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EFFECT OF DIETARY SUPPLEMENTATION OF *MONOTHECA BUXIFOLIA* LEAF POWDER ON THE GROWTH PERFORMANCE OF BROILER CHICKENS

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Abstract. The aim of this study was to investigate the effect of dietary supplementation of *Monotheca buxifolia* leaf powder on the growth performance of broiler chickens. A total of 250 -1-day old broiler chicks (Ross 308) were randomly distributed into five treatments with five replicates and each replicate consists of ten birds. Prior to the arrival of birds, basal diet adequate in all nutrients was formulated according to the requirement of birds by Nutritional Research Council in 1994. Birds in treatment one was fed basal diet without *Monotheca buxifolia* leaf powder, those in treatment two, three, four and five were fed same diet with *Monotheca buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g respectively. The experiment lasted for 42 days and birds had unrestricted access to clean water and feed. A completely randomized experimental design was adopted and all management practices was strictly adhered to. Result on the phytochemical content of *Monotheca buxifolia* leaf powder flavonoids (863.2 mg/g), phenols (511.8 mg/g) and terpenoids (102.3 mg/g) were the most prominent compounds followed by saponins (72.56 mg/g), tannins (62.34 mg/g), alkaloids (41.88 mg/g) and steroids (30.41 mg/g). Average daily weight gain and average daily feed intake values which varied from 41.24 - 51.37 g/b and 103.7 - 107.5 g/b were higher among birds fed *Monotheca buxifolia* leaf powder (treatment two, three, four and five) relative to treatment one ($P<0.05$). Similarly, feed conversion ratio whose value ranged from 2.09 - 2.50 were significantly ($P<0.05$) influenced by the treatment. In conclusion, feeding broilers *Monotheca buxifolia* leaf powder up to 400 g/kg diet does not pose any detrimental effect on the performance of birds.

Keywords: *Monotheca buxifolia, phytochemicals, growth, performance, food safety, dose.*

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1. Introduction

Using antibiotics in sub therapeutic dosages was for a long time a general tool for the control of diseases, however, their misuse in animal husbandry has contributed to the development of multiple resistance of pathogens, deposit of drug residues in edible animal product and the environment and the potential transfer of antibiotic resistance to human pathogens has directed research towards alternative solutions such as the use of medicinal or herbal plants (Daniel, 2020; Peter, 2021). Plants are natural reservoir of medicinal agents almost free from the side effects normally caused by synthetic chemicals (Fennel *et al*., 2004). They also contain a wide variety of free radicals scavenging molecules including phenols, flavonoids, vitamins, terpenoids that are rich

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in antioxidant activity (Cai & Sun, 2003). Medicinal plants are known to contain phytochemicals which can be found in stems, roots, leaves, stem bark, flowers amongst others, possess numerous pharmacological properties, antimicrobial, anti-fungal, antioxidant, gastro-protective, cytotoxic, hypolipidemic, anti-nociceptive, antidiuretic, immune-stimulatory, anti-inflammatory and antiviral (Alagbe, 2023; John, 2024).

Monotheca buxifolia is one of the numerous underexplored medicinal plant belonging to the family Sapotaceae (Maryam *et al*., 2020). The plant is widely distributed in Pakistan, Afghanistan, Oman, Saudi Arabia and some parts of India (Ihsan *et al*., 2020). Extracts from the leaves, stem and roots of the plant can be used for the traditional treatment of digestive disorders, urinary tract disease, fever, sexually transmitted infections, diabetes, peptic ulcers, piles, yaws, dysmenorrhea, infertility and helminthic infections (Irfan *et al*., 2016; Jan *et al*., 2013). Uses of its root, root bark and bark of stem are extensive, particularly for their astringent, haemostatic, hypotensive, vulnerary and diaphoretic activities (Rehman *et al*., 2013). The leaves contain, flavonoids, terpenoids, glycosides, phenolic compound, tannins and anthraquinones at different concentrations which contributes to their several therapeutic or biological functions, anti-inflammatory, antioxidant, cytotoxic, phytotoxic, anti-pyretic, central nervous system depressant and hepato-protective (Ullah *et al*., 2016). This is possible because concentration of plant constituents of the same plant organ can vary from one geographical location to another depending on the age of the plant, differences in topographical factors, the nutrient concentrations of the soil, extraction method (Alagbe, 2023; Ojediran *et al*., 2024). Ethanolic and methanolic extracts from the leaves of *Monotheca buxifolia* possesses antimicrobial properties and have been reported to inhibit the activities of *Escherichia coli*, *Klebsiella spp*, *Salmonella spp* and *Staphyllococus spp* (Ullah *et al*., 2016).

Previous studies by notable researchers have shown that phytogenics exerts positive influence on the growth performance, immune response and microbial population in the gastrointestinal tract of birds (Oloruntola *et al*., 2016; Kanduri *et al*., 2013; Hashemi & Davoodi, 2010; Rabelo *et al*., 2003; Seidavi & Simoes, 2015). However, outcome of their findings have not been consistent, this could be due to differences in inclusion levels, specie of plant used as well as their chemical constituents (Adewale *et al*., 2021). There is little or no report on the effect of *Monotheca buxifolia* leaf powder on the growth performance of broiler chickens. This research is timely as it will help to address the increasing cases of antimicrobial resistance, provide optimum levels for birds and help to promote food safety.

2. Materials and methods

Experimental area

The experiment was carried out at the Poultry Section, Sumitra Research Institute, Gujarat, India between the month of January to March, 2023. The institute is located between 23º 13' N and 72º 41' E.

Collection and preparation of Monotheca buxifolia leaf powder

Freshly harvested leaves of *Monotheca buxifolia* were harvested from Orathur village in Kancheepuram district, India. The collected leaves were washed with running tap water and air dried in an open shade for 10 days after authentication at the department of taxonomy, Sumitra Resarch Institute, Gujarat and assigned a reference number (GB/056F/2023). The dried leaves were grounded into powder with electric

blender and packed into a labeled polythene bag before it was sent to the laboratory for further analysis.

Management of experimental animal and design

This study was carried out according to the guidelines of animal protocol approved by the Research and Ethics Committee of the department of Animal Nutrition and Biochemistry, Sumitra Research Institute, Gujarat, India. 250 - 1-day old broiler chick (Ross 308) mixed sex with an average initial body weight of 51.2 ± 0.02 g randomly distributed to five treatments with five replicates consisting of 10 birds each. Birds were reared in a battery cages equipped with nipple drinkers and manual feeders kept in a semi-closed pens. Prior to the arrival of bird's, battery cages were properly disinfected and a basal diet which is adequate in all nutrient was formulated according to Nutritional Research Council's guidelines (1994) for broilers. A completely randomized experimental design was adopted with birds in treatment 1 fed basal diet without *Monotheca buxifolia* leaf powder while those in treatment 2, 3, 4 and 5 were fed same diet with *Monotheca buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g/kg diet. Birds had unrestricted access to clean water and feed. Weight gain and feed intake were taken into consideration throughout the experiment which lasted for 42 days.

Determination of phytochemical contents in Monotheca buxifolia leaf powder

Quantification of flavonoids, alkaloids, saponins, steroids, tannins and terpenoids contents in *Monotheca buxifolia* leaf powder was carried out according to procedures recently published by Alagbe (2024). Each phyto-constituents were recorded at different optical densities using GC/MS Tripod (Model 821W-011J, China).

Proximate content of experimental diet

Proximate content of experimental diet was carried out using near infra- red automated kit (NIR -7000, USA) which uses SensorVu windows® based PC software. All operations were carried out according the manufacturers recommendation.

Statistical analysis

All the data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS version 25. The differences among the treatment means were determined ($P<0.05$) by Duncan multiple range test of the same software.

3. Results and discussion

Phytochemical content of *Monotheca buxifolia* leaf powder is presented in Table 2. Flavonoids had the highest concentration of 863.2 mg/g followed by phenols (511.8 mg/g), terpenoids (102.3 mg/g), saponins (72.56 mg/g), tannins (62.34 mg/g), alkaloids (41.88 mg/g) and steroids (30.41 mg/g). The presence of these phyto-constituents showed that *Monotheca buxifolia* leaf possesses several medicinal or pharmacological properties (Singh *et al*., 2022; John, 2024). Daniel et al. (2024); Adewale et al. (2021) reported that the concentration of phyto-constituents in medicinal plants are influenced by age of plant, geographical location, species, processing methods amongst others. Concentration of flavonoids and phenolic compound recorded in this study was higher than those reported for *Dysphania ambrosiodes* (2.29 mg/g, 15.24 mg/g) and *Crassocephalum crepidioides* leaves (1.62 mg/g, 13.07 mg/g) by Falowo et al. (2023). Phenols and flavonoids have been suggested to have antioxidant properties (Dhan *et al*., 2007) and these antioxidants exert their activity by scavenging the "free oxygen radicals" thereby giving rise to a fairly "stable radical". The free radicals are metastable chemical species, which tend to trap electrons from the molecules in the immediate

surroundings. These radicals if not scavenged effectively in time, they may damage crucial bio molecules like lipids, proteins including those present in all membranes, mitochondria and the DNA resulting in abnormalities leading to disease conditions (Uddin *et al*., 2008). Other properties include; antimicrobial (Dandan, 2009), anticacinogenesis (Aritra & Sumana, 2012), anti-inflammatory (Daljit & Gurinder, 2007), cardio-protective (Alagbe, 2024) and immune-stimulatory (Gupta *et al*., 2003). Saponins and terpenoids have been suggested to possess hypolipidemic and anticancer properties (Kris-Etherton *et al*., 2002). Alkaloids have pharmacological applications as analgesics, antimalarial and central nervous system stimulants (Madziga *et al*., 2010; John, 2024). The result obtained in this study is in agreement with the reports of Maryam et al. (2020); Ullah et al. (2016).

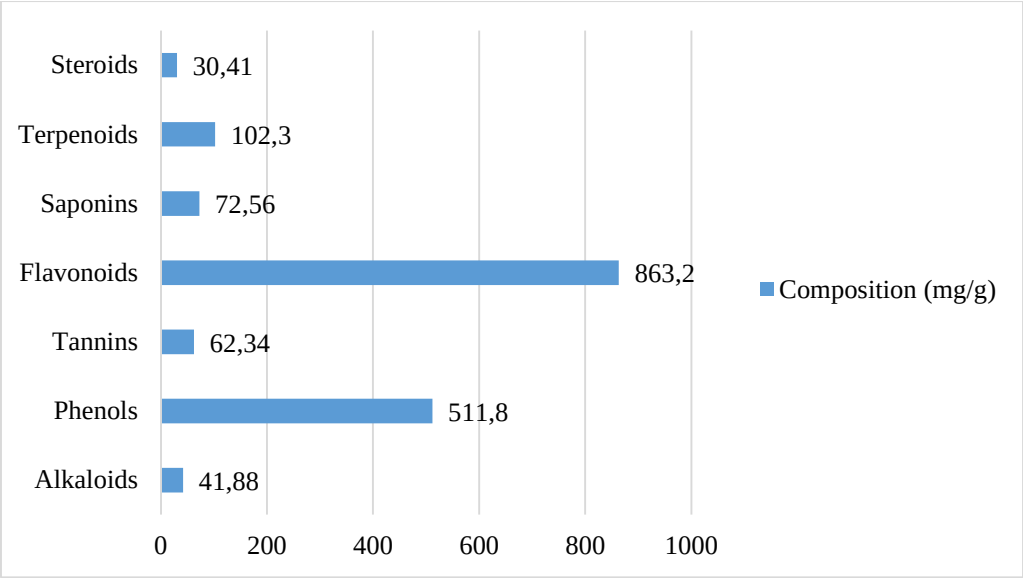
Table 1. Ingredient and chemical composition of experimental diet (as fed basis)

Ingredients	Starter mash (0-28 d)	Finishers mash (29 – 42 d)
Corn	50.00	52.00
Wheat bran	5.60	8.00
Soya bean	34.00	30.00
Fish meal	6.20	5.00
Di-calcium phosphate	2.50	3.00
Limestone	1.20	1.50
DL-methionine	0.25	0.20
Lysine	0.25	0.20
[1,2]*Mineral-vitamin premix	0.25	0.25
Salt	0.30	0.35
Total	100.0	100.0
Chemical composition		
Dry matter	91.29	91.04
Crude protein	23.04	21.22
Crude fibre	4.20	5.06
Ether extract	3.92	3.55
Methionine	0.50	0.62
Methionine +cysteine	0.92	0.98
Lysine	1.17	1.19
Ash	6.92	7.11
Calcium	1.43	1.61
Phosphorus	0.61	0.72
Metabolizable energy (kcal/kg)	2907.1	3204.8

[1]2.5 kg Mineral/vitamin premix for starter contains: Vit. A, 12000000 IU; Vit.D3 1800000 IU; Vit.E, 15000 mg; Vit.K3, 1000 mg; Vit.B1, 1200 mg; Vit.B2, 5100 mg; Vit. B6, 1500 mg; Vit.B12, 10mg; biotin, 50mg; pantothenic acid, 10000 mg; nicotinic acid, 30000 mg; folic acid, 1000 mg; choline chloride, 250000 mg; Mn, 60000 mg; Zn, 50000 mg; Fe, 30000 mg; Cu, 10000 mg; I, 1000 mg; Se, 100mg; Co, 100mg

[2]2.5 kg Mineral/vitamin premix for finisher contains: Vit. A, 12000000 IU; Vit.D3 2000000 IU; Vit.E, 10000 mg; Vit.K3, 2000 mg; Vit.B1, 1000 mg; Vit.B2, 5000 mg; Vit. B6, 1500 mg; Vit.B12, 10mg; biotin, 50mg; pantothenic acid, 10000 mg; nicotinic acid, 30000 mg; folic acid, 1000 mg; choline chloride, 250000 mg; Mn, 60000 mg; Zn, 50000 mg; Fe, 30000 mg; Cu, 10000 mg; I, 1000 mg; Se, 100mg; Co, 100 mg

Table 2. Phytochemical content of *Monotheca buxifolia* leaf powder



Effect of *Monotheca buxifolia* leaf powder on the growth performance of broiler chicken is presented in Table 3. Average daily weight gain, average daily feed intake and feed conversion ratio were significantly ($P<0.05$) influenced by the treatments. Birds fed *Monotheca buxifolia* leaf powder had higher values compared to the control in T1 ($P<0.05$). Results obtained suggests that *Monotheca buxifolia* leaf powder was able to modulate the activities of digestive enzymes thus leading to efficient nutrient utilization among birds. This action is triggered by the presence of phytochemicals in the test ingredient (*Monotheca buxifolia* leaf) (Omokore & Alagbe, 2019; Agubosi *et al*., 2022). Outcome also suggests that *Monotheca buxifolia* leaf possess antibacterial properties thus preventing dysbiosis which could also translate to a better feed conversion ratio in birds (Musa *et al*., 2021). The average daily weight gain range observed in this study with the dietary supplementation of *Monotheca buxifolia* leaf powder 41.24 - 51.37 g/b was similar to the result of a study by John (2024), Alagbe (2019) who discovered that average daily weight gains of broilers fed *Rhamnus prinoides* leaf extract varied from 40.08 - 55.71 g/b. The result was higher than those presented by Agubosi et al. (2021) when sunflower oil was supplemented in the diet of broiler chicken at 0.3 %. Findings of this study on average daily feed intake (103.1 - 107.5 g/b) were lower than 81.18 - 82.30 g/b reported by Oloruntola et al. (2021); Kholoud et al. (2021) when phyto-additives were fed to broiler chickens but similar to 99.60 - 114.8 g/b recorded by Al-Mufarrej et al. (2019) when clove powder was supplemented in the diet of broilers. Feed conversion ratio values which varied from 2.09 - 2.50 was similar to the results of a study by Dibaji et al. (2014) who found that feed conversion ratio of broilers fed symbiotic ranged from 2.00 - 2.20. This result was lower than those reported by Goliomytis et al. (2014) when quercetin was fed to broiler chickens.

Table 3. Effect of *Monotheca buxifolia* leaf powder on the growth performance of broiler chicken

Variables	T1	T2	T3	T4	T5	SEM
Number of birds per treatment	50.00	50.00	50.00	50.00	50.00	-
Duration of experiment (days)	42.00	42.00	42.00	42.00	42.00	-
Initial body weight (g/bird)	51.2	51.22	51.03	51	51.01	0.01
Final body weight (g/bird)	1783.1	2206.7	2207.5	2208.3	2208.5	61.82
[1]Weight gain (g/bird)	1731.9	2155.4	2156.5	2157.3	2157.5	58.07
[2]Average daily weight gain (g/bird)	41.24	51.33	51.34	51.36	51.37	0.02
[3]Total feed intake (g/bird)	4328.7	4506.7	4511.2	4513.2	4515.1	91.14
[4]Average daily feed intake (g/bird)	103.1	107.3	107.4	107.5	107.5	0.05
[5]Feed conversion ratio	2.50	2.09	2.09	2.09	2.09	0.01

Means on the same row having different superscripts are significantly different (P<0.05); SEM: standard error of mean; T1: basal diet without *Monotheca buxifolia* leaf powder; T2, T3, T4 and T5: basal diet supplemented with *Monotheca buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g per kg diet respectively. [1]Final body weight – initial body weight ;[2]Average daily weight gain /42 days ;[3]Feed served – left over; [4]Total feed intake/42 days; [5]Average daily feed intake/average daily weight gain.

4. Conclusion

In conclusion, *Monotheca buxifolia* leaf powder contains several phyto-constituents with medicinal value with flavonoids, phenols and terpenoids dominating as major bioactive compounds. This compounds performs multiple biological activities such as, anti-inflammatory, anti-pyretic, antioxidant, antifungal, cytotoxic, gastro-protective, immuno-stimulatory functions amongst others. Dietary supplementation of *Monotheca buxifolia* leaf powder to broilers up to 400 g/kg diet had no negative effect on their growth performance.

References

Adewale, A.O., Alagbe, J.O. & Adeoye, A.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.

Agubosi, O.C.P., Alexander, J. & Alagbe, J.O. (2022). Influence of dietary inclusion of Sunflower (Helianthus annus) oil on growth performance and oxidative status of broiler chicks. *Central Asian Journal of Medical and Natural Sciences, 2*(7), 187-195.

Agubosi, O.C.P., Soliu, M.B. & Alagbe, J.O. (2022). Effect of dietary inclusion levels of *Moringa oleifera* oil on the growth performance and nutrient retention of broiler starter chicks. *Central Asian Journal of Theoretical and Applied Sciences*, *3*(3), 30-39.

Alagbe, J.O. (2019). Growth response and bacteria count of broiler starter given *Delonix regia* leaf extract as a natural alternative to antibiotics. *Food and Nutrition: Current Research*, *2*(3), 197 – 203.

Alagbe, J.O. (2024). Clerodendron splendens leaf extract supplementation in weaner rabbits: Impact on growth performance, haematology and intestinal microbial population. *Cerrado: Agricultural and Biological Research*, *1*(1), 21-31.

Alagbe, J.O. (2024). Effect of coconut shell extract on the growth performance and some haemato-biochemical parameters of broiler chicken. *Brazilian Journal of Science*, *3*(6), 82-95.

Alagbe, J.O. (2024). Effect on performance, serum biochemistry and haematological

components of feeding Japanese quails phytogenic feed additions comprising Megaphrynium macrostachyum leaves. *Brazilian Journal of Science, 3*(5), 51-64.

Alagbe, J.O. (2024). Growth performance, haemato-biochemical indices of broiler chicken fed Aristolochia indica as a phytogenic feed additive. *Cerrado: Agricultural and Biological Research*, *1*(1), 42-53.

Alagbe, J.O. (2024). Impact of dietary supplementation of Rhamnus prinoides leaf extract on the growth performance, nutrient retention and intestinal microbial count of Japanese quails. *Brazilian Journal of Science*, *3*(5), 40-50.

Alagbe, J.O., Adejumo, D.O., Ademola, S.G., Abiola, A.O., Samson, B.O. & Ushie, F.T. (2021). Productive performance, caeca microbial population and immune-modulatory activity of broiler chicks fed different levels Sida acuta leaf extract in replacement of antibiotics. *Bioinformatics and Proteomics Open Access Journal, 5*(1), 000143.

Alagbe, J.O., Shittu, M.D. & Tanimomo, B.K. (2022). Influence of *Anogeissusleio carpus* stem bark on the fatty acid composition in meat of broiler chickens. *European Journal of Life Safety and Stability*, *14*(22), 13-22.

Alagbe, J.O., Shittu, M.D., Adesina, A.Y., Grace, C.J., Cincinsoko, K.M., Oluwafemi, B.S. & Erikanobong, E. (2024). The approximate mineral and phytochemical content of the leaves, stem bark and roots of Pterocarpus erinaceus in India. *Cerrado: Agricultural and Biological Research*, *1*(1), 32-41.

Alagbe, J.O., Shittu, M.D., Ramalan, S.N., Tanimomo, K.B. & Adekunle, D.A. (2022). Growth performance, semen quality characteristics and hormonal profile of male rabbit bucks fed *Rubia cordifolia* root extracts. *International Journal of Biological Engineering and Agriculture, 1*(1), 1-13.

Alagbe, O.J. (2024). Novel phytogenics' impact on weaned pigs growth performance, haematology and serum biochemical indicators. *Black Sea Journal of Agriculture*, *7*(2), 82-89.

Al-Mufarrej, S.I., Qaid, M.M., Fazea, E.H. & Al-Baadani, H.A.B. (2019). Effects of clove powder supplementation on performance, blood biochemistry and immune responses in broiler chickens. *South African Journal of Animal Science*, *49*(5), 835-844.

Arora, D.S., Kaur, G.J. (2007). Antibacterial activity of some Indian medicinal plants. *Journal of Natural Medicines*, 61, 313-317.

Bashir, M., Alagbe, J.O., Betty, A.M. & Omokore, E.A. (2020). Growth Performance, caeca microbial population and immune response of starter broiler chicks fed aqueous extract of Balanites aegyptiaca and Alchornea cordifolia stem bark mixture. *United Journal for Research and Technology*, *2*(2), 13-21.

Cai, Y.Z., Sun, M. (2003). Antioxidant activity of betalins from plants of the Amaranthacea. *Journal of Agriculture and Food Chemistry,* 51, 2288-2294.

Chatterjee, A., Chatterjee, S. (2012). Proximate analysis, phyto-chemical screening and anti-inflammatory activity of Coccinia indica. *International Journal of Pharmaceutical Chemical Biological Sciences, 2*(3), 299-304.

Daniel, M. (2020). Synergistic effect of bioactive herbal extracts in gut stabilization. *International Poultry Magazine, 2*(3), 5-7.

Dibaji, S.M., Seidavi, A., Asadpour, L. & da Silva, F.M. (2014). Effect of a synbiotic on the intestinal microflora of chickens. *Journal of Applied Poultry Research, 23*(1), 1-6.

Falowo, A.B., Oloruntola, O.D. & Akinmoladun, O.F. (2023). Assessment of nutritional composition and antioxidant properties of Dysphania ambrosioides (L.) mosyakin & clemants and Crassocephalum crepidioides Leaf meal as potential feed additives. *Turkish Journal of Agriculture-Food Science and Technology*, *11*(2), 274-279.

Goliomytis, M., Tsoureki, D., Simitzis, P.E., Charismiadou, M.A., Hager-Theodorides, A.L. & Deligeorgis, S.G. (2014). The effects of quercetin dietary supplementation on broiler growth performance, meat quality and oxidative stability. *Poultry Science, 93*(8), 1957-1962.

Gupta, M., Mazumder, U.K., Sambath, K.R. & Siva, K.T. (2003). Studies on anti-inflammatory, analgesic and antipyretic properties of methanol extract of Caesalpinia bonducella leaves in experimental animal models. *Iranian Journal of Pharmacology and Therapeutics*, 2, 30.

Hashemi, S.R., Davoodi, H. (2010). Phytogenics as new class of feed additive in poultry industry. *Journal of Animal and Veterinary Advances*, 9, 2295-9304.

Irfan, U., Jamshaid, A.K., Muhammad, S., Ajmal, K., Achyut, A., Peer, A.H., Ibrahim, J., Faisal, S. & Umar, K. (2016). Pharmacological screening of Monotheca buxifolia (Falc.) A. DC. for antinociceptive, anti-inflammatory and antipyretic activities. *BMC Complementary and Alternative Medicine, 16*(273).

Jan, S., Khan, M.R., Rashid, U. & Bokhari, J. (2013). Assessment of antioxidant potential, total phenolics and flavonoids of different solvent fractions of Monotheca buxifolia fruit. *Osong Public Health and Research Perspectives*, *4*(5), 246-254.

Khan, I., Ali, J.S., Ul-Haq, I. & Zia, M. (2020). Biological and phytochemicals properties of Monotheca buxifolia: An unexplored medicinal plant. *Pharmaceutical Chemistry Journal*, 54, 293-301.

Kholoud, O.A., Intisar, Y.K. & Mohammed, A. (2021). Effect of supplemented graded levels of clove extracts on broiler chick's performance. *Journal of Animal Sciences and Livestock Production, 5*(4), 8812.

Kris-Etherton, P.M., Hecker, K.D., Bonanome, A., Coval, S.M., Binkoski, A.E., Hilpert, K.F. & Etherton, T.D. (2002). Bioactive compounds in foods: Their role in the prevention of cardiovascular disease and cancer. *The American Journal of Medicine*, *113*(9), 71-88.

Kuete, V., Tangmouo, J.G., Beng, V.P., Ngounou, F.N. & Lontsi, D. (2006). Antimicrobial activity of the methanolic extract from the stem bark of Tridesmostemon omphalocarpoides (Sapotaceae). *Journal of Ethnopharmacology*, *104*(1-2), 5-11.

Liu, D., Hu, Z., Liu, Z., Yang, B., Tu, W. & Li, L. (2009). Chemical composition and antimicrobial activity of essential oil isolated from the cultured mycelia of Ganoderma japonicum. *Journal of Nanjing Medical University*, *23*(3), 168-172.

Madziga, H.A., Sanni, S. & Sandabe, U.K. (2010). Phytochemical and elemental analysis of Acalypha wilkesiana leaf. *Journal of American Science*, *6*(11), 510-514.

Nnadozie Anorue, D., Ubong, F. & Alagbe, O.J. (2023). Investigating the effects of pawpaw (*Carica papaya*) essential oil dietary supplementation on the growth performance and carcass characteristics of broilers. *Research in: Agricultural and Veterinary Sciences*, *7*(3), 164-174.

Ojediran, T.K., Alagbe, O.J., Victor, D. & Adewale, E. (2024). Analysis of Kigelia africana (Lam.) Benth. fruit powder's antioxidant and phytochemical properties. *Brazilian Journal of Science*, *3*(7), 38-49.

Ojediran, T.K., Emiola, I.A., Durojave, V. & Alagbe, J.O. (2024). Proximate, vitamin and GC-MS profiling of Kigelia africana fruit powder. *Cerrado: Agricultural and Biological Research*, *1*(1), 13-20.

Oloruntola, O.D., Adu, O.A., Gbore, F.A., Falowo, A.B. & Olarotimi, O.J. (2021). Performance of broiler chicken fed diets supplemented with Irvingia gabonensis kernel powder and Ocimum gratissimum leaf powder. *Slovak Journal of Animal Science*, *54*(1), 7-20.

Omokore, E.O., Alagbe, J.O. (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.

Peter, K. (2021). In-feed probiotic versus sub-therapeutic antibiotics. *International Pig Magazine, 5*(2), 3-4.

Prakash, D., Suri, S., Upadhyay, G. & Singh, B.N. (2007). Total phenol, antioxidant and free radical scavenging activities of some medicinal plants. *International Journal of Food Sciences and Nutrition*, *58*(1), 18-28.

Rabelo, M., Souza, E.P., Soares, P.M., Miranda, A.V., Matos, F.J. & Criddle, D.N. (2003).

Antinociceptive properties of the essential oil of Ocimum gratissimum L. (Labiatae) in mice. *Brazilian Journal of Medical and Biological Research*, 36, 521-524.

Rehman, J., Khan, I.U., Farid, S., Kamal, S. & Aslam, N. (2013). Phytochemical screening and evaluation of in-vitro antioxidant potential of Monotheca buxifolia. *E3 Journal of Biotechnology and Pharmaceutical Research*, *4*(4), 54-60.

Seidavi, A., Simoes, J. (2015). Evaluation of dietary fish oil plus green tea supplementation on the gizzard, ileum and cecum microflora in broiler chickens. *Archivos de Zootecnia*, 64, 397-402.

Sharma, S., John, A.O., Xing, L., Ram, S. & Amita, K. (2022). Comparative analysis of ethanolic Juniperus thurifera leaf, stem bark and root extract using gas chromatography and mass spectrometry. *International Journal of Agriculture and Animal Production*, *2*(6), 18-27.

Uddin, S.N., Akond, M.A., Mubassara, S. & Yesmin, M.N. (2008). Antioxidant and Antibacterial activities of Trema cannabina. *Middle-East Journal of Scientific Research*, *3*(2), 105-108.

Ullah, I., Khan, J.A., Adhikari, A. & Shahid, M. (2016). Hepatoprotective effect of Monotheca buxifolia fruit against antitubercular drugs-induced hepatotoxicity in rats. *Bangladesh Journal of Pharmacology*, *11*(1), 248-256.

Ullah, I., Khan, J.A., Adhikari, A., Khan, A., Hannan, P.A., Wadood, A. & Farooq, U. (2016). Bioassay-guided isolation of new urease inhibitory constituents from Monotheca buxifolia (Falc.) fruit and their molecular docking studies. *Records of Natural Products*, *10*(6), 744.