AJBS Asian Journal of Biological Sciences

OPEN ACCESS

Effect of *Costus afer* Extract on Serum Mineral, Biochemical, Haematological Indices and Carcass Characteristics of Broiler Chickens

Azodo Lilian, Uzoma Chinenye, Nduka Christiana, Irelen Terry and Olabode Adeyemi
Federal College of Agriculture, ishiagu, Ebonyi State, Nigeria

ABSTRACT

Background and Objective: The use of the extract in poultry production has gained recognition over the years, especially in broiler birds. Extracts are part of phytogenic plant materials which have been used over the years. Extracts of plants could either be from the leaf, bark or stem of plants. The objective of this research is to determine the influence of *Costus afer* extract (leaf and stem) on serum mineral, biochemical, haematological indices and carcass characteristics of broiler chickens. **Materials and Methods:** A total of 120 unsexed, 7 day old broiler chicks were randomly assigned to four treatments, each replicated thrice, in a completely randomized design. Bush cane leaves and stems, sourced from Anambra State, were washed, dried and ground into powder for extract preparation. The extract was administered at inclusion levels of 0, 5, 10 and 15 mL/L across treatments. Data were analyzed using ANOVA, with significant differences determined by Duncan's multiple range test at a 5% significance level. **Results:** The study revealed that *Costus afer* extract significantly influenced serum calcium, potassium levels and carcass traits in broiler chickens. Treatment 4 showed the highest live weight (3646.67 g) and carcass weight (3446.67 g), while the highest calcium level (9.31 mg/dL) was observed in treatment 2. Packed cell volume, eosinophil and cholesterol levels varied significantly across treatments, while red blood cell, triglyceride, sodium and back muscle values showed no significant differences. **Conclusion:** It can be concluded that the inclusion of *Costus afer* extract up to the level of 15 mL/L can be tolerated by the birds, without any detrimental effects on the bird's immune system as there was no record of mortality throughout the research period.

KEYWORDS

Serum mineral, serum biochemistry, hematology, carcass evaluation, *Costus afer*, broiler chickens, extracts

INTRODUCTION

Restrictions on the use of synthetic growth promoters in animal nutrition worldwide have triggered great interest of livestock producers in the use of alternative sources most of which are currently plant-based. And these include such as phytogenic feed additives, phytobiotics etc[1]. Phytogenic feed additives are plant-based products (e.g. extracts, dried plant materials, essential oil, pure isolated compounds) usually plant metabolites as active principles[2]. Most of the active secondary plant metabolite belongs to classes of flavonoids, isoprene derivatives and glucosinolates; a large amount of which have been used

ISSN: 1996-3351 (Print)
https://doi.org/10.3923/ajbs.2025.406.411

Received: 04 Oct. 2024
Accepted: 20 Jan. 2025
Published: 30 Jun. 2025

as antioxidants and antibiotics in livestock production[3]. In the current nutrition of farm animals, phytochemicals and phytogenic feed additives are been used as replacements for antibiotic growth promoters and as a source of anabolic compounds that enhance growth and immune stability in animals[4]. Useful herbs such as lemongrass, garlic, ginger, black pepper, alchemy, etc have been reported to improve the performance of various species of livestock throughout time[1]. Some of these phytochemicals have been proved through different research works to possess anti-microbial properties, increase the immune system and promote the release of natural chemicals that attack tumor cells[4]. The use of phytogenic plant materials in ethnomedicine application and performance improvement in broiler chicken has also been reported by notable authorities[5]. However, it has been observed and reported that the use of phytochemicals as feed additives or supplements could cause major deviations from normal physiological state and reflect in the haemological indices of the animals if not properly used at the right level and dosage of inclusion in livestock nutrition[1].

Costus afer is a special plant from the Zingiberaceae family, which is a tall and perennial herbaceous, unbranched creeping plant (up to 4 m) commonly found in West African countries like Nigeria, Ghana and Cameroun. It is primarily known as 'ginger lily' or 'bush cane', '*Okpete*' by Igbo, *'Kakizawa'* by Hausa, *'Tete-egun'* by Yoruba and *'Mberitem'* in Efik[6]. *C. afer* is mostly used indigenously, because of its nutrient and therapeutic constituents, which entails the use of some of the plant parts in food preparation[7]. The chemical composition of different parts of *Costus afer* reveals the presence of macro- and micronutrients. The leaves and stems are rich in essential nutrients such as carbohydrates, crude protein, fat, ash, moisture and a good source of fiber. Other studies have observed the presence of some quantity of multivitamins in the leaves[8]. The phytochemical examination of some parts of this plant shows the presence of alkaloids, phenols, saponins, triterpenes, tannins and glycosides in different solvents[9]. The phytochemicals and nutritional compositions contained in the plant usually justify the nutraceutical use of the plant. A study on the chemical identification and isolation of bioactive compounds from *C. afer* in recent times has also been reported[7]. This study evaluated the impact of *Costus afer* extract on serum mineral levels, biochemical parameters, hematological indices and carcass characteristics in broiler chickens.

MATERIALS AND METHODS

Experimental site: The study was carried out at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Chukwuemeka Odumegwu Ojukwu University (COOU), Igbariam, Anambra State of Nigeria from June to July, 2022.

Source and processing of *Costus afer* extract: The bush cane leaves and stem were sourced from Amuwo, Amesi, Aguata L. G. A. Anambra State. The leaves and stems were duly processed via washing to remove debris and then spread out on a mat for 2 hrs to drain properly under room temperature. The leaves and stems were then air-dried in a well-ventilated and clean room, this was to avoid the loss of some important components when exposed to sunlight, especially vitamin C. The processed materials were then ground into fine particles using a hammer mill. The extract was thereafter prepared from the ground leaves and stem by squeezing with the cloth. The product is stored in a plastic container and kept in the fridge until needed for use.

Experimental design and management of birds: The (120), unsexed 7 days old, broiler chicks were procured from Delight Integrated Farms Limited Imo State, Nigeria. The birds were randomly assigned to four treatment groups of *Costus afer* leaves and stem extract (CALSE) in a completely randomized design (CRD) experiment. Each of these treatment groups was replicated thrice with ten birds in each of the replicas. The birds were kept for one week for acclimatization before being given the experimental treatments. The home erogenous CALSE was administered at inclusion levels of 0, 5, 10 and 15 mL/L of drinking water for T_1, T_2, T_3 and T_4, respectively. Feed and treated drinking water were given *ad libitum*.

Table 1: Experimental diets

Parameter	Starter	Finisher
Nutrient content of fame feed		
Metabolizable energy (Kcal/kg)	2900.00	3200.00
Crude protein (%)	22.00	24.00
Fibre (%)	3.00	7.10
Cystine	0.80	0.11
Phosphorus	0.50	0.8
Fat (%)	5.00	8.0

Table 2: Proximate composition of *Costus afer* extract

Parameter (%)	Percentage (%)
Dry matter	2.84
Moisture	97.16
Ash	0.12
Crude protein	2.50
Ether extract	0.00
Crude fiber	0.00
Nitrogen free extract	0.22

Blood samples (4 mL) were collected from two birds per replicate on the last day of the study through a marginal wing web vein using the sterilized syringe. The assessment haematological parameters and serum biochemical indices was done[10]. The 2 mL was collected from the marginal wing web vein of the birds into a labeled sterile universal bottle containing 1.0 mg/mL ethyldiaminetetracetic acid (EDTA) for hematological analysis. Another 2 mL was collected into the anti-coagulant-free bottle for determination of the serum biochemistry parameters. The blood sample was allowed to clot at room temperature and the serum was separated by centrifuging within three hours of collection. Nutrient content and proximate composition of *Costus afer* extract are given in Table 1 and 2.

Statistical analysis: Data collected were subjected to Analysis of Variance (ANOVA) and significantly different means were separated according to the method of Duncan's multiple range test at a 5% significant level.

Ethical consideration: The research posed no risk or injury to the birds as there were no zoonotic occurrences throughout the research work and the level of morbidity was at its minimum.

RESULTS AND DISCUSSION

The results of broiler chickens administered with *Costus afer* extract on serum biochemical and hematological indices were presented in Table 3. A packed cell value of 29.93% was highest in treatment 4. The lowest value of 26.17% was observed in treatment 2 which differs from those obtained in treatment 1 with 28.47% respectively. Higher values of packed cell volume obtained in treatments 3 and 4 could be due to the impact of the extract on the birds in those treatments. It could suggest that the bioactive nutrients and phytochemicals embedded therein were able to support increased and improved levels of blood volume (which is usually made up of red blood cells). This in turn improves the immune system of the broiler chickens. This work was similar to the work carried out by Nwokocha *et al.*[11] where they reported improvement in the packed cell volume when *Costus afer* and *Boerhavia diffusa* were mixed in the ground and administered to broiler birds. Data obtained for red blood cells had values that did not differ across the treatment group with values of 2.66×10^6/µL observed in both treatments I and 2, while treatments 3 and 4 had values of 2.81×10^6/µL and 2.83×10^6/µL. The influence of the extract was notable in the higher levels of red blood cells in the treatments fortified with *Costus afer* the extract. Values obtained were within the standard range[12]. White blood cell had a superior value of 47.50×10^3/µL in treatment 1, which was significantly different from the value of 38.17×10^3/cells/µL observed for white blood cells in treatment 4, the lowest value obtained for white blood cells. White blood cell values in treatments 2 and 3 were similar with values of 43.17×10^3/µL and 41.83×10^3/µL, respectively. The

Table 3: Effect of *Costus afer* extracts on haematological and serum biochemical indices of broiler chickens

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Packed cell volume (%)	28.47^{ab}	26.17^{b}	29.93^{a}	29.83^{a}	0.62
Haemoglobin (g/dL)	8.47^{ab}	6.17^{b}	9.93^{a}	9.83^{a}	0.23
Red blood cell (x10^{6}/µL)	2.66	2.66	2.81	2.83	0.04
White blood cell (x10^{3}/µL)	47.50^{a}	43.17^{b}	41.83^{b}	38.17^{c}	1.95
Total protein (g/L)	33.74^{b}	33.27^{b}	36.38^{a}	36.64^{a}	0.77
Albumin (g/L)	26.08	25.07	26.48	26.66	0.26
Globulin (g/L)	7.66^{c}	8.20^{b}	9.89^{a}	10.98^{a}	0.88
Creatinine (mg/dL)	0.66^{a}	0.58^{b}	0.64^{a}	0.55^{b}	0.03
Urea (mg/ dL)	21.20	21.07	20.12	21.07	0.70
Total cholesterol (mg/dL)	156.95^{a}	142.42^{b}	143.40^{b}	143.26^{b}	3.09

^{abc}Means on the same row with different superscripts are significantly (p<0.05) different and SEM: Standard Error of Mean

Table 4: Serum mineral indices of broiler chickens administered with *Costus afer* extract

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Calcium (mg/dL)	9.02^{a}	9.31^{a}	9.15^{a}	8.69^{b}	0.18
Phosphorus (mg/dL)	10.85	10.01	10.37	9.81	0.31
Sodium (mmol/L)	136.87	131.57	135.48	135.95	40.92
Chloride (mmol/L)	97.73	99.18	102.18	101.29	29.40
Potassium (mmol/L)	3.31^{b}	3.38^{b}	3.25^{b}	4.14^{a}	0.15

^{ab}Means on the same row with different superscripts are significantly (p<0.05) different and SEM: Standard Error of Mean

Table 5: Carcass characteristics of broiler chickens administered with *Costus afer* extract

	Treatments				
Parameter	T1	T2	T3	T4	SEM
Liveweight (g)	2346.67^{d}	2923.33^{c}	3273.33^{b}	3646.67^{a}	147.01
Carcass weight (g)	2173.33^{d}	2750.00^{c}	3096.67^{b}	3446.67^{a}	144.12
Dressed weight (%)	92.61^{b}	94.07^{a}	94.60^{a}	94.52^{a}	12.53
Thigh (%)	29.14^{a}	23.49^{b}	21.92^{b}	19.21^{b}	6.53
Breast muscle (%)	18.68^{a}	17.01^{a}	15.53^{b}	14.18^{b}	2.20
Back muscle (%)	13.81	11.02	12.82	11.51	2.04
Wing (%)	9.63^{a}	7.86^{b}	7.36^{b}	7.65^{b}	1.68
Drumstick (%)	15.14^{a}	12.60^{b}	12.19^{b}	11.46^{b}	3.21

^{abcd}Means on the same row with different superscripts are significantly (p<0.05) different and SEM: Standard Error of Mean

low level of white blood cells in treatments administered with *Costus afer* extract suggests the immune stability and status of the birds when compared with that of the control treatment. A high level of white blood cells could suggest a problem shooting in the system of the birds[12]. Serum biochemical indices results are presented in Table 3. Results showed that total protein was higher in treatment 4 with 36.64 g/L, which did not differ from those obtained in treatment 3 (36.38 g/L). The lowest value of 33.27 g/L was obtained in treatment 2 which was not significantly different from the value of 33.74 g/L observed in treatment 1. Higher values of total protein reported in treatments 3 and 4 could be due to the ability of the birds in those groups to optimize the protein content in the diet to their advantage[13]. Albumin values were not significantly affected by the test ingredients across the treatment groups studied. Albumin values of 26.08, 25.07, 26.48 and 26.66 g/L were recorded for birds in treatments 1, 2, 3 and 4, respectively. Superior values of 0.66 and 0.64 mg/dL were observed for creatinine in treatments 1 and 3, respectively, which differ from the values of 0.58 mg/dL and the least value of 0.55 mg/dL, which were by themselves similar to each other. Data obtained for total cholesterol was highest in treatment 1 with 156.95 mg/dL, while the least value of 142.42 mg/dL was seen in treatment 2 with 142.42 mg/dL. Birds in treatments 3 and 4 had similar total cholesterol values of 143.40 and 143.26 mg/dL, respectively. It was observed that treatments given *Costus afer* extract had lower values of total cholesterol compared to the control. This is similar to the report of Agu *et al.*[14] where they observed low cholesterol value in treatments fortified with phytogenic herbs.

Results for serum mineral of broiler chickens administered *Costus afer* were presented in Table 3. Data obtained showed that calcium had a superior value of 9.13 mg/dL in treatment 2, which was not significantly different from the values of 9.02 and 9.15 mg/dL obtained in treatments 1 and 3. The lowest value of 8.69 was seen in treatment 4, respectively. Values obtained for phosphorus were not significantly influenced across the treatment group. Phosphorus values of 10.85, 10.01, 10.37 and 9.81 mg/dL were obtained in treatments 1, 2, 3 and 4, respectively. Sodium and chloride had similar values across the groups studied. Superior value of 4.14 mmol/L was obtained in treatment 4 for potassium, which differed from the least value of 3.25 mmol/L observed in treatment 3, which did not differ from the value of 3.31 and 3.38 mmol/L observed in treatments 1 and 2, respectively.

Table 4 displayed the results of carcass characteristics of broiler chickens administered with *Costus afer* extract. Live weight value was superior in treatment 4 with 3646.67 g, while the least value of 2346.67 g was obtained in treatment 1. Treatments 2 and 3 had values of 2923.33 and 3273.33 g which were by themselves different from each other. Higher values of overweight obtained in treatments administered with *Costus afer* extract could suggest the positive impact of bio-nutrient and phytochemicals in the *Costus afer* on the birds in those treatments which indirectly improved the weight of the birds, especially in treatment 4. Carcass weight followed a similar trend to that of the live weight with treatment 4 having the highest value of 3446.67 g, followed by those of 3096.67 g observed in treatment 3. The least value of 2173.33 g was obtained in treatment 1 which differed significantly from that of 2750.00 g observed in treatment 2, respectively. Values obtained for dressed weight were significantly higher in treatments administered with *Costus afer* extract. Data obtained for dressed weight in treatments 2, 3 and 4 did not differ from each other with a value of 94.07, 94.60 and 94.52%, while the lowest value for dressed weight was observed in treatment 1 with a value of 92.61%. Breast muscle was highest in treatment 1 with a value of 18.68% which was followed closely by 17.01% in treatment 2, with the least in treatment 4 (14.18%). A superior value of 15.14% was obtained for drumstick in treatment 1, while the lowest value was observed in treatment 4 with 11.46%, which did not differ from the value of 12.60 and 12.19% seen in treatments 2 and 3, respectively.

CONCLUSION

It can be concluded that *Costus afer* extract administered in broiler chickens is possible up to the level of 15 mL/L of drinking water without any deficiencies or negative effects on the serum mineral and carcass characteristics as obtained in the results of the present study. This can be justified by observing that the parameters values obtained in the present study were within the normal standard range for broiler birds and the values reported for carcass cut parts, especially the prime cuts were better in treatments administered with the *Costus afer* extract.

SIGNIFICANCE STATEMENT

It can be stated categorically that the study focuses on the effect of *Costus afer* extract on the blood profile (hematological and serum biochemical indices) of broiler chickens. The study revealed the possibility and potential of *Costus afer* extract in improving the immune system of the birds thereby reducing the incidence of diseases and deaths in the overall flocks. The study further opens up the channel of usage of the extract in other poultry birds such as Turkey, layers, geese, duck etc to check if there could also be positive impact therewith.

REFERENCE

1. Olabode, A.D., M. Amos and C.E. Nduka, 2023. Impact of phytobiotics on growth performance and cost analysis of starter broiler birds. Acta Sci. Vet. Sci., 5: 100-103.
2. Nduka, C.E., U.H. Ukpabi, A.D. Olabode and E. Eli, 2023. Impact of *Tetrapleura tetraptera* fruit meal on the growth performance and economic evaluation of laying chickens. J. Anim. Sci. Vet. Med., 8: 99-103.

3. Azodo, L.N., A.J. Bamidele, T.U. Irelen, C. Uzoma, A.D. Olabode and A.O. Aniebo, 2023. Impact of ginger lily (*Costus afer*) extract on the growth performance and cost benefit analysis of finisher broiler birds. J. Anim. Sci. Vet. Med., 8: 95-98.
4. Olabode, A.D., L. Azodo, O.E. Okelola, N.A. Olorunfumilola and P. Onyishi, 2022. Growth response and cost benefit analysis of starter broiler birds fed supplemental levels of black plum leaf meal (A case study in Ishiagu, Ivo Local Government Area of Ebonyi State). Int. J. Environ. Agric. Res., 8: 38-41.
5. Mishael, A., O.A. David, N. Christiana and O. Noah, 2024. Effect of black plum leaf meal on the growth performance characteristics, cost benefit evaluation and serum biochemical indices of finisher broiler birds. Curr. Res. Poult. Sci., 14: 10-15.
6. Anaga, A.O., C.J. Njoku, E.S. Ekejiuba, M.N. Esiaka and I.U. Asuzu, 2004. Investigations of the methanolic leaf extract of *Costus afer*. Ker for pharmacological activities *in vitro* and *in vivo*. Phytomedicine, 11: 242-248.
7. Anyasor, G.N., K.O. Ogunwenmo, O.A. Oyelana and B.E. Akpofunure, 2010. Phytochemical constituents and antioxidant activities of aqueous and methanol stem extracts of *Costus afer* Ker Gawl. (Costaceae). Afr. J. Biotechnol., 9: 4880-4884.
8. Ekpe, I.P., E.O. Udosen and D. Amaechi, 2018. Evaluation of some vitamins and macro-nutrients composition of ethanolic extract of *Tecoma stans* and *Costus afer* leaves. Int. J. Biochem. Res. Rev., Vol. 23. 10.9734/IJBCRR/2018/44554.
9. Akpan, M.M., C.S. Odeomena, C.N. Nwachukwu and B. Danladi, 2012. Antimicrobial assessment of ethanolic extract of *Costus afer* leaves. Asian J. Plant Sci. Res., 2: 335-341.
10. Jiwuba, P.C., I.P. Ogbuewu and K. Nwachukwuguru, 2018. Performance and economy of production of broilers fed Siam weed (*Chromolaena odorata*) leaf meal (SWLM). Trop. Anim. Health Prod., 50: 1305-1311.
11. Nwokocha, J.V., N.J. Nwokocha, O. Ogbuji, C.I. Ukpabi and M.S. Egere, 2013. Studies on the effect of the combination of *Boerhavia diffusa* and *Costus afer* leaf extracts on the haematological parameters of broiler chickens. Int. J. Acad. Res. Progressive Educ. Dev., 2: 135-145.
12. David, O.A., N. Christiana, O.O. Emmanuel, O. Noah and A. Chibuzo, 2024. Growth performance and haematological profile of broiler chickens fed graded levels of lemon grass leaf meal. Curr. Res. Poult. Sci., 14: 21-26.
13. Ogbonna, C.G., A.O. Akintunde, O.M. Dupe, A.O. Arinola and N.O.L. Chidinma *et al*., 2017. Carcass and performance characteristics of broiler chickens fed with *Cymbopogon citratus* leaf meal as alternative to Mycotoxin binder. Int. J. Agric. Sci. Res., 6: 18-23.
14. Agu, C.I., C. Uzoma, O.E. Okelola, A.D. Olabode and V. Ebiaku, 2021. Influence of supplemental levels of turmeric meal (*Curcuma longa*) on the growth performance and serum biochemistry indices of finisher broiler birds (A case study in Ishiagu, Ivo, Lga of Ebonyi State, Nigeria). Int. J. Agric. Biosci., 10: 229-232.