PROSOPIS AFRICANA OIL: PHYTOCHEMICAL COMPOSITION AND EFFECTS ON THE CARCASS CHARACTERISTICS OF BROILER CHICKEN

[1]**Oluwafemi, R.A**., **Agubosi, O. C. P., Alagbe, O. J, Musah, R., Asiji, S. C., Sunday, M. C., Usmana, P.I., 2 Babuk, N.G and 2 Shaahu, D. T**

[1]*Department of Animal Science, Faculty of Agriculture, University of Abuja.*

[2]*Department of Animal Production, College of Animal Science,Joseph Sarwuan Tarka University, Makurdi*

Corresponding author: oluwafemi.adebisi@uniabuja.edu.ng

ABSTRACT

The use of phytogenic feed additives is constantly gaining interest globally due to risk pose by the indiscriminate use of antibiotics especially among livestock farmers in developing countries, leading to cases of antimicrobial resistance and residue of toxic substances in animal products (milk, egg and meat) which has also led to the increasing cases of diseases and deaths. This study was carried out to evaluate the effect of Prosopis africana oil as feed additive on the carcass and sensory charateristics of broiler chicken. Two hundred- and twenty-five-day-old (arbo acre) broiler chicks were sourced from reputable hatchery in Ibadan. The birds were randomly divided into five dietary treatments each with three replications of 15 chicks in a completely randomized design. Standard management procedures were strictly followed while feed and clean tap water were offered ad libitum throughout the period of the experiment which will lasted for 8 weeks. Dietary treatments were as follows: Treatment 1 (T1): Basal diet with no Prosopis africana oil; T2: Basal diet + 0.5% Prosopis oil while T3, T4, and T5 ~~w~~ith 0.6%, 0.7% and 0.8% Prosopis africana oil respectively. Phytochemical analysis revealed the presence of tannins (2.88%), flavonoids (5.07%), terpenoids (3.96%), alkaloids (1.60%), phenols (10.18%), steroids (2.57%) and oxalates (0.02%). All the carcass parameters evaluated (live weight, dressed weight, eviscerated weight, dressing, head, breast, thigh, drumsticks, wings, back, neck, spleen, heart, livers, gizzard and kidney) were significant (P<0.05) and positively influenced by the treatments. It was concluded that the dietary supplementation of Prosopis africana oil up to 0.8%g in broiler chickens could increase carcass quality as well as reduction of free radicals.

Keywords: Essential oil, *Prosopis africana* seed, broiler chickens, carcass characteristics.

INTRODUCTION

Agriculture continues to play significant roles in the livelihood and economic development of nations all over the world. In Nigeria, the sector is the largest employer of labour with the livestock subsector responsible for the supply of animal protein which is highly essential in human nutrition (Agubosi *et al.,* 2019). Poultry is the most abundant livestock species that account for more than 90% of the total bird's population of the world (Agubosi *et al*., 2019) and contributes significantly to income and employment among people of Africa. Among the poultry species, broiler is the most widely organic meat consumed and predicted to have increased consumers demand and production because it's a good source of protein with relatively high concentration of polyunsaturated fatty acids (Agubosi *et al*., 2022b).

The use of plant extract has been proven to help prevent the residual effect of synthetic chemicals, via the use of oil from plants known as Essential oils. Essential oils, also called volatile odoriferous oil, are aromatic oily liquids extracted from different parts of plants, for example, leaves, peels, barks, flowers, buds, seeds, and so on. They can be extracted from plant materials by several methods, steam distillation, expression, and so on. Among all methods, for example, steam distillation method has been widely used, especially for commercial scale production (Di Leo *et al.,* 2009).

The continuous and indiscriminate use of antibiotics has led to increasing cases of antimicrobial resistance and possible transmission of toxic residues into livestock products such as meat and eggs (Oluwafemi *et al*., 2021).. Among the potential alternatives used to replace antibiotics are: organic acids, prebiotics, probiotics and most recently essential oils (Zhaikai *et al.*, 2015). Essential oils contain several biological active chemicals (phytochemicals or secondary metabolites) with therapeutic properties required for growth of animals, suppression of pathogenic bacteria, improving palatability, scavenging free radicals, immune booster and efficient nutrient utilization (Baser and Demirci, 2007; Huang *et al*., 2010).. Among the potential plants loaded with several bioactive chemicals is *Prosopis africana* (African mesquite) seeds.. The present study was designed to evaluate the effect of *Prosopis africana* (African mesquite) oil as an alternative to antibiotic feed additives on carcass characteristics of broiler chicken.

MATERIALS AND METHODS

Experimental site

This study was carried out at the Department of Animal Science, 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 80 571 and 80 551N and longitude 70 051 and 70 061E (Balogun, 2001).

Collection of and processing of the test ingredient

Prosopis africana oil were purchased from a local market in Kano, it was identified at the department of biological sciences, University of Abuja, Nigeria ~~where a voucher number were assigned.~~ Extraction of the oil were carried out using stream distillation method technique using Clevenger apparatus. 250g of *Prosopis africana* were measured into a round bottom flask and heated for 75^{0C} for 30 minutes. Steam from the inter goes through a separatory funnel to obtain pure *Prosopis africana* oil.

Experimental birds and their managements

The experimental house and pen, watering and feeding troughs were thoroughly cleaned, disinfected and sprayed against external parasites before placing the chicks. Two hundred- and twenty-five-day-old (arbo acre) broiler chicks were sourced from reputable hatchery in Ibadan. The birds were randomly divided into five dietary treatments each with three replications of 15 chicks in a Completely Randomized Design (CRD). The chicks were brooded using 200W electric bulbs as source of heat. All routine vaccinations and necessary medications were administered to the birds. Feed and clean tap water were offered *ad libitum* throughout the experiment which will lasted for 8 weeks.

Feed formulation and Experimental set up

Basal feed was formulated to meet the nutrient requirements of broiler chicks according to NRC (1994).

Treatment 1: Basal diet + 0% *Prosopis africana* oil

Treatment 2: Basal diet + 600 mg/kg *Prosopis africana* oil

Treatment 3: Basal diet + 800 mg/kg *Prosopis africana* oil

Treatment 4: Basal diet + 1000 mg/kg *Prosopis*

africana oil-
Treatment 5: Basal diet + 1200 mg/kg *Prosopis africana* oil

Carcass characteristics

At the end of the 8th week, 3 birds were randomly selected per replicate of each treatment; they were feed fasted for about 12 hours to empty their crops for the experiment. They were slaughtered by cervical dislocation, allowed to bleed, scalded in warm water and de-feathered. The carcass weight, dressed weight, weight of the visceral organs and cut-up parts of the birds were taken using a sensitive electronic scale. Relative organ weights of the carcass were expressed as percentage of live weight according to "Modified Kosher" method as described by Abe *et al*., (1996), while the dressing percentage were calculated as follows.

$$\text{Dressing \%} = \frac{\text{Dressed weight}}{\text{Liveweight}} \times \frac{100}{1}$$

Statistical analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using the procedure of SPSS (23.0) and means were separated using Duncan Multiple Range Test of the same statistical package (Duncan, 1955).

Table 1. Gross compositionof the experimental diets

Components	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	23.50
Groundnut cake	8.00	4.00
Fish meal (72%)	2.00	2.00
Limestone	1.50	1.50
Bone meal	3.00	3.00
Lysine	0.20	0.20
Methionine	0.20	0.20
*Premix	0.25	0.25
Salt	0.30	0.30
Toxin binder	0.05	0.05
Total	100.0	100.0
Calculated analysis (%)		
Crude protein	23.30	21.40
Crude fibre	4.18	5.01
Ether extract	3.93	4.07
Calcium	1.50	1.60
Phosphorus	0.78	0.89
Energy (Kcal/kg)	2900.3	3100.8

**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's mash)*

***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's mash)*

Table 2 Phytochemical composition of *prosopis africana* oil

Parameters	Concentration (%)	Tolerable level (%)
Tannins	2.88	1.50 - 6062
Flavonoids	5.07	2.00 – 18.00
Terpenoids	3.96	1.52 – 10.00
Alkaloids	1.60	1.00 – 5.57
Phenols	10.18	2.00 – 16.00
Steroids	2.57	0.06 – 4.00
Oxalates	0.02	0.01 – 0.09

Research study 2023

Table 3 Carcass and organ characteristics of broiler chicken fed different levels of *prosopis africana* oil

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Live weight	1996.3^{c}	2300.0^{b}	2315.1^{b}	2400.2^{a}	2481.9^{a}	42.4
Dressed weight	1896.3^{c}	2189.3^{b}	2198.3^{b}	2300.1^{a}	2380.1^{a}	40.55
Eviscerated weight	1496.3^{b}	1789.3^{b}	1778.3^{b}	1870.1^{a}	1900.6^{a}	38.92
Dressing (%)	74.95^{b}	77.80^{a}	76.81^{a}	77.19^{a}	76.57^{a}	6.15
Head	58.10^{c}	61.33^{b}	61.91^{b}	64.02^{a}	65.00^{a}	5.06
Breast	566.3^{d}	615.7^{c}	655.9^{b}	680.1^{a}	685.7^{a}	11.2
Thigh	218.6^{c}	330.6^{b}	339.5^{b}	371.4^{a}	380.6^{a}	6.63
Drumsticks	196.5^{d}	225.1^{c}	246.0^{b}	266.3^{a}	271.2^{a}	5.02
Wings	200.2^{b}	291.6^{b}	308.5^{a}	311.5^{a}	323.7^{a}	4.95
Back	188.4^{c}	255.6^{b}	260.9^{b}	300.6^{a}	302.0^{a}	4.04
Neck	71.60^{d}	82.93^{c}	85.00^{b}	87.16^{a}	87.18^{a}	3.8
Spleen	0.01^{b}	1.22^{b}	1.20^{a}	1.21^{a}	1.20^{a}	0.01
Heart	10.80^{b}	10.92^{b}	12.05^{a}	12.11^{a}	12.80^{a}	0.06
Liver	20.15^{b}	28.02^{a}	28.40^{a}	28.42^{a}	28.45^{a}	0.08
Gizzard	30.92^{c}	41.65^{b}	42.06^{b}	42.11^{b}	45.00^{a}	0.05
Kidney	4.62^{c}	5.05^{b}	5.18^{a}	5.20^{a}	5.25^{a}	0.01

^{abc} *Means in the same row with different superscripts differ significantly (P<0.05)*
SEM: standard error of mean

RESULTS

Phytochemical composition of *prosopis africana* oil

The phytochemical composition of *prosopis africana* oil is presented in Table 2. Phytochemical analysis revealed the presence of tannins (2.88%), flavonoids (5.07%), terpenoids (3.96%), alkaloids (1.60%), phenols (10.18%), steroids (2.57%) and oxalates (0.02%) respectively. In order of abundance phenols > flavonoids > terpenoids > tannins > steroids > alkaloids > oxalates.

Carcass and organ characteristics of broiler chickens fed different levels of P*rosopis africana* oil

Carcass and organ characteristics of broiler chickens fed different level of P*rosopis africana* oil is presented in Table 3. The live weight, dressed weight, eviscerated weight, dressing, head, breast, thigh, drumsticks, wings, back, neck, spleen, heart, livers, gizzard and kidney values ranges between 2481.90 – 1996.30 g, 1896.30 – 2380.10 g, 1496.30 – 1900.60 g, 74.95 – 77.19%, 58.10– 65.00%, 566.30 – 685.70%, 218.60 – 380.60%, 196.50 – 271.20%, 200.20 – 323.70%, 188.40 – 302.20%, 71.60 – 87.18%, 0.01 – 1.20%, 10.80 – 12.80%, 20.15 – 20.45%, 30.92 – 45.00% and 4.62 – 5.25% respectively. All the parameters evaluated (live weight, dressed weight, eviscerated weight, dressing, head, breast, thigh, drumsticks, wings, back, neck, shank, heart, spleen, livers and gizzard) under this study were significantly ($P < 0.05$) different across the treatments.

DISCUSSION

The phytochemical composition of *Prosopis africana* oil (Table 2) reveals the presence of several bioactive chemicals or secondary metabolites that occur naturally in plants and are capable of promoting the health status of animals (Alagbe, 2019; Agubosi *et al*., 2022). According to Oluwafemi *et al*. (2021), phytochemicals also have therapeutic properties and are capable of performing multiple biological functions such as antibacterial, antiviral, anti-inflammatory, anti-helminthic, antidiuretic, antioxidants, antifungal, antispasmodic, immune-modulatory, neuro-protective, anti-inflammatory and neuroprotective functions (Adewale *et al*., 2021; Singh *et al*., 2021). The concentration of phytochemicals in plants are not the same for all species, it depends on the extraction method, storage condition, environmental factors, anti-nutrients, stage and age of plants, parts of plants used as well geographical origin (Adewale *et al*., 2021).

Phytochemicals have also been reported to be safe and effective without causing any negative effective on animals once administered in right doses and concentrations (Oluwafemi *et al*., 2021). For instance, Alkaloid exhibits cytotoxic and analgesic effects and also capable of inhibiting bacteria growth (Faizi *et al*., 2008; Agubosi *et al*., 2022). Tannins have been shown to possess antimicrobial and antibacterial activity (Oluwafemi *et al*., 2021). Phenols are strong antioxidants capable of scavenging free radicals, thus strengthening the immune system and preventing diseases (Shittu *et al*., 2021). Saponins inhibit the growth of gram positive and gram-negative bacteria and also performs antiprotozoal role (Alagbe and Oluwafemi, 2019). Flavonoids are used as adjuvants in vaccine production and have the ability to scavenge free radicals (Agubosi *et al*., 2022). Steroids play a vital role in fertility (Agubosi *et al*., 2022). However, all the phytochemical components in the test ingredient in this study

were within the safety level recommended for broiler chickens according to Alagbe and Oluwafemi (2019).

The carcass and organ characteristics of broiler chickens fed different levels of P*rosopis africana* oil is presented in Table 3. The live weight, dressed weight, eviscerated weight, dressing, head, breast, thigh, drumsticks, wings, back, neck, spleen, heart, livers, gizzard and kidney values ranges between 2481.90 – 1996.30 g, 1896.30 – 2380.10 g, 1496.30 – 1900.60 g, 74.95 – 77.19%, 58.10– 65.00%, 566.30 – 685.70%, 218.60 – 380.60%, 196.50 – 271.20%, 200.20 – 323.70%, 188.40 – 302.20%, 71.60 – 87.18%, 0.01 – 1.20%, 10.80 – 12.80%, 20.15 – 20.45%, 30.92 – 45.00% and 4.62 – 5.25% respectively. All the parameters were significantly different ($P< 0.05$) among the treatments. No noticeable inflammations were observed in the organs, which is an indication that anti-nutrients in *Prosopis africana* oil were below the thresh hold levels reported by Alagbe (2021). According to Alagbe (2017), presence of anti-nutritional factors is associated with enlargements of internal organs like liver, kidney, pancreas and spleen. According to Shittu *et al*. (2017) organ weight are influenced by age of birds, sex, breed as well as presence of toxic substance in feed (nutrition). However, the result obtained in this study confirmed the earliar reports of Soltan *et al*. (2008); Jamoz *et al*. (2003) who evaluated the influence of phytogenic extracts on performance, nutrient digestibility and carcass characteristics of broiler chickens. Again, the present finding is in agreement with report of Alagbe (2021) who evaluated the effect of *Prosopis africana* stem bark in broiler chicken diets. This finding also confirmed the report of Oluwafemi *et al*. (2021) who evaluated the effects of dietary inclusion of ginger (*Zingiber officinale*) and garlic (*Allium sativum*) oil mixtures on carcass characteristics and sensory evaluation of broiler chickens.

Conclusion

Essential oils are rich in phytochemicals or secondary metabolites which are potential sources of drugs and essential oils of therapeutic importance. Essential oils are cheap, safe, effective and easily available. Dietary inclusion of *Prospis africana* oil in broilers is capable of performing several pharmacological activities which includes: anti-inflammatory, antioxidant, cytotoxic, antimicrobial, hepato-protective, hypolipidemic, etc. In order to ensure food safety, increasing healthy poultry production to meet the growing demand globally and to also reduce the high cases of antibiotic resistance diagnosed in human and animals, the use of medicinal plants is highly recommended even as they are effective with no side effects.

REFERENCES

Adewale, A.O., Alagbe, J.O., Adeoye, Adekemi. O. (2021). Dietary Supplementation of Rauvolfia Vomitoria Root Extract as A Phytogenic Feed Additive in Growing Rabbit Diets: Haematology and serum biochemical indices. International Journal of Orange Technologies, 3(3): 1-12. 3

Alagbe, J.O and Oluwafemi, R.A. (2019). Performance and haematological parameters of broiler chicks gives different levels of dried lemon grass (Cymbopogon citratus) and garlic (Allium sativum) extract. Research in: Agricultural and Veterinary Sciences. 3(2): 102 – 111

Alagbe, J.O. (2017) effect of Miadasan as a dietary supplement on performance, carcass characteristic and blood profile of broiler chicken. Scholarly Journal of Agricultural Science, 7(2):27-33.

Alagbe, J.O. (2021). Prosopis africana Stem Bark as an alternative to antibiotic feed additives in broiler chicken diets: performance and carcass characteristics", Journal of Multidimensional Research and Review (JMRR), Vol.2, Iss.1, pp.64-77,

Agubosi, O.C.P., Wika, Bekitda Kiritmwa and Alagbe, J.O (2022a). Effect of dietary inclusion of sunflower (*Helianthus annus*) oil on the growth performance of broiler finisher chickens. *Texas Journal of Multidisciplinary* Studies; Volume 8

Alagbe, J.O. (2022). *Prosopis africana* (African mesquite) oil as an alternative to antibiotic feed additives on broiler chicken diets: haematology and serum biochemical indices. Central *Asian Journal of Theoretical and Applied Sciences* 3(2): 19-29.

Balogun, O. (2001). The Federal Capital Territory of Nigeria: A Geography of Its Development. University of Ibadan Press Limited.

Baser, K.H.C and Demirci, F. (2007). Chemistry of essential oils. Bioprocessing and Sustainability edited by Berger, RG, NewYork Springer. Pp 43-86.

Di Leo Lira, P., Retta, D., Tkacik, E., Ringuelet, J., Coussio, J. D., Baren, C. and Bandoni, A. L. (2009). Essential oil and by-products of distillation of bay leaves (Laurusnobilis L.) from Argentina. Industrial Crops and Products, 30: 259–264.

Duncan, D.B. (1955). Multiple range and multiple Ftests. Biometrics, 11:1-42.

Huang, Y., Yoo, J.S., Kim, H.J., Chen, Y.J and Cho, J.H. (2010). Effects of dietary supplementation with blended essential oil on growth performance, nutrient digestibility and blood profile in weaning pigs. Asian-Australian *Journal of Animal Science* 23: 607-613.

NRC, National Research Council (1994) Nutrient Requirement for Poultry (9th red) National Academy Press. Washington D. C, USA.

Oluwafemi, R.A., Uankhoba, I.P and Alagbe, J.O. (2021). Effects of turmeric oil as a dietary supplement on the growth performance and carcass characteristics of broiler chicken. *International Journal of Orange Technologies*, 3(4): 1-9.

Singh, A.S., Alagbe, J.O., Sharma, S., Oluwafemi, R.A and Agubosi, O.C.P. (2021). Effect of dietary supplementation of melon (Citrallus linatus) seed oil on the growth performance and antioxidant status of growing rabbits. Journal of Multidimensional Research and Reviews, 2(1): 78-95

Soltan, M.A., Shewita, R.S., El-Katcha, M.I. (2008). Effect of dietary anise seeds supplementation on growth performance, immune response, carcass traits and blood parameters of broiler chickens. International Journal of Poultry Science, 7: 1078-1088.

Zhaikai, Z., Sai, Zhang., Hongliang, W and Xiangshu, P. (2015). Essential oil and aromatic plants as feed additives in non-ruminant nutrition: a review. *Journal of Animal Nutrition and Biotechnology*: 6-7.