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Prosopis africana (African mesquite) oil as an alternative to antibiotic feed additives on broiler chickens diets: performance and nutrient retention

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ABSTRACT

The study aimed to examine the use of *Prosopis africana (African mesquite)* oil as an alternative to antibiotic feed additives on broiler chickens diets: performance and nutrient retention. Five hundred and forty 1-day old broiler chicks of mixed sex (Ross 308) were used for the experiment. Birds were divided into 6 treatments each of the groups had 6 replicates with 15 birds in a completely randomized design experimental model. The experiment lasted for 56 days, clean feed and water was provided *ad libitum*. Birds in treatment 1 (T1) were fed basal diet with no *Prosopis* oil (PRO), T2 (basal diet + 1.5 g/kg feed), T3, T4, T5 and T6 were fed PRO at 100 mg, 200 mg, 300 mg and 400 mg /kg feed respectively. Feeding PRO significantly ($P<0.05$) affected the final body weight, average daily weight gain (ADWG), feed conversion ratio and mortality. ADWG values increased as the level of *Prosopis* oil increased across the treatments. Similarly, PRO significantly influenced the nutrient retention of crude protein, ether extract, crude fibre and nitrogen free extract among the treatments. Average daily feed intake of birds were not significantly ($P<0.05$) different among the treatments. It was concluded that PRO is rich in several phytochemicals and its inclusion up to 400 mg/kg of feed had no negative effect on the performance of broiler chicks.

Keywords: *Prosopis africana*; phytochemicals; performance; nutrient retention; broiler chicks

1. INTRODUCTION

The indiscriminate use of antibiotics is a serious problem in Africa especially in Nigeria, this has led to high cases of antimicrobial resistance, harmful residue in animal products (meat, eggs and milk) and death as a result of damage of vital organs in the body of livestock's (Alagbe et al. 2019; Islam et al., 2018). There is an urgent need to diversify to promote food safety and create sustainable alternative to the above problem to development livestock production (Appiah et al., 2017; Alagbe, 2019). Among the potential alternatives are: prebiotics, probiotics and the use of medicinal plants due to the presence of their phytogenic components or

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chemicals (Verpoorte, 2000; Zhou et al., 2013; Olafadehan et al. 2020a; Alagbe, 2020; Alagbe et al., 2020).

Recently, the use of medicinal plants is gaining more interest globally because they are safe, effective and cause no pollution to the environment; they are also able to synthesize primary metabolites (carbohydrates, protein, fats and amino acids) and secondary metabolites or phytochemicals (alkaloids, flavonoids, saponins, terpenoids, tannins etc) (Weir et al., 2004; Yu et al., 2005). These phytochemicals are produced in the stem, roots, seeds, stem bark and other parts of the plants and are capable of producing several pharmaceutical response such as: antimicrobial, antifungal, antibacterial, antioxidant, hepatoprotective, hypolipidemic and antiviral (Gurib-Fakim, 2006; Chintamunnee and Mohamoodally, 2012). According to Schippmann et al. (2002), there are about 422,000 flowering plant species out of which 52,885 have medicinal properties. Some of these medicinal plants are still underutilized due to lack of information, interest and non-availability of research grant especially among developing countries (Alagbe, 2019).

Prosopis africana is a leguminous medicinal plant belonging to the family fabaceae and sub-family mimosoideae grown in many African countries and Asia (Lokesh et al., 2018). The genus prosopis consist of 44 species of trees and shrubs with slender branches. The leaflets are characterized by green colour with sickle-shaped pods of about 10 – 20 cm long (Bari et al., 2007). The pods are used as seasoning agents in most parts of Nigeria and are rich in several nutrients such as: carbohydrates, protein, amino acids, minerals and vitamins (Ayanwuyi *et al*., 2010). Many parts of the plants (leaf, stem, roots and seeds) are capable of providing multiple biological activities and are easily metabolized when they come in contact with the cells of animals (Miller *et al*., 2002).

Recently, it has been reported that *Prosopis africana* stem bark are potential antimicrobial agent against pathogenic organisms due to the presence of tannins, flavonoids and alkaloids and have been used traditionally for the treatment of headache, malaria, sores, urinary tract infections and gastrointestinal disorders (Prakash and Gupta, 2009). Essential oils from Prosopis seed are found to be highly abundant in prosogerin (flavonoids) (Lokesh et al., 2018). Flavonoids have been reported to perform antioxidant, antiviral, anti-inflammatory and hepato-protective properties (Alagbe, 2019).

Previous studies have shown that essential oils are capable of improving feed intake, palatability and flavor of feeds, creates an ideal digestive system, improves nutrient utilization by stimulating the release of enzymes, scavenge free radicals and prevents the proliferation of pathogenic microorganisms (Mahomoodally, 2013; Atawodi, 2005; Okoro et al., 2011). In view of these abundant potentials in Prosopis oil, there is scanty information on its use as a phytogenic feed additive in broiler chicks. Exploring its bioactive chemicals will not only promote food safety but will give an idea on the ideal inclusion level to birds.

The aim of this experiment is to evaluate the *Prosopis africana (African mesquite)* oil as an alternative to antibiotic feed additives on broiler chickens diets: performance and nutrient retention.

2. MATERIALS AND METHODS

Experimental site and ethical approval

This study was carried out at the Department of Animal Science, Faculty of Agriculture, University of Abuja Teaching and Research Farm, Main Campus, along Airport Road, Gwagwalada, Abuja, Nigeria. Gwagwalada is the headquarters of the Gwagwalada Area Council; located between latitudes $8^{o}57^{1}$ and $8^{o}55^{1}$N and longitude $7^{o}05^{1}$ and $7^{o}06^{1}$E. The experiment was done according to the guidelines of animal protocol approved by the research committee of the Department of Animal Science, University of Abuja, Nigeria.

Collection and identification of plant sample

The seeds of *Prosopis africana* samples used for this research work were collected from Gwagwalada environ. The seeds were identified and authenticated at the Herbarium of Department of Crop Protection, University of Abuja, Gwagwalada, Nigeria, with a voucher number ULH 2021D.

Processing and extraction of *Prosopis africana* oil

The pods containing the seeds were broken to remove the seeds and shade dried for 13 days to obtain a constant weight after which it was grinded into a powder form using a laboratory blender (Pansonic, Model: 15GT-045F, Japan). Extraction of *Prosopis africana* oil was done using cold press machine (Model LYZX18). Cold press expeller is a new generation of low temperature screw oil expeller and is especially well suited for mechanical processing of seeds. It has a total power of 27.2 kW, boundary dimensions (3176 × 1850 × 2600 mm) and operates at low temperature (10 – 15 degrees). Grinded powder of *Prosopis africana* (2000g) was poured into the funnel (feeder) of the machine it then passes through the stainless valve which prevents the sample from contamination. The machine runs for 10 minutes and *Prosopis* oil (PAO) was collected via the squeeze cage (outlet) and stored in a clean well labeled container for further analysis.

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Pre-experimental activities

A battery cage measuring (length × width × height: 300 × 150 × 90 cm) was used for the experiment; distance between the base and the main cage is 35 cm. The pen and cages were swept, disinfected with Cid 2000 at 3 ml to 10 litres of water two weeks before the arrival of the birds. Cages were labeled for easy identification of each treatment group. Feed and plastic water troughs (5 litres each) used was properly washed; air dried and set in a place accessible to the birds. Old papers were spread on base of the galvanized cage to absorb litters and allow easy movement for birds. Foot bath was provided at the entrance of the pen to ensure proper biosecurity and a vaccination program was designed in accordance with the prevailing veterinary guidance in the area is presented in Table 1; 200 watts bulb was used in the cages to provide heat to the animals.

Management of birds, diets and experimental design

A total number of 540 one-day-old broiler chicks (Ross 308) weighing 45 ± 0.2 g were used for the experiment. Animals were sourced from a reputable commercial hatchery in Ibadan, Oyo State in Nigeria and transported to University of Abuja Teaching and Research Farm, Gwagwalada Abuja. Chicks were weighed on arrival and randomly divided into six treatments; each of the treatments had 6 replicates with 15 birds in a completely randomized design experimental model. Birds were given anti-stress (Vitalyte wsp® at the rate of 30 g to 100 litres of water) on arrival and kept under the same environmental conditions. The initial brooding temperature was 35°C; feed (starter and finisher) was formulated to meet the nutrient requirement of the birds is presented in Table 2. Feed and fresh clean water was provided *ad libitum*. Birds in treatment 1 (T1) was fed basal diet + 0 % antibiotics (negative control), T2: basal diet + 1.25 g of neomycin/kg feed (positive control), T3, T4, T5 and T6 were fed 100 mg, 200 mg, 300 mg and 400 mg of *Prosopis africana* oil /kg feed.

Variables accessed

Daily feed consumption was recorded as a difference between feed offered and left-over.

Feed intake (g) = feed offered – left over

Weight gain is the difference between final weights minus initial weight. This is expressed as:

Weight gain (g) = final weight (FW) – initial weight (IW)

Average daily gain was calculated as:

$$\text{Average daily gain (ADG)} = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Total days of the experiment}}$$

Feed to gain ratio was expressed as:

Feed conversion ratio (FCR) = feed intake (g)/weight gain (g)

Average daily feed intake (ADFI) was expressed as:

$$\text{ADFI (g)} = \frac{\text{Total feed intake}}{\text{Total days of the experiment}}$$

Analysis of *Prosopis oil* by GC-MS

Prosopis africana oil was subjected to GC-MS analysis on Varian product model 450 GC system equipped with the following features: carrier gas is helium with a column head pressure of 10 psi and a flow rate of 500 mL/min with maximum temperature ramp rate of 120 °C/minutes, injectors: 1079 PTV (Programmable Temperature Vaporizing) ChromatoProbe™. The GC column was RT-7ms, fused with a 5 % methyl poly siloxane stationary phase with an internal diameter of 0.2 mm, length of 20 mm and thickness of 0.2 μm with scan range of 50 – 2000 amu.

Identifications of the compounds in *Prosopis africana* oil were based on mass spectral matching with standard compounds in National Institute of Standard and Technology (NIST) having more than 62000 patterns is presented in Table 3.

Digestibility trial

Digestibility trial was carried out on the 56th day of the experiment; four birds were selected per treatment. The birds were housed in a galvanized wire cages (80 cm high × 50 cm width and 45 cm length) equipped with drinkers and feeders. Animals were kept

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under the same conditions; the trial lasted for 5 days during which they were fed a known quantity of feed, faeces was collected daily, contaminants were removed before the sample was dried and stored in a well labeled container. It was taken to the laboratory to determine its proximate components using methods outlined by AOAC (2000).

Chemical analysis

NIRS™ model DS 2500 was used to analyze the experimental diet. It has a dimension of 375 × 490 × 300 mm (w × d × h) of 27 kg, wavelength range 400 – 2500 nm, silicon (400 – 1100 nm) as detector, optical wavelength 8.75 ± 0.1 nm, spectral resolution (0.5 nm), photometric noise (400 – 2500 nm), wavelength accuracy < 0.005 nm and analysis time < 1minutes.

Statistical analysis

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (23.0) and significance means were separated using software of the same package. Significant was declared if $P \leq 0.05$.

Table 1: Vaccination schedule for the experimental animals

Day/Week	Vaccines	Route of administration
Day 5	1st ND Lasota	drinking water
Day 8	1st IBD Gumboro	drinking water
Day 15	2nd ND Lasota	drinking water
Day 19	2nd IBD Gumboro	drinking water

Table 2 Ingredient composition of the experimental diets

Ingredients	Starters mash (0-4 weeks)	Finishers mash (5-8 weeks)
Maize	52.00	60.00
Wheat offal	2.50	5.00
Soya bean meal	30.00	25.00
Groundnut cake	6.50	4.00
Fish meal (72%)	2.00	1.00
Limestone	2.00	1.50
Bone meal	4.00	4.00
Lysine	0.20	0.20
Methionine	0.20	0.20
*Premix	0.25	0.25
Salt	0.30	0.30
Toxin binder	0.10	0.10
Total	100.0	100.0
Calculated analysis (% DM)		
Crude protein	23.41	21.09
Crude fibre	4.18	5.01
Ether extract	4.03	4.47
Calcium	1.50	1.60
Phosphorus	0.58	0.66
Energy (Kcal/kg)	2900.8	3104.5

Premix supplied per kg diet: - vit A, 13,000 I.U; vit E, 5mg; vit D3, 3000I.U, vit K, 3mg; vit B2, 5.5mg; Niacin, 25mg; vit B12, 16mg; choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu, 2.6g; folic acid, 2mg; Fe, 5g; pantothenic acid, 10mg; biotin, 30.5g; antioxidant, 56mg (Starter)

**Premix supplied per kg diet: - vit A, 9,000 I.U; vit E, 10mg; vit D3, 1500I.U, vit K, 3.8mg; vit B2, 10 mg; Niacin, 15mg; vit B12, 10mg; choline chloride, 250mg; Mn, 5.0mg; Zn, 56mg; Cu, 1.6g; folic acid, 2.8mg; Fe, 5.1g; pantothenic acid, 10mg; biotin, 30.5g; antioxidant, 56mg (finisher)*

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3. RESULTS AND DISCUSSION

GC-MS analysis of *Prosopis africana* oil

Table 3 reveals the result on gas chromatography – mass spectrometry (GC-MS) of *Prosopis* oil. 18 bioactive chemicals were identified including: methylencedioxyl flavone (25.44 %), pentametoxyflavone (18.02 %), trimethyloxyflavone (20.10 %), tetramethyloxyflavone (11.58 %), patuletin (2.49 %), quercertin (0.11 %), luteolin (1.50 %), kaemperol (0.67 %), 3-nitropropanoic acid (0.77 %), isovitexin (1.35 %), Cis-(6αβ, 12αβ)-hydroxyrotenone (1.75 %), 12-Oleanen-13,11-dione (2.04 %), methyl 11-octadecenoate (1.71 %), prosopilosidine (0.45 %), pentane,1,3-epoxy-4methyl (3.93 %), ellagic acid (0.16 %), 9-octadecanoic acid (4.70 %) and hexadecanoic acid (2.23 %) respectively. Methylencedioxyl flavone, pentametoxyflavone, trimethyloxyflavone and tetramethyloxyflavone which are the major compounds in Prosopis oil are group of flavonoids have diverse physiological functions: antibacterial, anti-inflammatory and antioxidants which are capable of scavenging free radicals (Onyeka and Nwambekwe, 2007; Alagbe, 2021). The presence of prosopilosidine in the sample therefore supports its use as antimalarial, antimicrobial, antihypertensive and antioxidant properties (Sexena *et al*., 2013; Alagbe, 2021). The chemical constituents *Prosopis* oil allows them perform multiple biological roles: antibacterial (Thomas and Nahar, 2007), antifungal (Sofowora, 2008), anti-inflammatory (Vats *et al*., 2011), antiviral activity (Okigbo *et al*., 2008), anti-helminthic (Cowan, 2005) and antioxidant (Musa *et al*., 2020). Saker and Nahar (2009); Shittu and Alagbe (2020) reported that age of plants, method of processing, harvesting, geopgraphical location, genetic variation and antinutrients could influence the efficacy of bioactive compounds in plants. Sitosterol is a group of compound under steroids which have been reported to perform anti-inflammatory roles (Alagbe et al., 2019). Other compounds in *Prosopis africana* oil accessed during this experiment also performs several pharmacological roles and could be used as a natural alternative to antibiotics due to their safety and efficacy (Olafadehan et al., 2020b).

Table 3: GC-MS result of *Prosopis africana* oil

Compounds	Peak area (%)	Retention time
Methylencedioxyl flavone	25.44	5.33
Pentametoxyflavone	18.02	3.10
Trimethyloxyflavone	20.10	1.73
Tetramethyloxyflavone	11.58	5.70
Patuletin	2.49	11.21
Quercertin	0.11	9.60
Luteolin	1.50	9.12
Kaemperol	0.67	7.37
3-nitropropanoic acid	0.77	2.50
Isovitexin	1.35	4.57
Cis-(6αβ, 12αβ)-hydroxyrotenone	1.75	4.08
12-Oleanen-13,11-dione	2.04	11.39
Methyl 11-octadecenoate	1.71	9.06
Prosopilosidine	0.45	9.50
Pentane,1,3-epoxy-4methyl	3.93	9.02
Ellagic acid	0.16	10.55
Sitosterol	4.70	10.15
Hexadecanoic acid	2.23	8.80

Growth performance of broiler chicks fed different levels of *Prosopis africana*

Growth performance of broiler chicks fed different levels of *Prosopis africana* during the starter and finisher phase is presented in Table 4. Body weight gain (BWG), average daily body weight (ADWG), feed intake (FI), average daily feed intake (ADFI), feed conversion ratio (FCR) and mortality in the starter phase ranged from 836.19 – 1326.2 g, 30.00 – 47.36 g, 1400.2 – 1420.4 g, 50.00 – 50.73 g, 1.07 – 1.67 and 1.10 – 6.50 % respectively while in the finisher phase BWG (903.1 – 2340.6 g), ADWG (32.25 – 835.9 g), FI (3332.1 – 3458.0 g), ADFI (119.0 – 123.5 g), FCR (1.48 – 3.00) and mortality (1.00 – 2.50 %) respectively. During the starter phase (0-28 days) ADWG, FCR and mortality of birds fed *Prosopis africana* oil (T3, T4, T5 and T6) were similar ($P>0.05$) but differ significantly ($P<0.05$) from those in T1 and T2. Similarly during the finisher phase (29-56 days), BWG were highest in T3, T4, T5 and T6,

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intermediate in T2 and lowest in T1 ($P<0.05$). Highest mortality was recorded in T1 in both the starter and finisher phase (9.00 %) followed by T2 (3.00 %) and T3 (1.10 %) respectively ($P<0.05$). None was recorded in T3, T4, T5 and T6 ($P<0.05$). FI were not significantly different in all the phases ($P>0.05$). The variability in BWG could be attributed to the presence of bioactive compounds in *Prosopis africana* oil as stated in Table 3. According to Dhama et al. (2015); Stanacev et al. (2011), Alagbe (2017) and Rahimi et al. (2011) essential oil are capable of creating an ideal digestive and nutrient condition that inhibits non-beneficial bacteria and promotes the growth of beneficial bacteria. The bioactive compounds in *Prosopis* oil could also promote multiple biological activities (antimicrobial, antibacterial, antiviral, antifungal, hypolipidemic and antioxidant) and improved the BWG and FCR in T3, T4, T5 and T6. Flavonoids is the major in *Prosopis africana* oil and they act in plants as antioxidants, antimicrobials, anti-inflammatory, antioxidative, anti-carcinogenic and anti-mutagenic properties (Hossain et al., 2012; Lejeune et al., 2015 and Kim et al., 2015; Singh et al., 2021). Prosopis oil did not exert any effect on feed intake across the experimental animals in all the phases ($P>0.05$). This result is in agreement with the reports of Lee et al. (2011); Lee et al., 2013 but contrary to the findings of Adewale et al. (2021); Olafadehan et al. (2020b) when *Daniellia oliveri* extracts was fed to broiler chicks at 400 mL/ liter of water. Previous study by Acicek et al. (2003) revealed that the supplementation of clove essential oil at 100-200 mg/kg feed seems to improve growth performance and feed intake of birds. Similar report was obtained by Agoshni et al. (2012) confirms a significant increase in feed intake of birds fed diet supplemented with oregano oil at 300 mg/kg feed. The non-variation in feed intake recorded in this study could be attributed to differences in extraction methods of oil and specie of plant (Alagbe and Betty, 2019; Alagbe et al., 2018). The presence of phytochemicals in Prosopis oil could also explain the reasons why mortality was not recorded in birds fed T4, T5 and T6. This is in agreement with Lee et al. (2010); Kim et al. (2013) who reported that phytochemicals are capable of proliferating the immune cells, modulation of cytokines and increased antibody titres.

Table 4: Growth performance of broiler chicks fed different levels of *Prosopis africana* oil

Parameters	T1	T2	T3	T4	T5	T6	SEM
Starter (1-28 days)							
IBW (g)	45.10	44.93	45.00	44.88	45.03	45.11	0.14
FBW (g)	881.29^{c}	1010.2^{b}	1049.1^{b}	1300.2^{a}	1323.6^{a}	1371.3^{a}	28.40
BWG (g)	836.19^{b}	965.27^{b}	1004.1^{a}	1255.3^{a}	1278.6^{a}	1326.2^{a}	25.02
ADWG (g)	30.00^{b}	34.47^{b}	35.86^{b}	44.83^{a}	45.66^{a}	47.36^{a}	0.71
FI (g)	1400.2	1402.1	1405.3	1412.3	1418.7	1420.4	23.45
ADFI (g)	50.01	50.08	50.19	50.44	50.67	50.73	0.78
FCR	1.67^{a}	1.45^{b}	1.40^{b}	1.13^{c}	1.11^{c}	1.07^{c}	0.05
MOR (%)	6.50	2.00	1.10	-	-	-	0.02
Finisher (29-56 days)							
BWG (g)	903.1^{c}	1206.7^{b}	2001.6^{a}	2180.5^{a}	2300.1^{a}	2340.6^{a}	41.70
ADWG (g)	32.25^{c}	36.00^{b}	71.49^{a}	77.88^{a}	82.15^{a}	83.59^{a}	0.62
FI (g)	3332.1	3400.2	3420.5	3447.1	3452.1	3458.0	56.07
ADFI (g)	119.0	121.4	122.2	123.1	123.3	123.5	2.42
FCR	3.00^{a}	2.81^{a}	1.71^{b}	1.58^{b}	1.50^{b}	1.48^{c}	0.07
MOR (%)	2.50	1.00	-	-	-	-	0.02

Means within rows with different letters are significantly different ($p<0.05$); IBW: initial body weight; FBW: final body weight; BWG: body weight gain; ADWG: average daily weight gain; FI: feed intake; ADFI: average daily feed intake; FCR: feed conversion ratio; MOR: mortality; SEM: standard error of mean; T1: basal diet + 0 % *Prosopis africana* oil; T2: basal diet + 1.5g/kg neomycin; T3: basal diet + 100 mg PAO; T4: basal diet + 200 mg PAO; T5: basal diet + 300 mg PAO; T6: basal diet + 400 mg PAO

Nutrient digestibility of broiler chicks fed different levels of *Prosopis africana* oil

Nutrient digestibility of broiler chicks fed different levels of *Prosopis africana* oil is presented in Table 5. Dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and nitrogen free extract (NFE) composition ranged from 70.30 – 89.59 %, 66.58 – 78.85 %, 35.01 – 46.12 %, 49.10 – 69.30 % and 60.43 – 78.31 % respectively. All the values recorded in this study follow similar pattern as birds in T3, T4, T5 and T6 were significantly higher than those in T2 (intermediate) and lowest in T1 ($P<0.05$). The higher nutrient utilization in T3, T4, T5 and T6 could be attributed to the presence of phytochemicals or bioactive compounds (Table 5) in *Prosopis africana* oil which is capable of stimulating digestive enzymes activities and improving gastrointestinal morphology (Upadhaya et al., 2016; Alagbe et al., 2017). The result obtained in this experiment is in agreement with the findings of Emami et al. (2012) who observed a positive effect on nutrient digestibility of broiler chicks fed 200 mg/kg essential oil from peppermint. Similarly, Ahmed (2013) reported an increase in crude protein, ether extract digestibility in animals fed 0.0125 % oregano essential oil. The improvement in this nutrient (DM, CP, CF, EE and NFE) digestibility could be attributed to enhanced enzymatic activities (Janz et al., 2007; Olafadehan et al., 2020b).

Table 5: Nutrient digestibility of broiler chicks fed different levels of *Prosopis africana* oil

Components	T1	T2	T3	T4	T5	T6	SEM
Dry matter (%)	69.70^{c}	77.02^{b}	80.60^{a}	83.11^{a}	88.04^{a}	89.59^{a}	1.42
Crude protein (%)	66.58^{c}	69.12^{b}	71.57^{a}	75.51^{a}	76.50^{a}	78.85^{a}	0.91
Crude fibre (%)	35.01^{c}	37.02^{b}	40.16^{a}	42.95^{a}	45.09^{a}	46.12^{a}	0.05
Ether extract (%)	49.10^{bc}	55.67^{b}	60.80^{a}	65.73^{a}	67.01^{a}	69.30^{a}	0.03
NFE (%)	60.43^{b}	68.07^{b}	70.45^{a}	74.95^{a}	76.31^{a}	78.31^{a}	0.15

NFE: Nitrogen free extract; SEM: standard error of mean; T1: basal diet + 0 % *Prosopis africana* oil; T2: basal diet + 1.5g/kg neomycin; T3: basal diet + 100 mg PAO; T4: basal diet + 200 mg PAO; T5: basal diet + 300 mg PAO; T6: basal diet + 400 mg PAO

4. CONCLUSION

The medicinal value of *Prosopis africana* oil lies in its ability to produce phytochemicals or biocactive chemicals which are capable of performing several biological activities. The major bioactive compounds in the oil are prosogerins (A, B and C). The phytogenic inclusion of *Prosopis africana* oil at 400 mg/kg of feed had a significant impact on the average final weight as well as the nutrient utilization of the experimental birds when compared to the control. Higher feed conversion ratio and mortality was also recorded among birds fed oil. It can be concluded the inclusion of *Prosopis africana* oil had no negative effect on the performance of broiler chicks.

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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