feed additives were supplemented in the diet of broiler chicks. The crude fibre (4.28% - 5.03 %) fall within the recommended ranges by [9,24,30-31,32]. The calcium and phosphorus values are in close agreement with the findings of [54] who examined the effect of phytogenic additives on the performance and caecal microflora of broiler chickens. The energy contents (2936 kcal/kg - 3100.2 kcal/kg) are in

conformity with the values obtained by [33] but lower than that obtained by [34] and [35] who examined the effects of supplemental essential oil on the performance and carcass traits in broilers. However, all values in the experimental diets were within nutritional requirement for broilers according to NRC (1994).

Materials	Starter (1 day - 21 days)	Grower (22 days - 35 days)	Finisher (36 days - 56 days)
Maize	50.00	56.00	60.50
Wheat Offal	8.00	7.00	8.05
Soya Meal	28.55	22.00	21.00
Groundnut Cake	10.00	11.55	6.05
Fish Meal	2.00	2.00	2.00
Bone Meal	0.35	0.40	0.40
Limestone	0.20	0.20	0.20
Lysine	0.15	0.15	0.15
Methionine	0.20	0.20	0.20
Premix	0.25	0.25	0.25
Salt	0.30	0.30	0.30
Total	100.0	100.0	100.0
Calculated Analysis			
Crude Protein	23.08	20.11	19.33
Ether Extract	5.03	4.87	4.28
Crude Fibre	3.06	3.95	3.42
Calcium	0.98	1.00	1.10
Phosphorus	0.47	0.40	0.51
Lysine	1.17	1.29	1.60
Meth + Cyst	0.87	0.82	0.51
ME (Kcal/kg)	2936	3000.8	3100.2

Table 2: Chemical composition of experimental diets.

Note: *Premix: Supplied per kg diet: Vitamin A, 13,000 I.U; Vitamin E, 5 mg; Vitamin D_3, 3000 I.U; Vitamin K, 3 mg; Vitamin B_2, 5.5 mg; Niacin, 25 mg; Vitamin B_{12}, 16 mg; Choline Chloride, 120 mg; Manganese, 5.2 mg; Zinc, 25 mg; Copper, 2.6 gm; Folic acid, 2 mg; Iron, 5 gm; Pantothenic Acid, 10 mg; Biotin, 30.5 gm; Antioxidant, 56 mg.

Proximate Analysis of Daniellia oliveri Leaf Meal

Proximate analysis of *Daniellia oliveri* leaf meal is presented in (Table 3). The sample contained dry matter, crude protein, crude fibre, ether extract, ash, neutral detergent fibre, acid detergent fibre and nitrogen free extract at 89.11%, 18.95%, 13.11%, 4.78%, 6.10%, 28.10%, 47.50% and 47.50% respectively. The crude protein (18.95%) value in *Daniellia oliveri* leaf meal is in agreement with those reported for *Delonix regia* leaves (18.77%) by [1], but contrary to those reported for *Piliostigma thonningii* stem and root (4.22% and 7.40%), *Indigofera tinctoria* leaves (30.53%) reported by [36]. The result suggests that the sample cannot supply adequate amount of protein in the diets of animals [37]. The crude fibre obtained is higher than values for *Sida acuta* leaves (6.24%) by Shittu and Alagbe (2020). Dietary inclusion of fibre encourages proper digestion, reduces serum cholesterol level and risk of cardiovascular diseases [38, 30-32]. The result showed that the sample contains ether extract (4.78%) and ash (6.10%). These values are lower than the values for *Pentadiplandra brazzeana* (5.70% and 12.11%) respectively reported by [24] (2020). All values obtained in this study were in agreement with the findings of [39].

Vaccine	Day/week	Route of administration
1st ND Lasota	Day 5	Drinking water
1st IBD (Gumboro)	Day 8	Drinking water
Immucox Vaccine (Coccidial Vaccine)	Day 10	Drinking water
2nd ND Lasota	Day 15	Drinking water
2nd IBD (Gumboro)	Day 21	Drinking water
3rd ND Lasota	Day 28	Drinking water
3rd IBD (Gumboro)	Day 33	Drinking water

Table 3: Vaccination schedule for birds.

Proximate Composition of Breast Meat

The proximate composition of breast meat is presented in (Table 4). The moisture, crude protein, lipid and ash ranged between 71.63% - 76.08%, 19.23% - 23.86%, 1.15% - 2.44% and 1.29% - 2.02% respectively. The values were highest in T4 and T5, intermediate in T2, T3 and lowest in T1 ($P < 0.05$). This is a clear indication that feeding *Daniellia oliveri* leaf extract (DOFE) is capable of modifying the meat composition of birds; it could also be attributed to the presence of phytochemicals in DOFE [40]. Concentrations of phytochemicals or bioactive chemicals in plants are determined by variety and environmental growth conditions, harvesting time, stage of maturity, method and duration of conservation and storing, extraction methods as well as possible synergistic or antagonistic effects and anti-nutritional factors in plants [41,24,42,43]. The result obtained in this study is in agreement with the findings of [44,45] who examined the effect of black soldier fly (*Hermetia illucens*) meals on the meat quality in broilers.

Parameters (%)	T1	T2	T3	T4	T5	SE
Breast Meat	-	-	-	-	-	-
Moisture	71.63	72.00	74.18	75.20	76.08	2.0
Crude Protein	19.93^{c}	22.24^{b}	23.00^{a}	23.47^{a}	23.86^{a}	1.10
Fat	1.15^{b}	1.83^{b}	2.00^{a}	2.21^{a}	2.44^{a}	0.0
Ash	1.29^{b}	1.42^{b}	1.94^{b}	2.00^{a}	2.02^{a}	0.1

Table 4: Proximate composition of breast meat.

Fatty Acid Composition of Breast Meat of Broiler Chicks Fed different Levels of DOFE

Effects of *Daniellia oliveri* leaf extract on the fatty acid profile of broiler chicks (breast) meat is presented in (Table 5). C12:0 (Lauric acid), C14:0 (myristic acid), C16:0 (palmitic acid), C18:0 (stearic acid), C20:0 (arachidic acid) and C22:0 (behenic acid) ranged between 1.52% - 2.91 %, 2.21% - 3.18 %, 15.0% - 22.9 %, 5.73% - 11.20 %, 1.88% - 4.21 % and 0.24% - 0.31 % was lowest ($P < 0.05$) for T5 relative to other treatments. C22:1 (myristoleic acid), C14:1c (palmitoleic acid), C16:1c (linoleic acid), C18:1c (oleic acid), C18:1n9t (elaidic acid), C18:1n9c (linolelaidic acid), C:22:1 (erucic acid), C20:$5n^3$ (eicosapentenoic acid), C18: $3n^3$ (α-linolenic acid), C20: $4n^6$ (arachidonic acid), C20: $3n^6$ (dihomogammalinolenic acid) and C22: $6n^3$ (docosahexenoic acid) ranged between 0.10% - 0.65 %, 1.81% - 2.97 %, 2.01% - 3.51 %, 13.4% - 21.7%, 1.2% - 1.86%, 0.82% - 0.87 %, 0.13% - 0.66 %, 15.4% - 23.4 %, 0.88% - 1.51 %, 3.04% - 14.3%, 2.08% - 3.81%, 0.92% - 1.28%, 0.05% - 2.00 % respectively. Values were highest in T5, intermediate in T3 and lowest in T1 ($P < 0.05$).

T1	T2	T3	T4	T5	SEM
2.91^{a}	1.98^{b}	1.65^{b}	1.61^{b}	1.52^{b}	0.07
3.18^{a}	2.48^{b}	2.42^{b}	2.37^{b}	2.21^{c}	0.08
22.9^{a}	18.0^{b}	17.2^{b}	16.3^{c}	15.0^{c}	0.51
11.2^{a}	8.71^{b}	7.62^{b}	6.00^{c}	5.73^{c}	0.30
4.21^{a}	3.93^{a}	2.81^{b}	2.40^{b}	1.88^{c}	0.73
0.31^{a}	0.21^{b}	0.27^{b}	0.20^{b}	0.24^{b}	0.01
1.81^{c}	2.88^{a}	2.73^{a}	2.91^{a}	2.97^{a}	0.08
2.01^{b}	2.21^{b}	2.93^{b}	3.18^{a}	3.51^{a}	0.04
13.4^{c}	18.7^{b}	19.5^{b}	21.0^{a}	21.7^{a}	0.26
1.20^{c}	1.51^{b}	1.40^{b}	1.44^{b}	1.86^{a}	0.06
0.82	0.86	0.80	0.83	0.87	0.02
0.13^{b}	0.47^{a}	0.51^{a}	0.53^{a}	0.66^{a}	0.04
15.4^{c}	19.8^{b}	22.0^{a}	22.8^{a}	23.4^{a}	0.23
0.88^{c}	1.05^{b}	1.10^{b}	1.14^{b}	1.51^{a}	0.18
3.04^{c}	8.08^{b}	10.3^{b}	13.1^{a}	14.3^{a}	0.22
2.08^{b}	2.21^{b}	2.59^{b}	2.87^{b}	3.81^{a}	0.05
0.92^{b}	1.08^{a}	1.17^{a}	1.21^{a}	1.28^{a}	0.01
0.05^{c}	1.35^{b}	1.40^{b}	1.44^{b}	2.00^{a}	0.61
44.71^{a}	35.31^{b}	31.97^{b}	28.88^{c}	26.58^{c}	0.06
41.47^{c}	61.94^{b}	66.43^{b}	72.45^{a}	77.87^{a}	0.02
19.37^{c}	26.63^{b}	27.87^{b}	29.89^{b}	31.57^{a}	0.14
22.37^{c}	33.57^{b}	38.56^{b}	42.56^{a}	46.30^{a}	0.47
4.67^{a}	2.20^{b}	2.01^{b}	1.71^{c}	1.75^{c}	0.03
0.93^{a}	0.48^{b}	0.43^{b}	0.38^{c}	0.33^{c}	0.05

Table 5: Effect of *Daniellia oliveri* leaf extract on the fatty acid profile of broiler chicks (breast) meat.

Note; 1. Total saturated fatty acid= C12:0 + C14:0 + C16:0 + C18:0 + C20:0 +C22:0.
2. Unsaturated fatty acid = (3 + 4).
3. Mono unsaturated fatty acid= C14:1C + $C16:1_C$ + $C18:1_C$ + C18:1n9t + C18:1n9c + C22:1.
4. Polyunsaturated fatty acid = C18: 2n6 + C20: 5n3 + C18: 3n3 + C20: 4n6 + C20: 3n6 + C22: 6n3.
5. n-6: n-3 = (C18: 2n6 + C20: 4n6 + C20: 3n6) / (C20: 5n3 + C18:3n3 + C22: 6n3).
6. Antherogenic index = (C12:0 + 4×C14:0 + C16)/ ε of UFA.

Total saturated fatty acid (26.58% - 44.71%) and total unsaturated fatty acid (41.47% - 77.87%) were affected (*P*

<0.05) by the oral administration of *Daniellia oliveri* leaf extract. TSFA were highest and lowest for T1 and T5 respectively (P <0.05) while TUFA was lowest (P <0.05) in T1 relative to other treatments. TUFA and TSFA obtained in this study are in conformity with the values obtained by [46,47,48]. Birds in T5 had the highest concentration of polyunsaturated fatty acid (PUFA), which is in agreement with the reports of [49]. According to [50] meat from birds are low in lipids or fats, but high in PUFA. Antheriogenic index (A.I) values ranges between 0.33% - 0.93%, the values significantly reduced as the level of DOFE increased (P <0.05). Antheriogenicity is an index used to ascertain the safety of the meat and prevent the incidence of cardiovascular diseases [47,51]. According to Katalin and Loana (2017) omega - 3 and omega - 6 polyunsaturated fatty acids perform multiple biological roles such as influencing the inflammatory cascade, reducing oxidative stress, presenting neuro - protection and cardiovascular protection.

CONCLUSION

It was concluded that DOFE contains several bioactive chemicals or phytochemicals which are capable of modification of meat fatty acid composition of animals, these chemicals are safe, effective, cheap and can also influence secretion of digestive fluids and total feed intake in animals, thus promoting food safety. Feeding birds DOFE at 80 ml/litre is safe and does not have any deleterious effect on the general performance of the animal.

FUNDING

This research received no external funding.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

REFERENCES

1. Hyun L, Yanhong L, Sergio C, et al. (2018) Phytochemical as antibiotic alternatives to promote growth and enhance host health. Journal of Biomedical Sciences 49(1): 76.
2. Bourre J (2004) Effect of increasing the omega - 3 fatty acid in the diets of animals on the animal products consumed by humans. Journal of Medical Sciences 21(8-9): 773-779.
3. Duncan DB (1955) Multiple ranges and multiple F-tests. Biometrics 11(1): 1-42.
4. Folch J, Lees M, Stanyley SG (1957) A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biological Sciences 226(1): 497-509.
5. Kamran K, Sarzamin K, Nazir AK, et al. (2018) Effect of flaxseed supplementation of feed on growth, carcass yield, meat and fatty acid profile of rabbit carcass. Pakistan Journal of Zoology 50(6): 2037-2043.
6. Ramiah KS, Rahim AAN, Ebrahimi M, et al. (2014) Effects of two herbal extracts and Virginiamycin supplementation on the growth performance, intestinal microbial population and fatty acid composition of broiler chickens. Asian Australasian Journal of Animal Science 27(3): 375-382.
7. Trebusak T, Leva A, Frankic T, et al. (2014) Effect of dietary linseed oil and *Ganoderma lucidum* or olive leaves supplementation on fatty acid composition and oxidative status of rabbits. World Rabbit Science 22(1): 71-81.
8. Elshater AE, Muhammad MAS, Mahrous MAM (2009) Effect of ginger extracts consumption on levels of blood glucose, lipid profile and kidney functions in alloxane induced-diabetic rats. Egyptian Academic Journal of Biological Sciences 2(1): 153-162.

9. Teodora P, Evgeni P and Maya I (2020) Effect of black soldier fly (*Hermetia illucens*) meals on the meat quality in broilers. Agricultural and Food Science 29(3): 177-188.
10. Li RG, Wang XP, Wang CY, et al. (2012) Growth performance, meat quality and fatty acid metabolism response of growing meat rabbits to dietary linoleic acid. Asian Australian Journal of Animal Science 25(12): 1169-1177.
11. Wenk C (2012) Herbs and botanicals as feed additives in monogastric animals. Asian-Australasian Journal of Animal Sciences 16(2): 282-289.
12. Fasola TR, Adeyemo FA, Adeniji JA, et al. (2002) Antiviral potentials of *Enantia chlorantha* extracts on yellow fever virus. Nature and Science 9(9): 99-102.
13. Norton BW (1994) The nutritive value of tree legumes in: Forage tree legumes in tropical agriculture. Gutteride RC and Shelton HM (Eds.). Cab International 191: 202-215.
14. Alabi OJ, Malik AD, Obaje P, et al. (2017) Effect of aqueous *Moringa oleifera* extracts on growth performance and carcass characteristics of hubbard broiler chicken. Brazilian Journal of Poultry Science 19(2): 273-280.
15. Ahsan U, Kuter E, Raza I, et al. (2018) Dietary supplementation of different levels of phytogenic feed additive in broiler diets: The dynamics of growth performance, caecal microbiota, and intestinal morphometry. Brazilian Journal of Poultry Science 20(4): 737-746.
16. Fascina VB, Sartori JR, Gonzales E, et al. (2012) Phytogenic additives and organic acids in broiler chicken diets. Brazilian Journal of Animal Science 41(10): 2189-2197.
17. Hong JC, Steiner T, Aufy A, et al. (2012) Effects of supplemental essential oil on growth performance, lipid metabolites and immunity, intestinal characteristics, micro biota and carcass traits in broilers. Livestock Science 144(3): 253-262.
18. Toghyani M, Tohidi M, Gheisari AA, et al. (2010) Performance, immunity, serum biochemical and aematological parameters in broiler chicks fed dietary thyme as alternative for an antibiotic growth promoter. African Journal of Biotechnology 9(40): 6819-6825.
19. Vrajnes MV, Tolimir N, Vukmirovic D, et al. (2013) Effect of phytogenic additives on performance, morphology and caecal microflora of broiler chickens. Biotechnology in Animal Husbandry 29(2): 311-319.
20. Wati T, Ghosh TK, Syed B, et al. (2015) Comparative efficacy of a phytogenic feed additive and an antibiotic growth promoter on production performance, caecal microbial population and humoral immune response of broiler chickens inoculated with enteric pathogens. Animal Nutrition 1(3): 213-219.
21. Alagbe JO (2019) Proximate, mineral and phytochemical analysis of *Piliostigma thonningii* stem bark and roots. International Journal of Biological, Physical and Chemical Studies 1(1): 1-7.
22. Alagbe JO, Shittu MD, Bamigboye SO, et al. (2019) Proximate and mineral composition of *Pentadiplandra Brazzeana* Stem Bark. Electronic Research Journal of Engineering, Computer and Applied Sciences 1(2019): 91-99.
23. Oluwafemi RA, Olawale I, Alagbe JO (2020) Recent trends in the utilization of medicinal plants as growth promoter in poultry nutrition - A review. Research in: Agricultural and Veterinary Sciences 4(1): 5-11.
24. Alagbe JO, Balogun OM (2020) Effect of dietary supplementation of *Albizia lebbeck* seed oil on the fatty acid composition of growing rabbits. Biochemistry and Biotechnology Research 8(2): 29-33.
25. Alagbe JO (2019) Haematology, serum biochemistry, relative organ weight and bacteria count of broiler chicken given different levels of *Luffa aegyptiaca* leaf extracts. International Journal of Advanced Biological and Biomedical Research 7(4): 299-382.

26. Alagbe JO, Shittu MD, Ojo AE (2020) Prospect of leaf extracts on the performance and blood profile of monogastric -A review. International Journal of Integrated Education 3(7): 122-127.
27. Alagbe JO, Sharma DO, Liu X (2019) Effect of aqueous *Piliostigma thonningii* leaf extracts on the haematological and serum biochemical indices of broiler chicken. Noble International Journal of Agriculture and Food Technology 1(2): 62-69.
28. Akintayo BO, Alagbe JO (2020) Probiotics and medicinal plants in poultry nutrition - A review. United International Journal of Research and Technology 1(4): 1-5.
29. Musa B, Alagbe JO, Motunrade BA, et al. (2020) Growth performance, caeca microbial population and immune response of broiler chicks fed aqueous extract of *Balanites aegyptiaca* and *Alchornea cordifolia* stem bark mixture. United Journal for Research and Technology 1(11): 13-21.
30. Shittu MD**,** Alagbe JO (2020) Phyto-nutritional profiles of broom weeds (*Sida acuta*) leaf extract. International Journal of Integrated Education 3(11): 119-124.
31. Olafadehan OA, Oluwafemi RA, Alagbe JO (2020) Carcass quality, nutrient retention and caeca microbial population of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. Journal of Drug Discovery 14(33): 146-154.
32. Olafadehan OA, Oluwafemi RA, Alagbe JO (2020) Performance, haemato-biochemical parameters of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. Advances in Research and Reviews 14(33): 135-145.
33. Alagbe JO (2020) Performance, hematology and serum biochemical parameters of weaner rabbits fed different levels of fermented *Lagenaria brevifora* whole fruit extract. Advances in Research and Reviews 2020: 1-5.
34. Omokore EO, Alagbe JO (2019) Efficacy of dried *Phyllantus amarus* leaf meal as an herbal feed additive on the growth performance, haematology and serum biochemistry of growing rabbits. International Journal of Academic Research and Development 4(3): 97-104.
35. Alagbe JO, Soares DM (2018) Effects of feeding different levels of *Azolla pinnata, Polyalthia longifolia, Tithonia diversifolia, Moringa olifera, Azadiracta indica* leaf meal infusion as an organic supplement on the performance and nutrient retention of growing grass cutters. Greener Journal of Agricultural Sciences 8(1): 01-11.
36. Alagbe JO (2017) Effect of dietary inclusion of *Polyalthia longifolia* leaf meal as phytobiotic compared with antibiotics on the nutrient retention, immune response and serum biochemistry of broiler chicken. Greener Journal of Agricultural Sciences 7(3): 74-81.
37. Muhammad S, Masood SB, Muhammad AS, et al. (2015) Lipid stability, antioxidant potential and fatty acid composition of broiler breast meat as influenced by quercertin in combination with ά-tocopherol enriched diets. Lipids in Health and Disease 14(16): 1-15.
38. Alagbe JO (2019) Effects of dried *Centella asiatica* leaf meal as an herbal feed additive on the growth performance, haematology and serum biochemistry of broiler chicken. International Journal of Animal Research 3(23): 1-12.
39. Omolere ABM, Alagbe JO (2020) Probiotics and medicinal plants in poultry nutrition: A review. United International Journal for Research and Technology 3(6): 214-221.
40. Oluwafemi RA, Akinbisola SA, Alagbe JO (2020) Nutritional and growth performance of feeding *Polylathia longifolia* leaf meal as partial replacement of wheat offal in the diet of broiler chicks. European Journal of Biotechnology and Bioscience 2: 92-101.

41. Oluwafemi RA, Egwuiyi GN, Alagbe JO (2020) Effect of feeding Polylathia longifolia leaf meal as partial replacement of wheat offal. European Journal of Agricultural and Rural Education 1(1): 8-16.
42. Olafadehan OA, Okunade SA, Njidda AE, et al. (2020) Concentrate replacement with Daniellia oliveri foliage in goat diets. Tropical Animal Health Production 52(1): 227-233.
43. National Research Council (1994) Nutrient requirement for poultry (9th edition) National Academy Press, Washington, D.C, USA.
44. Olafadehan OA, Okunade SA (2018) Fodder value of three browse forage for growing goats. Journal of the Saudi Society of Agricultural Sciences 17: 43-50.
45. Alagbe JO, Sharma R, Shittu MD, et al. (2020) Chemical evaluation of the proximate, minerals, vitamins and phytochemical analysis of Daniellia oliveri stem bark. International Journal of Biological, Physical and Chemical Studies 2(1): 16-22.
46. Musa A, Kalid A, Alagbe JO (2020) Preliminary phytochemical screening of *Albizia lebbeck* stem bark. International Journal on Integrated Education 3(12): 112-116.
47. Uzama D, Bwai MD (2012) Physicochemical properties and antioxidant potentials of Daniellia oliveri seed oil. Research Journal in Engineering and Applied Sciences 1(6): 389-392.
48. Jimoh FO, Oladiji AT (2005) Preliminary studies on *Piliostigma thonningii* seeds: Proximate analysis, mineral composition and phytochemical screening. African Journal of Biotechnology 4(12): 1439-1442.
49. Iwueke AV, Nwodo OFC (2008) Anti-hyperglycemic effect of aqueous extract of *Daniellia oliveri* and *Sarcocephalus latifolius* roots on key carbohydrate metabolic enzymes and glycogen in experimental diabetes. Biokemistri 20(2): 63-70.
50. Ahmadu A, Haruna AK, Garba M, et al. (2004) Phytochemical and antimicrobial activities of the *Daniellia oliveri* leaves. Fitoterapia 75(7-8): 729-732.
51. Muanda F, Kone D, Dicko A, et al. (2011) Phytochemical composition and antioxidant capacity of three malian medicinal plant parts. Evidence - Based Complementary and Alternative Medicine 2011: 674320.
52. Musa AD, Yusuf GO, Ojogbane EB, et al. (2010) Screening of eight plants used in folkloric medicine for the treatment of typhoid fever. Journal of Chemical and Pharmaceutical Research 2(4): 7-15.
53. Onwukaeme ND, Lot TY, Udoh FV (1999) Effects of *Daniellia oliveri* stem bark and leaf extracts on rat skeletal muscle. Phytotherapy Research 13(5): 419-421.
54. Ahmadu AA, Zezi AU, Yaro AH (2007) Anti-diarrheal activity of the leaf extracts of *Daniellia oliveri* Hutch and Dalz (*Fabaceace)* and *Ficus sycomorus Miq (Moraceace)*. African Journal of Traditional, Complementary and Alternative Medicines 4(4): 524-528.
55. Lamy C, Sauvan NM, Renimel IT, et al. (2010) Use in the cosmetic field of an exudate of plant Daniellia oliveri, in particular as an anti-wrinkle agent.
56. Olatunji G (2000) Diterpene lactone from the heartwood of Daniellia oliveri. Cellulose Chemistry and Technology 34 (5-6): 505-507.
57. Arnao MB, Cano A, Acosta M (1998) Total antioxidant activity in plant materials and its interest in food technology, Recent Developments in Agricultural Food Chemistry 2: 893-905.
58. Oyagade JO, Awotoye OO, Adewumi TJ, et al. (1999) Antibacterial activity of some Nigerian medicinal plants. Screening for antibacterial activity. Bioscience Biotechnology Research Communications 11(3): 193-197.

59. Topcu G, Oksit S, Sheih H, et al. (1993) Cytotoxic and antibacterial seiguiterphenes from *Inula graveolens*. Phytochemistry 33(2): 407-410.
60. AOAC (2000) Association of official analytical chemists. Official Methods of Analysis 19th Edition, Washington DC.
61. Alagbe JO, Omokore EA, Tijani TD (2018) Effect of dietary supplementation of dried *Spondias mombin* linn leaf on the performance and blood profile of broiler chickens. Pacific International Journal 2(2): 46-58.
62. Alagbe JO, Eimoga AA, Alagbe OO (2017) Growth response and carcass characteristics of weaner grass cutters fed diets supplemented with *Polyalthia longifolia* seed oil as a natural growth promoter. Greener Journal of Agricultural Sciences 7(5): 112-119.
63. Alagbe JO (2020) Proximate, phytochemical and vitamin compositions of *Prosopis africana* stem bark. European Journal of Agricultural and Rural Education 1(4): 1-7.