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Effects of *Cyperus articulatus* (*Kajiji*) Aqueous Extract on Broiler Blood Parameters

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Abstract

The study was conducted at Federal Polytechnic, Bauchi Poultry Teaching and Research Farm. The experiment employed a Completely Randomized Design (CRD). The 12 birds were randomly assigned to four (4) treatment groups, with 3 birds per treatment and each bird serving as a replicate. Results showed that PCV values ranged from 28.73% ± 1.50% (T3) to 32.33% ± 2.02% (T4). All values fell within the normal reference range. Albumin values ranged from 1.70 ± 0.17 g/dL (T3) to 1.87 ± 0.12 g/dL (T4). T2 and T3 (80-180 g/L) showed significantly higher globulin than T1 and T4, T1 (40 g/L) and T4 (control) showed similar globulin levels. The elevated globulin in T2 and T3 parallels the elevated WBC in these groups.

Keywords: Hematology, Albumin, Total Protein, Biochemical value.

Introduction

Background of the Study

The cost of conventional feed ingredients constitutes a major constraint to poultry production in developing nations, often accounting for 60-70% of total production costs. This economic pressure has driven researchers to explore alternative, locally available feed additives and growth promoters. One such promising plant is *Cyperus articulatus*, commonly known as *Kajiji* (in Hausa) or jointed flatsedge. This sedge plant is abundant in the wetlands and savannah regions of West Africa, particularly within the Southern Guinea Savannah zone where Bauchi, Nigeria is located *Cyperus articulatus* is traditionally valued for its medicinal properties, including anti-inflammatory, anti-

microbial, and antioxidant activities, attributed to its rich phytochemical composition of alkaloids, flavonoids, tannins, and essential oils. While widely used in ethnoveterinary medicine, its potential as a natural feed additive in broiler production, particularly at the finisher stage (where growth efficiency and carcass quality are paramount), remains largely underexplored. There is a critical need to scientifically validate the effects of this plant on the physiological status and overall health of broiler chickens.

Problem Statement

The poultry industry in Nigeria faces the dual challenge of high input costs and increasing consumer demand for safe, antibiotic-free poultry products. Sub-therapeutic antibiotic use as growth promoters is being phased out globally due to concerns over antimicrobial resistance. *Cyperus articulatus* presents a potential natural alternative; however, its safety and efficacy as a feed additive are not well-documented beyond anecdotal evidence. Notably, there is a lack of empirical data on its hematological and biochemical effects in broiler finishers. Hematological indices (e.g., red blood cell counts, hemoglobin) and biochemical parameters (e.g., serum proteins, cholesterol, liver enzymes) are critical indicators of an animal's health status, stress levels, and metabolic efficiency. Without this data, farmers cannot safely optimize inclusion levels for maximum productivity without risking physiological harm.

Research Objectives

- To determine the hematological parameters (PCV, Hb, RBC, WBC counts) of broiler finishers fed varying levels of *Cyperus articulatus*.
- To evaluate the serum biochemical profile (total protein, albumin, globulin, cholesterol, liver enzymes) of the experimental birds.
- To identify the optimal inclusion level of *Cyperus articulatus* in water that supports normal physiological function without adverse effects.

This research will provide baseline data on the physiological safety of *Cyperus articulatus* as a natural feed additive for broilers. The findings will benefit smallholder farmers by offering a low-cost, locally-sourced alternative to synthetic drugs and growth promoters. Furthermore, it will contribute to the academic literature on phytogenic feed additives in the context of Nigerian poultry production systems.

MATERIALS AND METHODS

The study was conducted at Federal Polytechnic, Bauchi Poultry Teaching and Research Farm. The area is tropical wet and dry climate with mean annual temperatures of 25–35°C and annual rainfall of 800–1200 mm]. The predominant poultry management system is extensive scavenging, with birds allowed to roam freely during the day and housed in simple shelters at night.

Experimental Design and Treatment Groups

The experiment employed a Completely Randomized Design (CRD). The 12 birds were randomly assigned to four (4) treatment groups, with 3 birds per treatment and each bird serving as a replicate. This ensured adequate sample size for hematological analysis. The treatments were defined by the level of *Cyperus articulatus* (Kajiji) powder dissolved in drinking water as follows:

Table 1: Composition of *Cyperus articulatus* (Kajiji) powder dissolved in drinking water

Treatment	Inclusion Rate (Cyperus articulatus : Water)	Feed Regime
T1	40 g in 1 liter of water	Commercial Finisher *ad libitum*
T2	80 g in 1 liter of water	Commercial Finisher *ad libitum*
T3	120 g in 1 liter of water	Commercial Finisher *ad libitum*
T4 (Control)	0 g (Clean water only)	Commercial Finisher *ad libitum*

Preparation of Cyperus articulatus (Kajiji)

Fresh *Cyperus articulatus* rhizomes were harvested from the wild, washed to remove soil, and air-dried under shade for 7 days. The dried rhizomes were milled into a fine powder using a laboratory hammer mill. The calculated amount of powder (40g, 80g, or 120g) was mixed with1 liter of potable water and stirred vigorously before being provided to the birds in each treatment group.

Management of Experimental Birds

Housing: Birds were housed in separate, well-ventilated pens within the same house to ensure uniform environmental conditions. All groups received the same commercial broiler finisher feed (crude protein: 20%, ME: 2900 Kcal/kg) *ad libitum* throughout the experimental period (finisher phase, approximately 4 weeks).

Health Management: All birds were vaccinated according to a standard schedule: Additionally, a broad-spectrum antibiotic and coccidiostat were administered prophylactically during the first week as per standard farm protocol.

Water: Water (with or without *Cyperus articulatus* according to treatment) was provided *ad libitum*.

Blood Sample Collection

At the end of the 4-week feeding trial (16 birds, 4 per treatment), 4 birds per treatment (randomly selected) were fasted for 12 hours. Blood samples (5 ml) were collected via the brachial wing vein: For hematology,2 ml was collected into EDTA-coated tubes to prevent clotting. Biochemistry test was conducted by collecting 3 ml of blood into plain (non-coated) tubes and allowed to clot. Serum was separated by centrifugation at 3000 rpm for 10 minutes and stored at -20°C for later analysis.

Hematological Indices

Whole blood samples were analyzed within 2 hours of collection. Parameters measured included:

- **Red Blood Cell (RBC) Count** ($\times 10^{12}$/L)
- **White Blood Cell (WBC) Count** ($\times 10^{9}$/L)
- **Packed Cell Volume (PCV)** (%)
- **Hemoglobin (Hb) Concentration** (g/dL)
- **Differential WBC Count** (Lymphocytes, Heterophils, Monocytes)

Serum Biochemical Parameters

Serum samples were analyzed using a semi-auto analyzer. Parameters included:

- **Total Protein (g/dL)**
- **Albumin (g/dL)**
- **Globulin (g/dL)** (Calculated: Total Protein – Albumin)
- **Cholesterol (mg/dL)**

Statistical Analysis

All data collected were subjected to **one-way Analysis of Variance (ANOVA)** using SPSS software

RESULTS AND DISCUSSION

PCV values ranged from 28.73% ± 1.50% (T3) to 32.33% ± 2.02% (T4). All values fell within the normal reference range of 22% to 35% reported for broiler chickens (Kongpechr et al., 2021; Miah et al., 2026). The lack of significant difference suggests that *Cyperus articulatus* extract at all tested concentrations (40, 80, and 180 g/L) did not adversely affect erythrocyte production or cause hemolysis. This observation aligns with studies evaluating herbal feed additives where PCV remained within normal ranges without significant treatment effects (Milewski et al., 2025).

Table 2. Effects of *Cyperus articulatus* Aqueous Extract on Broiler Blood Parameters

Treatment (n=3)	PVC (mean±SD)	HB (g/dL) (mean±SD)	RBC (x10^6/µL) (mean±SD)	WBC (x10^3/µL) (mean±SD)	Lymphocytes (%) (mean±SD)	Monocytes (%) (mean±SD)
1	29.67 ± 0.58	11.50 ± 0.00 ^{ab}	10.87 ± 13.97 ###	13.13 ± 0.12 ^{a}	42.67 ± 30.98 ^{ns}	5.67 ± 0.29 ^{b}
2	31.36 ± 1.18	9.40 ± 0.00 ^{c}	3.13 ± 0.12 ^{ns}	26.67 ± 0.58 ^{c}	46.17 ± 5.49 ^{ns}	3.67 ± 0.58 ^{a}
3	28.73 ± 1.50	10.80 ± 0.17 ^{bc}	2.67 ± 0.58 ^{ns}	26.73 ± 0.23 ^{c}	46.50 ± 0.00 ^{ns}	8.76 ± 0.21 ^{c}
4	32.33 ± 2.02	11.87 ± 0.75 ^{a}	2.75 ± 0.00 ^{ns}	18.13 ± 0.98 ^{b}	56.62 ± 0.38 ^{ns}	8.33 ± 0.58 ^{c}
p-value	0.076 ^{ns}	**0.013**	0.565 ^{ns}	**<0.001**	0.618 ^{ns}	**0.001**

Notes: Superscript letters (a, b, c): Different letters within a column indicate a statistically significant difference ($p < 0.05$) between the treatment groups based on the Games-Howell post-hoc test. **KEY:** PCV= Pack Cell Volume, HB= Hemoglobin, RBC=Red Blood Cell, WBC=White Blood Cell

The control group (T4) showed the highest Hb concentration (11.87 ± 0.75 g/dL), which was significantly higher than T2 (9.40 ± 0.00 g/dL) and T3 (10.80 ± 0.17 g/dL), *p* < .05. T1 (11.50 ± 0.00 g/dL) was comparable to T4.

The significantly lower Hb in T2 (80 g/L) is concerning, suggesting that this concentration may impair erythropoiesis or cause hemolytic effects. This finding contradicts a recent meta-analysis by Hayat et al. (2025), which reported that plant nutraceutical extracts significantly increase hemoglobin concentrations in broilers, 0.45, 95% CI [0.28, 0.62]. The decreased Hb at 80 g/L may indicate a toxic or stressful effect of *Cyperus articulatus* at this concentration. Studies on phytogenic feed additives have demonstrated that certain herbal supplements can positively modulate hematological indices without adverse effects (Rafeeq et al., 2023).

RBC values for T2 (3.13 ± 0.12 × 10^6/µL), T3 (2.67 ± 0.58 × 10^6/µL), and T4 (2.75 ± 0.00 × 10^6/µL) were within the normal range of 1.42 to 2.79 × 10^6/µL for broilers (Kongpechr et al., 2021). However, T1 showed an exceptionally high mean RBC (10.87 ± 13.97 × 10^6/µL). All WBC values exceeded the typical reference range of 0.94 to 13.60 × 10^3/µL (Kongpechr et al., 2021), indicating leukocytosis in all groups. The highest WBC counts were observed in T2 (80 g/L) and T3 (180 g/L), both approximately double the control (T4) and triple T1.

T2 and T3 (80-180 g/L) caused marked leukocytosis, suggesting a strong immunostimulatory or inflammatory response. This pattern may indicate that *Cyperus articulatus* at higher doses activates the immune system, potentially through stimulation of cytokine production or as a stress response (Wideman and Pevzner, 2012). Research has shown that stress can significantly alter leukocyte

dynamics in broilers (Miah et al., 2026). T1 (40 g/L). ymphocyte percentages ranged from 42.67% ± 30.98% (T1) to 56.62% ± 0.38% (T4). The large standard deviation in T1 indicates high individual variation.

The values fall within the low-normal range (47.2% to 85.0%) reported for broilers (Miah et al., 2026). The lack of significant differences suggests that *Cyperus articulatus* did not differentially affect lymphocyte proportions. However, the elevated WBC counts with normal lymphocyte percentages suggest heterophilia is driving the leukocytosis, which is a common stress response in poultry (Miah et al., 2026). The heterophil-to-lymphocyte (H:L) ratio is a more sensitive indicator of stress in birds (Miah et al., 2026).

All values fall within the normal range of 0.00% to 15.00% (Adekunle et al., 2024). T3 and T4 showed the highest monocyte percentages, significantly higher than T2 and T1, T3 (180 g/L) and T4 (control) had higher monocytes, which may indicate enhanced immune surveillance or tissue repair processes. This is consistent with the known anti-inflammatory properties of *Cyperus articulatus* constituents. Mittas et al. (2022) identified 12 sesquiterpenes, 3 stilbenes, 2 phenolic acids, 1 monoterpene, and 1 flavonoid from *C. articulatus*, with 14 compounds isolated for the first time from this species.

Effects of Cyperus articulatus Aqueous Extract on Serum Biochemical Parameters of Broiler

T4 (control) showed the highest total protein (8.33 g/dL), significantly higher than all *Cyperus*-treated groups, T1 (40 g/L) had the lowest total protein (5.20 g/dL), significantly lower than all other groups, . T2 (80 g/L) and T3 (180 g/L) showed intermediate values. The control group's higher total protein suggests that *Cyperus articulatus* extract, particularly at 40 g/L, may suppress protein synthesis or increase protein catabolism.

Table 3: Serum Biochemical Parameters

Parameters	T1	T2	T3	T4	PV
Albumin (g/dL)	1.83 ± 0.29	1.73 ± 0.23	1.70 ± 0.17	1.87 ± 0.12	.794
Globulin (g/dL)	1.83 ± 0.29	2.43 ± 0.06	2.43 ± 0.12	1.90 ± 0.17	.001
Uric Acid (mg/dL)	5.13 ± 0.12	4.33 ± 0.29	5.67 ± 0.58	1.67 ±1.32	.008
Bilirubin (mg/dL)	0.337 ± 0.012	0.243 ± 0.185	0.267 ± 0.115	0.233 ± 0.144	.0.637
Total Protein (g/dL)	5.20 ± 0.17	6.27 ± 0.23	6.67 ± 0.58	8.33 ± 0.29	0 .001

This is consistent with the lower Hb in treated groups and may indicate a negative metabolic effect of the extract. The dose-dependent pattern (T4 > T3 > T2 > T1) suggests that lower doses have a more pronounced protein-lowering effect, which is unusual and warrants further investigation. Hayat *et al*. (2025) reported that phytogenic feed additives generally improve blood parameters, including total protein and globulin, without adverse effects in broilers.

T2 and T3 (80-180 g/L) showed significantly higher globulin than T1 and T4, T1 (40 g/L) and T4 (control) showed similar globulin levels. The elevated globulin in T2 and T3 parallels the elevated WBC in these groups, strongly suggesting that *Cyperus articulatus* at doses ≥80 g/L elicits an immune response or inflammatory condition.

Albumin values ranged from 1.70 ± 0.17 g/dL (T3) to 1.87 ± 0.12 g/dL (T4). The lack of significant differences suggests that hepatic synthetic function was not markedly affected by *Cyperus articulatus* treatment. The differences observed in total protein are therefore primarily driven by changes in globulin fractions rather than albumin.

T4 (control) showed the highest uric acid (6.67 mg/dL). T2 (80 g/L) showed the lowest uric acid (4.33 mg/dL), significantly lower than T4. T1 and T3 showed intermediate values.

In birds, uric acid is the primary nitrogenous waste product (Adekunle *et al.,* 2024). The lower uric acid in T2 and T3 may indicate reduced protein catabolism, which contradicts the lower total protein observed in these groups. This discrepancy suggests that the extract may affect nitrogen metabolism through complex mechanisms. AL-Saeed (2016). Bilirubin values ranged from 0.233 ± 0.144 mg/dL (T4) to 0.337 ± 0.012 mg/dL (T1). The lack of significant differences indicates that *Cyperus articulatus* did not markedly affect hepatic bilirubin metabolism or excretion.

CONCLUSIONS AND RECOMMENDATION

The hematological data reveal significant treatment effects on hemoglobin, WBC, and monocyte percentages in broilers, while PCV, RBC, and lymphocyte percentages remained unaffected. The observed changes are generally within or slightly above physiological reference ranges, suggesting that treatments influence immune and hematopoietic parameters without causing severe pathological alterations.

The administration of *Cyperus articulatus* aqueous extract at 40, 80, and 180 g/L of water produced the following effects on broiler blood parameters: Negative effects at all doses tested**.** No parameter showed improvement over the control group. The control group (T4) consistently showed better or comparable values.

REFERENCES

Adekunle, O. O., Ogunleye, T. G., Akinwale, T. O., et al. (2024). Effects of management systems on hematological and serum biochemical parameters in broiler chickens. *Sokoto Journal of Veterinary Sciences, 22*(1), 45–53.

Al-Saeed, M. H. (2009). Effect of *Cyperus rotundus* tubers boiled extract on some physiological and biochemical parameters aspects in broiler. *Iraqi Journal of Veterinary Sciences, 23*(2), 85–90.

Ashari, M. S., Widodo, E., & Sudjarwo, E. (2024). The effect of additional leaf extract of *Cassia alata* L. on hematological profile of broiler. *Majalah Ilmiah Peternakan, 26*(2), 67–72.

Effects of dietary inclusion of black cumin seed meal on hematology and serum biochemical status of broiler chickens. (2026). *ScienceDirect*.

FAO. (2023). Effects of *Cyperus alternifolius*, *Echinochloa pyramidalis*, *Typha angustifolia*, and *Imperata cylindrica* on growth performance, feed digestibility, gut microbiota, haemato-biochemical and immunity parameters in broiler chickens. *AGRIS – International System for Agricultural Science and Technology*.

Ferreira, J. C. C., et al. (2025). *Cyperus articulatus*: Anti-inflammatory and antinociceptive activity of a medicinal plant from the Amazon. *Journal of Ethnopharmacology, 337*(Pt 3), 118947. https://doi.org/10.1016/j.jep.2024.118947

Games, P. A., & Howell, J. F. (1976). Pairwise multiple comparison procedures with unequal n's and/or variances: A Monte Carlo study. *Journal of Educational Statistics, 1*(2), 113–125.

Hayat, Z., Marij, & Riaz, T. (2025). The dietary inclusion of plant extracts improves growth performance, gut microbiota and blood parameters of broilers: A meta-analysis. *Italian Journal of Animal Science, 24*(1), 1028–1045. https://doi.org/10.1080/1828051X.2025.2491754

Kongpechr, S., Sukon, P., & Sohsuebngarm, D. (2021). The study of hematology incommercial broiler chickens of Cobb 500, Ross 308, and Arbor Acres Plus. *Journal of Mahanakorn Veterinary Medicine, 15*(2), 209–221.

Miah, M. A., Haque, M. I., Zannat, M. H., et al. (2026). Stress-induced alterations in leukocyte profile and serum biochemical parameters in broilers. *British Poultry Science, 67*(2), 284–295. https://doi.org/10.1080/00071668.2025.2541362

Milewski, S., Kiczorowska, B., Samolińska, W., et al. (2025). Effect of thyme and/or garlic on growth performance, carcass traits, intestinal microbiota and health status in broilers. *Poultry Science, 104*(2), 104689. https://doi.org/10.1016/j.psj.2024.104689

Mittas, D., et al. (2022). Bioassay-guided isolation of anti-inflammatory constituents of the subaerial parts of *Cyperus articulatus* (Cyperaceae). *Molecules, 27*(19), 5937. https://doi.org/10.3390/molecules27195937

Onunkwo, D. N., Udokwu, I. U., Ezea, J., & Ekundayo, E. O. (2021). Haematological indices of broiler chickens administered water containing medicinal plant leaf methanol extract. *Nigeria Agricultural Journal, 52*(2), 297–300.

Patrycja, R., Karolina, S., Agata, D., et al. (2026). Effects of *Leontopodium alpinum* supplementation on blood parameters in broiler chickens. *Scientific Reports, 16*, 12458.

Welch, B. L. (1951). On the comparison of several mean values: An alternative approach. *Biometrika, 38*(3-4), 330–336