2025 SCIENCELINE

Online Journal of Animal and Feed Research

Volume 15, Issue 5: 290-298; September 30, 2025

ISSN 2228-7701

DOI: https://dx.doi.org/10.51227/ojafr.2025.33

EVALUATION OF *Prunus africana* BARK EXTRACT AS AN ORGANIC ALTERNATIVE TO SYNTHETIC GROWTH PROMOTERS IN BROILER PRODUCTION

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RESEARCH ARTICLE

PII: S2228770125000033-15

Received: January 16, 2025

Revised: September 22, 2025

Accepted: September 25, 2025

ABSTRACT: Concerns over synthetic inputs in organic poultry production systems prompted an evaluation of aqueous *Prunus africana* bark extracts as natural feed additive via drinking water. Using 210 unsexed Cobb 500 day old broiler chicks, a 42 day trial was conducted to compare graded levels of ground *P. africana* bark infused in drinking water to oxy-tetracycline 80 and a conventional prophylactic calendar on growth, hematology and economic response in chickens. The feed efficiency, weight gain and final weights of birds fed *P. africana* did not differ significantly ($P > 0.05$) from those in the control groups. Carcass yields between the control and prunus groups did not vary significantly ($P < 0.05$) except the oxyterracycline control that had significantly ($P < 0.05$) higher slaughter weight (1913.3 g vs. 1681.7 g), carcass weight (1681.7 g vs. 1468.3 g) and drumstick weight (233.3 g vs. 198.3 g) compared to T4 (5 g/L). Significant differences ($P < 0.05$) were observed in hematological and serum biochemistry at the starter phase (day 21) but not ($P > 0.05$) during the finisher phase (day 42). The unit total expenses were significantly lower ($P < 0.05$) for treatments with inclusions of bark extract, thereby improving their gross margins, cost-to-benefit ratios, and economic efficiency. However, a progressive increase in the concentration of bark extracts did not significantly ($P > 0.05$) affect the profitability of the farm enterprises. Although metabolic challenges were observed in young chicks *P. aficana* bark extracts improved their growth, and carcass quality thereby confirming their potential use as a natural growth promoter in broiler production in replacement of the synthetic conventional prophylactic protocols.

Keywords: Chickens, Economic efficiency, Feed-additive, Natural products, Prophylactic.

INTRODUCTION

Global chicken and eggs consumption surpasses that of other meats (OECD-FAO, 2021). The high demand for chicken and its products has led to extensive use of synthetic inputs for growth promotion (Alshemani et al., 2021). This scenario contributes to the emergence of antimicrobial resistant bacteria and other ailments in the consumers. To meet up with postwar demands in the 1950s, the Food and Drug Administration of the United States approved the use of antibiotics as growth promoters for poultry hitherto, limited solely to human health. Today, there is increase demand for foods devoid of synthetic supplements because of health concerns often associated with them (Amarachukwu, 2022; Rashidinejad, 2024). To address the increasing demand for organic foods, the use of plant-based health supplements is encouraged (Kairalla et al., 2023). The bark extract of the *Prunus africana*, an afro-montane tree species, is widely used in human medicine to treat common fungal and bacterial infections in the urino-genital, digestive, reproductive and respiratory organs (Bii et al., 2010). *Prunus africana* extracts exhibit antimicrobial, anti-inflamatory, antiagiogenic, antiandrogenic, antioxidant, analgestic, antidipeptidyl peptidase-4 activity, and astringent properties which have been documented by many authors (Ndung'u et al., 2024). This is because the extracts contain phytochemicals that act in synergy (Stewart, 2003). The high demand for *P. africana* bark as an export commodity, has led to its overexploitation thereby prompting its protection via Appendix II of the Convention on International Trade in Endangered Species (CITES, 2022). The reliance on wild-collections from forest stands is responsible for this threat, therefore conservation practices including enrichment plantings have been recommended.

Unfortunately, motivation among local farmers is weak. However, the promotion of local uses such as the replacement of expensive prophylactic protocols in livestock production could boosts efforts at local conservation through cultivation of the species. This is because local farmers can easily identify with such local uses rather than exports. There is paucity of research that backs locally viable economic alternatives to the export of *P. africana* bark from producing countries. This study is therefore necessary to begin filling that research gap. The opportunities of using prunus a natural growth promoter in broiler production are therefore, more compelling in the present world, when healthy chickens produced with less synthetics and antibiotics are high in demand.

Citation: Ewane D, Ndam LM, Nsoyeh SK, Soh YN, Ehabe EE, and Chah KF (2025). Evaluation of *Prunus africana* Bark Extract as an Organic Alternative to Synthetic Growth Promoters in Broiler Production. *Online J. Anim. Feed Res.*, 15(5): 290-298. DOI: https://dx.doi.org/10.51227/ojafr.2025.33

MATERIALS AND METHODS

Ethical issues related to the experimental animals

Unsexed Cobb 500 broiler chickens were used as experimental animals for this study. The chickens were raised in standard pens and temperature and humidity were closely monitored using a thermo-hydrometer (model 288-ATH, SL Technologies). The experiments were carried out following the National Ethical Committee Guidelines (No. FWA-IRB00001954) and International (European Committee Council Directive of November 24, 1986(86/69/EEC); Guide for the Care and Use of Laboratory Animals (U.S. National Research Council, 1996) for the care and use of laboratory animals. All efforts were made to minimize the suffering and stress of chickens used at each stage of the study. Ethical approval was given by the University of Buea Institutional Animal Care and Use Committee (UB-IACUC) via permit No.UB-IACUC No.25/2023, signed by Committee Chair Prof Jane Francis Akoachere and Committee Secretary Dr Rene B Ayiseh.

Sample collection, preparation and experimental design

Stem bark from mature *Prunus africana* plant was collected in April 2023 from NSEH village of Bui division in North West Cameroon, with approximate coordinates of 6.0000 ^{0}N and 10.5000 ^{0}E; The plant material was chopped into small pieces, dried under shade for 8 weeks, ground to fine powder on a hammer mill, and sent to the Teaching & Research Farm of the University of Buea for eventual use. Average ambient diurnal temperature and humidity during drying ranged from 16.6^{o}C to 28^{o}C and 65% to 85% respectively. Daily, varying quantities of the powder (1g, 3g, 5g, 7g and 10g) were weighed, soaked separately overnight in one litre of potable water and the infusions filtered through a muslin cloth the following day to obtain aqueous bark extracts, that were used to compare in a conventional prophylactic calendar and oxyterracycline 80.

Experimental design

The experimental design used was a completely randomized design with the model: $Y=\mu+Tj+\sum eij$

Where Y1= the Jth measurement on the Ith treatment; μ= the overall mean; Tj= effect of the Ith treatment; $\sum eij$ = effect of the random error.

It was designed to have seven treatments sub-divided into 3 replicates of 10 birds each, to give 21 experimental units Two hundred and ten day-old unsexed Cobb 500 breed broiler chicks were obtained from the FECAM SARL Commercial Hatchery in Bafoussam (Cameroon), vaccinated and randomly assigned to the seven treatment groups that were given graded quantities of test ingredients in drinking water. The treatment groups comprised: a conventional prophylactic calendar (Table 1) as negative control (T0), Oxy-tetracycline 80 at 0.5 g/L water as positive control (T1), and five graded levels of aqueous *P. africana* bark extracts [1 g/L (T2), 3 g/L (T3), 5 g/L (T4), 7 g/L (T5) and 10 g/L (T6)].

At the start, the entire pens and their easily accessible feeders and drinkers, were washed with detergent and water, disinfected (using tetrahydrofuran and Virunet), and wood shavings spread out as deep litter. Charcoal pots and 100-Watt electric bulbs were centrally placed in each pen and the chicks were brooded at slightly decreasing temperatures (at 34°C, 32°C and 30°C in the first, second and third weeks, respectively) with the temperature monitored using a thermo-hydrometer (model 288-ATH, SL Technologies). A corn/soybean basal diet was formulated for the two growth phases; starter and finisher (Table 2), and water was offered *ad libitum* to the birds. Daily feed intake and weekly weight gains were measured using a digital electronic balance, (WANT WT-GF 0.1 g from WANT Balance Instrument Co Ltd- China).

Table 1 - Conventional prophylactic calendar for disease prevention for broilers in Buea used for birds in treatment 0 (T0)

Day/Age	Type of medication	Mode of administration	Dosage	Function
1	Avinew (A), Bioral (B) and Galivac (G)	Beak dipping or Intra ocular	1000D in 10L	Prevention of NCD, IB and Gumboro
1-5	Anti-stress and vitamin	Drinking water	5g in 5L	Against stress
6-8	Antibiotic(oxy)	Drinking water	5g in 2.5L	Disease prevention
8	Vaccine; A, B, G	Drinking water	1000D in 10L	Booster against viral infection
8-10	Vitamin (Amin total)	Drinking water	5g in 10L	Growth promoter
11-13	Anti-coccidiosis	Drinking water	5g in 10L	Prevention of coccidiosis
14-16	Vitamin (Amin total)	Drinking water	5g in 10L	Growth promoter
17-19	Antibiotic(oxy)	Drinking water	5g in 10L	Anti-infectious
20-22	Vitamin	Drinking water	5g in 10L	Growth promoter
21	Vaccine; A, B, G	Drinking water	1000D in 10L	Booster against viral infection
23-25	Anti-coccidiosis	Drinking water	5g in 10L	Prevention of coccidiosis
26-29	Vitamin	Drinking water	5g in 10L	Growth promoter
30	Dewormer(anthelmintic	Drinking water	5g in 2.5L	Against worms
35-37	Liver protector	Drinking water	1ml in 1L	Diuretic
38-42	Vitamin	Drinking water	5g in 10L	Growth promoter

Vaccine: A=Avinew, B=Bioral G=Galivac, NCD= New castle disease, IB= Infectious bronchitis.

Table 2 - Composition of basal and experimental diet for broiler starter and finisher.

Ingredients	Starter (%, w/w)	Finisher (%, w/w)
Maize	54.00	65.0
Soybean meal	35.35	27.50
Fishmeal	5.00	4.00
Premix *	1.50	1.50
Calcium Phosphate	3.00	1.00
Lysine	0.50	0.40
Methionine	0.40	0.35
Salt	0.25	0.25
Total	100	100
Calculated chemical composition		
Metabolizeable energy (Kcal/kg)	2817	2964
Crude protein (%)	24.6	21.2
Crude fiber (%)	2.50	2.60
Calcium (%)	1.40	0.90
Phosphorus (%)	0.90	0.50
Methionine (%)	1.00	0.80
Lysine (%)	1.30	1.20

*Premix Composition (Vitamins per kg); Vit A 3,000,000 UI; Vit D3 600,000 UI; Vit E 4,000 mg; Vit K3 500 mg; Vit B1 320 mg; Vit B2 1,000 mg; Vit B3 2400 mg; Vit B6 400 mg; Vit B12 7 mg; Vit PP/Ac nicot/niacin 4,800 mg; Biotin 10 mg; Choline chloride 100,000 mg; Folic acid 160 mg; Cupper II sulphate 200 mg; zinc oxide 10,000 mg; manganese oxide 14,000 mg; Calcium iodate 200 mg; Lysine 7800 mg; Meth 200,000 mg; Iron sulphate 8,000 mg, Sulfate 2,000 mg.

Data collection

Analysis of blood lipid, hematological and serum biochemical profiles

At the end of the starter and finisher phases hematological and serum biochemical profiles were analyzed. Blood lipid profile was additionally analyzed at the end of the finisher phase. Three birds were randomly selected for each replicate and from which 2 mL blood samples were collected (using a syringe) from each birds' wing vein, and kept in sets of tubes. Green topped tubes containing heparin were used for blood lipid analysis. This portion of blood was stored for 30 min, centrifuged at 2,000 rpm on a benchtop centrifuge (model TD4Y, China) and the serum retrieved and deep-frozen at -20°C for 24 h. The serum was later thawed and analyzed on a spectrophotometer (Unico-2400, Japan) for their total cholesterol, triglycerides, high-density and low-density lipoproteins (Aberare et al., 2011). The other portion was poured into EDTA coated-vacuum capillary tubes then analysed, using standard techniques (Abdul Hamid, 2012), for their white blood cell count, red blood cell count, hemoglobin concentration, packed cell volume, mean corpuscular volume and mean corpuscular hemoglobin contents. Blood for the serum biochemical analyses, was collected in dry tubes (without anticoagulant), refrigerated for 24 h at 20°C, centrifuged at 1500 rpm and the supernatant analyzed using the Chronolab kit (Chrono lab Systems, Spain) and the semi-automated spectrophotometer Sanymed kit (Sanymed Sas, Italy) (operating at 37°C) for alanine amino transferase and alkaline phosphatase, respectively.

Carcass and organ characteristics

The birds randomly selected for heamatological analysis in starter and finisher phases were sacrificed then characterized for their gut pH. Those at the finisher phase were particularly fasted overnight, then sacrificed, and characterized for their carcass, organ and weights. Organ weights were measured using a digital electronic balance, (WANT WT-GF 0.1 g from WANT Balance Instrument Co Ltd- China), while gut pH was measured a digital pH meter (MODENA, Apluste).

Costs benefit analysis

To analyze the economic performance of the broiler production, seven economic parameters were determined using values from the separate costs of feed, medication and other inputs. The unit cost of feed consumed (i) was estimated as the ratio of the cost of feed per unit weight gained while the cost of medication per growth promoter consumed (ii) was estimated as the ratio of the cost of medication to the unit quantity of growth promoter consumed. The total expenses incurred (iii) were estimated as the sum of the costs of feed and antibiotic/medication consumed while the total revenue (iv) was calculated as the product of the live body weight and the unit price (per kg) of the birds. The gross margin (v) on its part was estimated as the difference between the total revenue and total expenses, the benefit cost ratio (vi) as the ratio of the gross margin to the total expenses (Lundholm, 2005) while the economic efficiency (vii) was the ratio of the gross margin to the cost of feed consumed (Omar et al., 2019).

Statistical analysis

Data were entered into spreadsheets using Microsoft Excel and analyzed using SPSS version 22 software package. These were then used to estimate descriptive parameters like the means, the standard errors of the mean and statistical

differences between group means, as well as one-way analysis of variance (ANOVA). Shapiro-Wilk test for normality and Levene's test for homogeneity of variances were used to test whether the data meets the assumptions of ANOVA. Duncan Multiple Range Test was used for post-hoc test comparison of group mean values. Significant levels were measured at 95% confidence threshold.

RESULTS

Effects of extract inclusions on growth performance of broiler chicken

The growth performance of broiler chicken given varying levels of *P. africana* bark extract in drinking water (Table 3) showed that these effects were slightly different for the starter and finisher phases depending on the parameters measured. The average feed intake, daily weight gain and feed conversion ratio were not significantly different ($P > 0.05$) between the control and prunus groups, although T4 (5 g/L) showed significantly ($P < 0.05$) lower daily gain compared to the controls during the starter phase, and also lower daily feed intake during the finisher phase. Average daily water intake was not significantly different ($P > 0.05$) between the control and the prunus groups. However, chickens receiving higher densities of Prunus bark infusions (T3 (3 g/L); T4 (5 g/L); T5 (7 g/L) and T6 (10 g/L) significantly ($P < 0.05$) consumed smaller amounts of water during the finisher phase compared to T2 (1g/L), which received the lowest density. Also, mortality was recorded for all prunus groups in the starter but not in the finisher phase unlike the normal and positive controls which did not record any mortality.

Effect of extracts on the carcass, visceral organs and blood lipid profiles

Table 4 which presents the effect of aqueous *P. africana* bark extracts inclusion in drinking water on the weights of the carcass and visceral organs of broiler chicken, shows that the inclusions did not have any significant effect on the birds' live weights ($P > 0.05$). However, the positive control is associated with a significant ($P < 0.05$) increase in slaughter and carcass weights compared to T4, while the negative control (T0) was not significantly different ($P > 0.05$) from all test ingredients in the quantitative carcass parameters. As for the weights of the visceral organs, the aqueous *P. africana* bark extracts inclusions did not show any clear patterns on their evolution, except for a slight progressive decrease of the liver weight as the level of *P. africana* inclusion increased. The liver weight values of T6 were significantly ($P < 0.05$) lower than those of the positive control (T1), and also T2, T3 and T5, which had lower concentrations of the bark extract. Results on the birds' blood lipid profiles showed that the negative control (T0) had significantly ($P < 0.05$) higher levels of low density lipoproteins compared to the treatments with the highest levels of prunus bark inclusion (T5 and T6), while the positive control (T1) significantly ($P < 0.05$) had higher levels of Total triglycerides compared to T3. All other lipoprotein quality parameters did not differ significantly ($P > 0.05$).

Effect of aqueous *Prunus africana* bark extracts on the hematological parameters and serum biochemistry

The hematological parameters and serum biochemistry of broiler chickens exposed to graded levels of *P. africana* bark extract are presented in Table 5. Significant differences in hematological parameters observed in the starter phase were not significant ($P > 0.05$) during the finisher phase. During the starter phase, hemoglobin (Hb) levels were significantly ($P < 0.05$) higher for birds in the negative control (T0), compared to the oxytertacycline positive control (T1). However, the mean Hb concentration of the birds in the test ingredients and control groups did not vary significantly ($P > 0.05$). Similar trends observed for Hb in the starter phase were also observed for parked cell volume (PCV). Interestingly, birds that received lower levels of the test ingredients (T2, T3, T4, and T5) had a significantly ($P < 0.05$) higher mean white blood cell (WBC) counts compared to the negative control (T0) during the starter phase. However, the mean WBC counts of birds that received the highest level (T6) was not significantly different ($P > 0.05$) from both the positive and negative controls. For this study, the birds' serum was evaluated with respect to the changes in their alanine amino transferase (ALT) and alanine phosphatase (ALP) contents. Significant differences ($P<0.05$) observed during the starter phase were absent in the finisher phase. During the starter phase, the mean ALT concentrations were similar ($P > 0.05$) between negative control (T0) and all the test ingredient treatments. However, the positive control birds (T1) showed significantly ($P < 0.05$) lower mean ALT values compared to birds in T2. On the other hand, ALP did not vary significantly ($P > 0.05$) among the groups during the starter and finisher phases.

Effects of extracts on gut acidity in broiler guts

The pH of the various segments of the gut of birds exposed to graded levels of *P. africana* bark extract in drinking water is presented in Table 6. The pH of the crop, proventriculus, small intestine and large intestine of birds in the test ingredient and control groups did not vary significantly ($P > 0.05$) during the starter (day 21) and finisher (day 42) phases. However, during the starter phase the crop, small intestine and large intestine all had an alkaline pH which became acidic in the finisher phase. Also, the proventriculus of chickens increased in acidity with increasing levels of aqueous *P. africana* in the finisher phase compared to the normal and positive controls.

Table 3 - Growth performance of broiler chickens fed varying inclusion levels of aqueous *P. africana* bark extract as additive in drinking water.

Treatment	T0: Negative control	T1: Positive control	T2: 1 g/L extract	T3: 3 g/L extract	T4: 5 g/L extract	T5: 7 g/L extract	T6: 10 g/L extract	SEM	P-value
Starter									
Daily feed intake (g	39.18	38.06	38.72	37.55	35.93	37.97	36.01	0.432	P=0.092
Daily water intake (mL)	108.3	107.06	110.17	97.78	97.67	98.15	101.76	1.583	P=0.071
Daily weight gain (g)	27.08^{b}	27.07^{b}	25.74^{ab}	26.04^{ab}	24.19^{a}	26.73^{b}	26.18^{ab}	0.271	P=0.041
Feed conversion ratio	1.44	1.40	1.50	1.44	1.49	1.42	1.45	0.010	P=0.074
Mortality (%)	0.00	0.00	13.20	3.30	10.00	13.30	10.00	1.971	P=0.069
Finisher									
Daily feed intake (g	139.80^{b}	135.37^{ab}	144.55^{b}	132.04^{ab}	126.22^{a}	144.60^{b}	139.23^{b}	2.352	P=0.076
Daily water intake (mL)	310.83^{ab}	295.21^{ab}	333.76^{b}	284.95^{a}	274.87^{a}	304.85^{ab}	278.45^{a}	6.593	P=0.036
Daily weight gain (g)	70.56	71.94	73.15	70.24	68.84	71.18	71.79	0.971	P=0.068
Feed conversion ratio	1.98	1.88	1.98	1.89	1.84	2.03	2.02	0.020	P=0.079
Mortality (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	P=1.000

$^{a, b}$= means followed by the same letters in a row, were not significantly different (P > 0.05); SEM= Standard error of the mean.

Table 4 - Effect of aqueous *P. africana* bark extracts in drinking water on the weights (g) of carcass and visceral organs of broiler chicken.

Body section	Body part	T0: Negative control	T1: Positive control	T2: 1 g/L extract	T3: 3 g/L extract	T4: 5 g/L extract	T5:7 g/L extract	T6: 10 g/L extract	SEM	P-value
Carcass weights	Live weight (g)	1978.3	2050	1995	1921.7	1805	2008.3	1891.7	26.69	P=0.084
	Slaughter weight (g)	1828.3^{ab}	1913.3^{b}	1861.66^{ab}	1766.7^{ab}	1681.7^{a}	1863.3^{ab}	1760.0^{ab}	24.68	P=0.041
	Carcass weight (g)	1606.7^{ab}	1681.7^{b}	1620.0^{ab}	1590.0^{ab}	468.3^{a}	1618.3^{ab}	1638.3^{ab}	21.12	P=0.039
	Breast weight (g)	550	555	538.3	521.7	498.3	563.3	523.3	9.58	P=0.122
	Back muscle weight (g)	293.3	275	270	280	266.7	296.7	253.3	5.21	P=0.101
	Drumstick (g)	233.3^{b}	233.3^{b}	220.0^{ab}	210.0^{ab}	198.3^{a}	233.3^{b}	221.7^{ab}	3.78	P=0.045
	Wing (g)	80	88.3	76.7	83.3	75	82	76.7	1.74	P=0.082
	Intestines (g)	78.3	76.7	85,0	81.7	86.7	73.3	76.7	2.16	P=0.076
Visceral organs	Liver (g)	41.7^{ab}	46.7^{b}	46.7^{b}	48.3^{b}	41.7^{ab}	46.7^{b}	31.7^{a}	1.81	P=0.035
	Lungs (g)	13.3	13.3	15.0	18.3	21.7	15.0	13.3	1.39	P=0.078
	Heart (g)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.00	P=1.000
	Gizzard (g)	56.7	60.0	60.0	55.0	55.0	56.7	63.3	1.44	P=0.086
	Ilium (g)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	0.00	P=1.000
Blood lipid profile	Total cholesterol (%)	222.3	363.5	378.3	485.2	315.3	440.8	445.3	38.47	P=0.092
	Total triglycerides (%)	409.0^{ab}	662.8^{b}	387.7^{ab}	257.3^{a}	540.0^{ab}	421.3^{ab}	366.8^{ab}	38.92	P=0.024
	High Density lipoprotein (%)	57.8	68	59.5	58.7	55.7	51.0	47.8	2.45	P=0.073
	Low Density lipoprotein (%)	12.9c	11.2^{abc}	10.6^{abc}	10.9^{abc}	12.5^{bc}	8.80^{a}	9.50^{ab}	0.42	P=0.042

$^{a, b}$= means followed by the same letters in a row, were not significantly different (P > 0.05); SEM= Standard error of the mean

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Table 5 - Effects of graded levels of *P. africana* bark extract on the hematological parameters and serum biochemistry of broiler chickens on day 21 and day 42.

Parameters	T0: Negative control	T1: Positive control	T2: 1 g/L extract	T3: 3 g/L extract	T4: 5 g/L extract	T5: 7 g/L extract	T6: 10 g/L extract	SEM	P-value
Starter									
Hemoglobin (g/dL)	15.60^{b}	14.25^{a}	14.85^{ab}	14.35^{ab}	14.60^{ab}	14.58^{ab}	14.30^{ab}	0.52	P=0.046
Pack cell volume (%)	46.80^{b}	42.75^{a}	44.55^{ab}	43.05^{ab}	43.80^{ab}	43.75^{ab}	42.20^{a}	1.38	P=0045
Red blood cells (× 106 mm3)	3.5	3.41	3.5	3.5	3.5	3.41	3.41	0.08	P=0.082
White blood cells (× 106 mm3)	11.33^{a}	13.83^{ab}	14.83^{b}	15.50^{b}	16.00^{b}	19.50^{c}	13.50^{ab}	1.5	P=0.037
Alanine amino transferase (UI	0.50^{ab}	0.46a	0.61^{b}	0.55^{ab}	0.51^{ab}	0.50^{ab}	0.51^{ab}	0.02	P=0.041
Alanine phosphatase (UI)	7.76	8.55	8.15	8.54	6.66	7.65	7.1	1.12	P=0.072
Finisher									
Hemoglobin (g/dL)	12.49	11.66	12.21	12.49	12.49	12.21	12.49	0.48	P=0.121
Pack cell volume (%)	37.48	34.98	36.65	37.49	37.48	36.65	37.48	1.44	P= 0.096
Red blood cells (× 106 mm3)	3.25	3.08	3.16	3.25	3.25	3.33	3.25	0.14	P=0.153
White blood cells (× 106 mm3)	18.66	18.53	18	16.4	20.25	18	16.06	2.26	P=0.087
Alanine amino transferase (UI	27	34.16	37.16	32	35	37.83	32.33	2.24	P=0.084
Alanine phosphatase (UI)	68.8	58.31	71.99	69.2	60.06	59.05	70.39	2.68	P=0.096

$^{a, b}$= means followed by the same letters in a row, were not significantly different (P > 0.05); SEM= Standard error of the mean

Table 6 - pH of broiler gut exposed to graded concentrations of *P. africana* bark.

Treatment	T0: Negative control	T1: Positive control	T2: 1 g/L extract	T3: 3 g/L extract	T4: 5 g/L extract	T5: 7 g/L extract	T6: 10 g/L extract	SEM	P-value
Day 21									
Crop	8.66	8.16	7.50	8.33	8.16	7.66	8.16	0.232	P=0.081
Pro-ventriculus	5.50	5.50	6.00	6.50	5.83	5.66	5.66	0.312	P=0.094
Small intestine	8.33	8.50	8.33	7.83	8.16	8.33	8.33	0.142	P=0.076
Large intestine	8.83	9.00	8.16	8.50	8.83	8.66	8.66	0.312	P=0.087
Day 42									
Crop	5.66	7.00	5.16	6.50	6.00	6.33	5.66	0.142	P=0.073
Pro-ventriculus	3.83	5.00	3.83	3.83	3.50	3.33	3.00	0.131	P=0.064
Small intestine	5.66	5.83	5.81	5.60	5.16	5.33	5.33	0.161	P=0.084
Large intestine	6.33	5.66	5.83	5.36	5.35	5.36	5.36	0.122	P=0.059

SEM = Standard error of the mean

Cost benefit analysis

The effects of inclusions of aqueous *P. africana* bark extracts on the economic performance in broiler chickens over the entire experimental period (Table 7) showed that the cost of additive was significantly ($P < 0.05$) higher for the normal and positive control treatments than for all those with *Prunus* while no significant differences ($P > 0.05$) were observed in the cost of feed within the groups. The unit total expenses were significantly higher ($P < 0.05$) for the normal and positive control treatments when compared with those exposed to prunus, leading thereby to a significantly ($P < 0.05$) lower gross margin, cost-to-benefit ratio, and economic efficiency of the former treatments as compared to the latter. Overall, a progressive increase in the concentration of aqueous of bark extracts did not significantly ($P > 0.05$) affect the profitability of the farm enterprises.

Table 7 - Effects of aqueous *P. africana* bark extract in drinking water on economic performance, in US dollars, of broiler chicken

Economic parameters	T0: Negative control	T1: Positive control	T2: 1 g/L extract	T3: 3 g/L extract	T4: 5 g/L extract	T5: 7 g/L extract	T6: 10 g/L extract	SEM	P-value
Cost of additive consumed (USD)	2.45[a]	2.14[a]	0.29[b]	0.29[b]	0.27[b]	0.29[b]	0.28[b]	0.22	P=0.038
Cost of feed consumed (USD)	1.01	0.96	1.01	0.96	0.94	1.04	1.03	0.02	P=0.064
Total expenses (USD)	3.76[a]	3.10[a]	1.30[b]	1.26[b]	1.20[b]	1.33[b]	1.21[b]	0.22	P=0.028
Total revenue (USD)	6.05	6.27	6.10	5.88	5.52	6.15	5.79	0.08	P=0.086
Gross margin (USD)	2.59[a]	3.17[a]	4.80[b]	4.62[b]	4.32[b]	4.82[b]	4.48[b]	0.21	P=0.035
Benefit to cost ratio	0.8[a]	1.0[a]	3.7[b]	3.7[b]	3.6[b]	3.6[b]	3.4[b]	0.29	P=0.026
Economic efficiency	2.4[a]	3.3[a]	4.8[b]	4.8[b]	4.6[b]	4.7[b]	3.4[b]	0.20	P=0.024

[a, b]= means followed by the same letters in a row, were not significantly different (P>0.05); SEM= Standard error of the mean.

DISCUSSION

The similarity in growth performance with respect to feed intake, weight gain and feed conversion ratio, of broilers in the controls and *P. africana* bark extracts exposed groups, indicates the plant extract has growth promoter effects similar to oxytetracycline 80 and the conventional prophylactic protocol. Thus, *P. africana* aqueous bark extracts (1-10 g) did not impair growth performance. However, the extract seemed to trigger some metabolic challenges in young chicks during the starter phase, which were seemingly overcome during the finisher phase.

The normal and positive controls (T0 and T1, respectively) had similar carcass yield characteristics to test treatments with the higher levels of aqueous *P. africana* extracts (T5 and T6). However, these higher levels produced better carcass quality characterized by lowering levels of low-density lipoproteins, often associated with increased risks of cardiovascular diseases in humans.

Reduced liver weights in T6 suggest haepatoprotective effects of aqueous *P. africana* bark extracts to the broiler chicken. This is may be confirmed by the similarity ($P > 0.05$) in values of ALT in the finisher phase of the positive control (T1) and lowest *P. africana* inclusion level (T2) which were significantly different ($P < 0.05$) at the starter phase. Here, the continuous intake of the extract could have resolved an initial metabolic challenge in the starter phase, which caused broilers, fed with T2 to record significantly ($P < 0.05$) higher ALT values at the start. Hepatoprotective agents protect liver cells from damage and improve liver function by promoting regeneration of liver cells, thereby leading to small liver size. Mwitari et al. (2013) reported that *P. africana* bark is used for liver problems.

The hematological profile of control and test ingredient groups showed that differences observed at the starter phase were no longer present in the finisher phase, indicating therefore the adaptation of the chicks during their growth and development. The immune systems of younger birds are naturally more sensitive to stressors (pathogen load, diets and diet changes, vaccinations, new environments, etc.) that could provoke fluctuations in red and white blood cell counts (Niu et al., 2022). As the bird's progress to the finisher phase, their development is more complete and their immune systems are stronger. They are then better equipped to handle these stressors; hence their stable blood cell counts.

The determination of digesta pH in broilers serves as a tool to indicate the potential for optimum gut health and maximal nutrient absorption. The lowering of gut pH during the finisher phase following the intake of aqueous *P. africana* extracts can be explained in a similar observation reported by Anugom and Ofongo (2019) following administration of aqueous *Ocimum gratissimum* leaf extract. The increasing acidity (lowering of pH) of the small and large intestine associated the intake of the *P. africana* extract during the finisher phase certainly improved the gut health (Hinton et al., 2000) as increased intestinal acidity could stimulate growth of beneficial bacteria/microbes like *Lactobacillus*, inhibit the growth and colonization of enteropathogens and other harmful microbes like *Salmonellae*, *Enterobacterium* and *Escherichia coli*. At lower digestive pH, the nutrients are better partitioned for optimal growth and nutrient utilization (Lewis et al., 2003), the intestinal absorptive cells proliferate better (Niewold, 2007) and pancreatic secretions are stimulated (Dibner and Buttin, 2002).

A conventional prophylactic protocol is one of the major sources of synthetic inputs in conventional broiler production. This is because it requires the periodic addition of synthetic inputs in the feed or drinking water, to serve as

Citation: Ewane D, Ndam LM, Nsoyeh SK, Soh YN, Ehabe EE, and Chah KF (2025). Evaluation of *Prunus africana* Bark Extract as an Organic Alternative to Synthetic Growth Promoters in Broiler Production. *Online J. Anim. Feed Res.*, 15(5): 290-298. DOI: https://dx.doi.org/10.51227/ojafr.2025.33

anti-stress, antibiotics, anti-coccidia, anti-helminthes, diuretics, growth promoters and immune boosters. *Prunus africana* has been known to serve some of these purposes in literature (Ndung'u et al., 2024). Substitution of such chemicals in broiler production with organic constituents of plants like *P. africana* bark extracts, can go a long way to improve the health quality of broiler meat at the table. *Prunus africana* presents a unique opportunity as an organic feed additive, because it is a forest, species, which is not produced with synthetic inputs, either in natural or cultivated stands.

CONCLUSION

It is concluded from this study that, the aqueous extracts of *Prunus africana* bark between 1g/L and 10g/L, can be used as a natural growth promoter in broiler chicken production to replace a conventional prophylactic protocol or oxy-tetracycline 80. However, it seems to trigger some metabolic challenges in the young chick that require a further investigation. All the 5 levels tested are biologically and economically promising. This contributes to closing research gaps on alternatives to synthetic growth promoters and the export of *P. africana* bark from producing countries.

DECLARATIONS

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Data availability
Data are available from the corresponding author Email: ewane.divine@ubuea.cm, upon reasonable request

Author contribution
ED: Conceptualization; formal analysis; investigation; methodology; project administration; resources, supervision, validation, writing original draft, review and editing; NLM: Conceptualization; formal analysis, investigation; project administration; resources supervision, validation writing original draft; NSK: Conceptualization, Data curation, formal analysis, investigation, methodology, project administration, resources, validation writing original draft; SYN: Data curation, formal analysis, investigation, methodology, project administration, resources, validation writing original draft; EEE: Data curation, formal analysis; resources, supervision, validation, writing original draft, review and editing; CKF: formal analysis; resources, supervision, validation, writing original draft, review and editing

Acknowledgements
We acknowledge the Ministry of Higher Education, Cameroon and University of Buea that Co- sponsored this research via research allowances to the corresponding author. We are also grateful to the farm facilities provided by the Faculty of Agriculture and Veterinary Medicine and laboratory facilities of Maflekumen Higher Institute, Tiko Cameroon

Funding sources
This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

Consent to publish
All co-authors have given their full consent to publish

Competing interests
The authors declare no competing interests in the research and the publication

REFERENCES

Abdul Hamid G (2012). Manual of Hematology, University of Aden, Aden. https://doi.org/10.13140/2.1.1499.9681

Aberare OL, Okuonghae P, Mukoro N, Dirisu JO, Osazuwa F, Odigie E, et al. (2011). Triglycerides, total cholesterol, high density lipoprotein cholesterol and low density lipoprotein cholesterol in rats exposed to premium motor spirit fumes. North American Journal of Medical Sciences, 3(6): 277. https://pubmed.ncbi.nlm.nih.gov/22540098/

Amarachukwu UT (2022). The implications of replacing synthetic antioxidants with natural ones in the food systems. In: Prieto MÃ, Otero, & Carpena R. M. (Eds). (2022). Natural Food Additives. IntechOpen. https://doi.org/10.5772/intechopen.103810

Anugom YO and Ofongo RTS (2019). Impact of aqueous *Ocimum gratissimum* (Lyn) leaf extract on growth performance, gut pH and bacterial counts in broiler chickens. International Journal of Poultry Science, 18: 309-316. https://doi.org/10.3923/ijps.2019.309.316

Bii C, Korir K. R, Rugutt J. and Mutai C. (2010). The potential use of *Prunus africana* for the control, treatment and management of common fungal and bacterial infections. Journal of Medicinal Plants Research, 4(11): 995-998. https://academicjournals.org/journal/JMPR/article-abstract/648392322194

CITES (2022). CITES and Livelihood Case Study 2022, Harvest and Trade of Prunus africana bark in Cameroon. Retrieved April 29, 2025, https://cites.org/sites/default/files/eng/prog/Livelihoods/case_studies/2022/CITES_%26_livelihoods_fact_sheet_Prunus%20Africana%20Cameroon.pdf

Dibner JJ and Buttin P. (2002). Use of organic acids as a model to study the impact of gut microflora on nutrition and metabolism. Journal of Applied Poultry Research, 11: 453-463. https://doi.org/10.1093/japr/11.4.453

Hinton A, Buhr RJ. and Ingram KD. (2000). Physical, chemical and microbiological changes in the crop of broiler chickens subjected to incremental feed withdrawal. Poultry Science, 79: 212-218. https://doi.org/10.1093/ps/79.2.212

Kairalla MA, Alshemani MI. and Imdakim MM (2023). Effect of diet supplemented with different levels of moringa powder on growth performance carcass characteristics, meat quality, hematological parameters serum lipids and economic efficiency of broiler chickens. Archives of Razi Institute, 78 (5):1647. https://pmc.ncbi.nlm.nih.gov/articles/PMC10998937/pdf/ARI-78-1647.pdf

Lee NK, Lee Y, Shin DS, Ra J, Choi YM, Ryu BH, et al. (2024). Hepatoprotective effect of *Lactiplantibacillus plantarum* DSR330 in mice with high fat diet-induced nonalcoholic fatty liver disease. Journal of Microbiology and Biotechnology, 34(2): 399-406. https://doi.org/10.4014/jmb.2310.10026

Lewis MR, Rose SP, Mackenzie AM. and Tucker LA (2003). Effects of dietary inclusion of plant extracts on the growth performance of male broiler chickens. British Poultry Science, 44 (S1): 43-44. https://doi.org/10.1080/713655281

Lundholm M (2005). Cost benefit analysis and the marginal cost of public funds". Research Papers in Economics 2005, Stockholm University, Department of Economics. https://www.academia.edu/download/69526403/Cost-Benefit_Analysis_and_the_Marginal_C20210913-8084-1qz4nk9.pdf

Mwitari PG, Ayeka PA, Ondicho J, Matu EN and Bii CC (2013). Antimicrobial activity and probable mechanisms of action of medicinal plants of Kenya: *Withania somnifera, Warbugia ugandensis, Prunus africana* and *Plectrunthus barbatus*. PLoS ONE, 8(6): e65619. https://doi.org/10.1371/journal.pone.0065619

Ndung'u JK, Nguta JM, Mapenay IM and Moriasi GA (2024). A comprehensive review of ethnomedicinal uses, Phytochemistry, Pharmacology, and Toxicity of *Prunus africana* (Hook. F.) Kalkman from Africa. Scientifica (Cairo), 2024: 8862996. https://doi.org/10.1155/2024/8862996

Niewold TA. (2007). The non-antibiotic anti-inflammatory effect of antimicrobial growth promoters, the real mode of action? A hypothesis. Poultry Science, 86: 605-609. https://doi.org/10.1093/ps/86.4.605

Niu X, Ding Y, Chen S, Gooneratne R and Ju X (2022). Effect of immune stress on growth performance and immune functions of livestock: mechanisms and prevention. Animals (Basel), 12(7): 909. https://doi.org/10.3390/ani12070909

OECD, Food and Agricultural Organization of the United Nations (2021). OECD-FAO Agricultural Outlook 2021-2030. https://doi.org/10.1787/agr-outl-data-en

Omar MA, Abdel-Hamid TM and Sara E (2019). Growth and economic performance of using dried tomato pomace for mallad ducks. Slovenian Veterinary Research, 56 (Suppl. 22): 699–706https://www.slovetres.si/index.php/SVR/article/view/810/239

Rashidinejad A. (2024). The road ahead for functional foods: Promising opportunities amidst industry challenges. Future Postharvest and Food, 1(2): 266–273. https://doi.org/10.1002/fpf2.12022

Stewart KM (2003). The African Cherry (*Prunus africana*): Can lessons be learned from an over exploited medicinal tree? Journal of Ethnopharmacology, 89: 3–13. https://doi.org/10.1016/j.jep.2003.08.002