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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.

Key Words: *Monotheca buxifolia, phytochemicals, growth, performance, food safety, dose*

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 in antioxidant activity (Cai and 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 and Davoodi, 2010; Rabelo et al., 2003; Seidavi and 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.

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.

Results and discussion

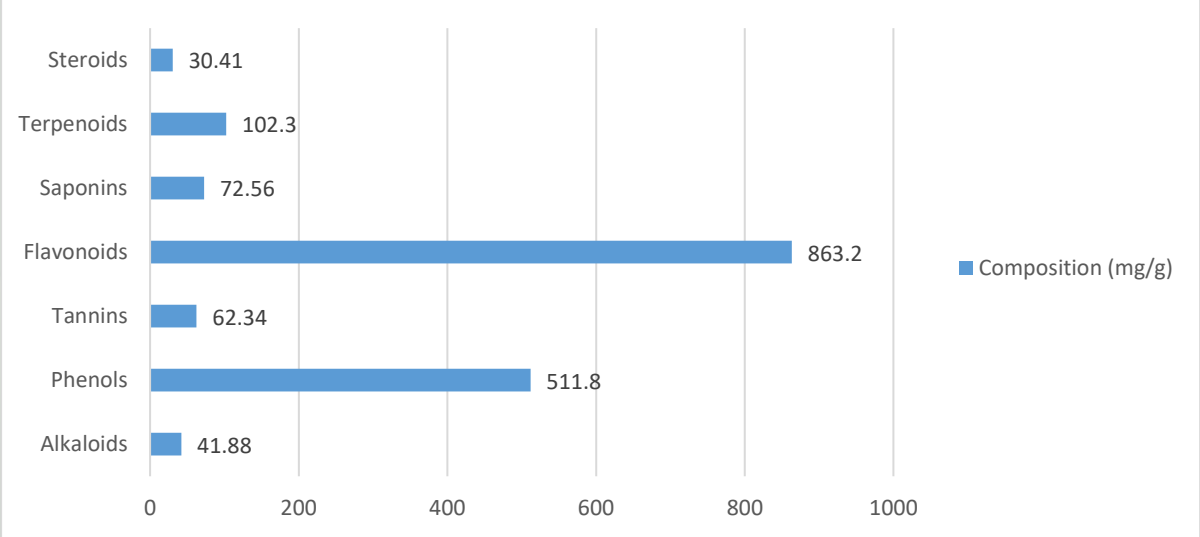
Phytochemical content of *Monotheca buxifolia* leaf powder is presented in Table 2. Flavonoids had the highest concentration of 863.2 mg/g followed by phenols (511.8 mg/g), terpenoids (102.3 mg/g), saponins (72.56 mg/g), tannins (62.34 mg/g), alkaloids (41.88 mg/g) and steroids (30.41 mg/g). The presence 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".

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



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 and Sumana, 2012), anti-inflammatory (Daljit and 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).

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 and 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.

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.

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