ANIMAL SCIENCE AND GENETICS
Published by the Polish Society of Animal Production
vol. 18 (2022), no 2, 57-71
DOI: 10.5604/01.3001.0015.9185
Research Article ***Open Access***

Growth performance and haematological and serum biochemical parameters of broiler chickens given varied concentrations of *Polyalthia longifolia* leaf extract in place of conventional antibiotics

Muritala Daniel Shittu[1#], John Olujimi Alagbe[2], Olusegun Ojeniyi Ojebiyi[3], Taiwo Kayode Ojediran[3], Trimisiyu Adewale Rafiu[1]

[1]Department of Animal production and Health, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria
[2]Department of Animal Nutrition and Biochemistry, Sumitra Research Institute, Gujarat India
[3]Department of Animal Nutrition and Biotechnology, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria

SUMMARY

The study was conducted to investigate the effect of *Polyalthia longifolia* leaf extract (PLLE) in the diet of broiler chickens on their growth performance, nutrient digestibility and blood profile in the finisher phase. A total of 180 broiler chicks were used for the experiment. The birds were weighed on arrival and randomly assigned to 5 treatments and 3 replicates with 12 birds/replicate using a completely randomized design. The data were subjected to analysis of variance using SPSS version 21, and significant means were separated using Duncan's Multiple Range Test in the same software. Vaccines were given to the birds in all treatments. The birds in treatment group 1 were not given any medication (negative control: without PLLE), T2 served as a positive control (given a conventional antibiotic), and T3, T4 and T5 received 15 g, 30 g and 45 g of *Polyalthia longifolia* per litre of water, respectively. The inclusion of PLLE had no significant (P > 0,05) effect on growth performance except for average total feed intake and daily feed intake. PLLE reduced the mortality rate of the broilers. Birds receiving 30 g PLLE per litre of water had similar final weight as treatment (T2 – positive control). This established the growth-promoting quality of PLLE in broiler production. Nutrient digestibility parameters were significantly different. Broilers receiving 45 g of PLLE per litre of water had similar nutrient digestibility to those receiving the conventional

[#]Corresponding author e-mail: shittumdaniel@gmail.com
Received: 15.03.2022 Received in revised form: 15.05.2022
Accepted: 30.05.2022 Published online: 30.06.2022

antibiotic. Birds in treatments 3-5 had significantly higher white blood cell counts, and lymphocyte, neutrophil and red blood cell counts were significantly higher in T3. Cholesterol levels increased with the concentration of PLLE, which indicates its hypercholesterolaemic quality. It was concluded that PLLE can be used without adversely affecting growth performance and thus provides an alternative to conventional antibiotics.

KEY WORDS: Phytobiotics, blood profile, nutrient digestibility, cholesterol, phytoadditives

INTRODUCTION

There is a global need to eliminate antibiotic growth promoters from animal feed. Phytoadditives in animal nutrition have attracted the attention of many farmers as a potential alternative to antibiotic growth promoters. This is because they are regarded as natural and believed to be free of by-products with residual effects, unlike conventional antibiotics. Phytoadditives, which are additives obtained from plants, are biologically active but may or may not be nutritive. The use of phytoadditives in animal nutrition and as antimicrobials improves performance parameters and prevents disease without compromising the health of consumers. According to Puvaca et al. (2013), a large body of research supports the potential role of phytoadditives as natural, non-antibiotic growth promoters in broiler nutrition. The biological activities of these phytoadditives have been positively assessed with regard to their antibacterial and antioxidant functions (Ruberto et al., 2002; Burt, 2004). Their antiviral, anti-toxigenic, anti-parasitic and insecticidal properties have also been reported by Burt (2004). Currently the use of various additives such as *Polyalthia longifolia* leaf in broiler production is increasing due to their influence on animal growth (Chandaka et al., 2018; Vera et al., 2021), with the aims of attaining the expected growth rate within the shortest time possible and reducing production costs, given the growing population in both developed and developing countries of the world.

Achieving these objectives has been hampered not only by the cost of production but also by diseases caused by many pathogenic microorganisms. The intestinal microbiome contains various bacterial species that consume amino acids and energy for their growth and colonization. Thus, a low bacterial population during the first few weeks post-hatch may provide an advantage to the host in terms of nutrient utilization. A microbiota capable of intense metabolic activity has both beneficial and detrimental effects on the host animal. It has been hypothesized that the gut microbiota decreases nutrient absorption by increasing GIT thickness and the passage rate, and also by competing with the host animal for dietary nutrients (Apajalahti et al., 2004). The solution is to control the population to a level that will not negatively affect the bird, using either conventional antibiotics or phytobiotics. There have been many arguments against the use of conventional antibiotics, including their contribution to acquired resistance in pathogenic organisms and the presence of antibiotic residues in meat and egg products from the chickens (Grashorn, 2010). This led to the ban on antibiotics in animal diets in the European Union in 2006. Developing countries have embraced alternatives for the same reason. Therefore, there is an urgent search for safe antibiotic alternatives that can be used to control pathogenic microorganisms on farms, leading to the use of numerous prebiotics, probiotics, organic acids, enzymes, silicates and phytobiotics with potential to replace antibiotic growth promoters in animal diets. Medicinal plants have been part of the culture of various countries around the world. Phytobiotics are well known for their pharmacological effects and thus are widely used in traditional and alternative human medicine (Grashorn, 2010). They are also added to animal feed to improve performance and control pathogenic microorganisms. Examples of such products include turmeric, garlic, and plant leaves such as *Polyalthia longifolia*.

Polyalthia longifolia is a phytobiotic belonging to the family Annonaceae. The therapeutic efficacy of *Polyalthia longifolia* is exploited in traditional Indian medicine for the treatment of various ailments, and scientific investigation has confirmed its significant medicinal properties (Faizi et al., 2003). The proximate composition and the phytochemical and mineral composition of mature *Polyalthia longifolia* leaves have been analysed by Ojewuyi et al. (2014). According to the authors, they contained 10% protein; 5% ash; 0,26% lipids; 19% fibre; 9% moisture and 57% carbohydrates. Quantification of phytochemicals revealed that *Polyalthia longifolia* leaves contained 3,69 (ppm) tannins; 0,33 (ppm) phenols and 63% flavonoids. The mineral analysis of the sample showed that it contained appreciable quantities of minerals: Na (30,03 mg/100 g), K (23,55 mg/100 g), Ca (89,18 mg/100 g) and Mg (27,55 mg/100 g). The report (Ojewuyi et al., 2014) showed that the leaves contain high levels of carbohydrates and fibre and low levels of fat and phenols, but are very rich in minerals. These findings suggest that the leaves of *Polyalthia longifolia* might be a potential source of carbohydrates, fibre, phytochemicals and mineral elements for human and animal use. Therefore, this research was designed to investigate the usefulness of *Polyalthia longifolia* in broiler production.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.

Collection and preparation of *Polyalthia longifolia* extract

Polyalthia longifolia leaves were collected from the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria. The leaves were weighed and washed in clean water, rinsed using distilled water, and then chopped with a sharp knife on a clean chopping board into smaller pieces to enable easy manual squeezing for the aqueous extract. Varied quantities of fresh leaves (15 g, 30 g and 45 g) were hand-squeezed to obtain the extract in a similar quantity of distilled water, twice a week from the first week of the experiment. The varied concentrations of extract were added to the same quantity of drinking water twice every week.

Experimental animals and management

A total of 180 one-day-old commercial broiler chicks (Arbor Acres strain) were purchased from a reputable hatchery in Ibadan. The birds were weighed on arrival and randomly allocated to five groups with three replicates of twelve birds in a completely randomized design. The chicks were raised under controlled temperature for three weeks. Feed and water were given to the experimental birds *ad libitum*, and other procedures such as vaccination, medications and bleeding were performed according to veterinary instructions as stipulated by the institution. The animal housing and management were similar throughout the experimental period. The birds were managed intensively in a deep litter system. The experiment lasted for 49 days (7 weeks). The feed was weighed daily, and the leftover feed was subtracted from the feed provided to determine the daily feed intake. Weight changes were determined weekly.

Administration of *Polyalthia longifolia* extract

Administration of *Polyalthia longifolia* began on the third day of the experiment. Five experimental treatments were prepared as follows:

Treatment 1: neither *Polyalthia longifolia* nor antibiotics (negative control)

Treatment 2: conventional antibiotic (active ingredient tetracycline) administered twice a week (positive control)

Treatment 3: 15 g of *Polyalthia longifolia* leaf extract/litre of water

Treatment 4: 30 g of *Polyalthia longifolia* leaf extract/litre of water

Treatment 5: 45 g of *Polyalthia longifolia* leaf extract/ litre of water

Experimental diets

The same broiler starter and finisher feeds were given to all the experimental birds. The dosage of *Polyalthia longifolia* in the drinking water was the only variation (Table 1).

Data collection

Growth parameters

Initial weight was recorded as the body weight of the day-old chicks on arrival from the hatchery, and final weight was the body weight of the birds at the end of the experiment, before slaughter. Initial weight was subtracted from final weight to obtain weight gain. Daily feed intake was the amount of feed consumed by each bird per day, and average total feed intake was estimated as the total feed consumed by each bird. The feed conversion ratio was calculated as feed intake divided by body weight gain. Mortality was calculated as a percentage.

Digestibility trial

On the 43rd day of the study, two birds per replicate were allowed a three-day adjustment period in a metabolic battery cage, during which faecal samples were not collected. Thereafter, faecal samples were collected for the next three days. The birds on the conventional antibiotic and *Polyalthia longifolia* extract were given the usual drug and test ingredient during the three days of faecal collection. The fresh faecal samples were oven-dried and then weighed using a sensitive digital scale. The feed intake for three days was also recorded per bird, and the faecal samples for each bird were pooled and transferred to the laboratory for proximate analysis.

Haematology and serum analysis

At day 46, two birds were randomly selected from each replicate for blood analysis. The birds were bled by puncturing the jugular vein to withdraw 5 ml of blood from each bird. The samples for testing of haematological parameters were collected into bottles containing EDTA (ethylenediaminetetraacetic acid), while samples for serum biochemistry analysis were collected into bottles free of EDTA. Selected haematological and serum biochemical parameters were measured as described by Shittu et al. (2013).

Ethics approval

According to local regulations such approval is not required.

Laboratory analysis

The experimental diets and faecal samples were subjected to proximate analysis according to the AOAC (1990) procedure at the Animal Production and Health Laboratory, LAUTECH, Ogbomoso.

Statistical analysis

All data collected were subjected to one-way analysis of variance (ANOVA) using IBM SPSS version 21, and significant means were separated using Duncan's multiple range test in the same software. Significance was determined at $p < 0{,}05$.

RESULTS AND DISCUSSION

Table 1 shows the gross compositions and proximate compositions of the starter and finisher diets. The crude protein was similar to NRC (1994) recommendation for broiler chickens. The cost of the broiler starter diet was higher than that of the finisher diet, possibly due to the lower crude protein percentage in the latter. Crude protein-based ingredients such as soybeans are known to be more expensive than energy and fibre sources. One of the most common and sought after plant protein feedstuffs is soybean meal. Reducing its inclusion level will dramatically reduce the cost of feed. The high cost of soybeans may be due to the high cost of importing them. According to a USDA (2015) report, the leading soybean-producing countries in the world were the United States, Brazil and Argentina, responsible for 83% of global production and 88,9% of soybean grain exports.

Table 1

Gross composition of experimental starter and finisher diets

Materials	Starter (%)	Finisher (%)
Maize	45,00	48,50
Soya meal	33,00	27,00
Wheat offal	11,00	10,00
Fish meal (72%)	2,50	1,50
Maize bran	5,00	10,00
Bone meal	1,50	1,00
Limestone	1,00	1,00
Lysine	0,25	0,25
Methionine	0,25	0,25
*Premix	0,25	0,25
Salt	0,25	0,25
TOTAL	**100,00**	**100,00**
Calculated analysis		
Crude protein (%)	22,87	19,97
ME (joules)	11.797.01	11.879.10
Crude fibre (%)	4,61	4,79
Ether extract	4,87	4,08
Calcium (%)	1,15	0,90
Phosphorus (%)	0,45	0,33
Cost of 1 kg feed (₦)	134,20	108,16

***** Premix composition per kg diet: vit A, 13,000 IU; vit E, 5 mg; vit D_3, 3000 IU, vit K, 3 mg; vit B_2, 5,5 mg; niacin, 25 mg; vit B_{12}, 16 mg; choline chloride, 120 mg; Mn, 5,2 mg; Zn, 25 mg; Cu, 2,6 g; folic acid, 2 mg; Fe, 5 g; pantothenic acid, 10 mg; biotin, 30,5 g; antioxidant, 56 mg

The growth responses of broiler chickens receiving *Polyalthia longifolia* extracts are presented in Table 2. The results indicate that there were no significant ($p > 0,05$) differences in final weight, daily weight gain, total weight gain, feed conversion ratio, or cost per kg weight gain. There was significant (p

≤ 0,05) variation in daily feed intake and average total feed intake. The daily feed intake of broiler chickens receiving a conventional antibiotic and those receiving *Polyalthia longifolia* aqueous extracts was similar (92,44 g; 94,38 g; 94,38 g; 93,92 g and 93,75 g for T2, T3, T4 and T5, respectively). The broiler chickens receiving the conventional antibiotic and test extract had improved feed intake compared with the negative control. The cost per kg weight gain was also more favourable in the treatments with *Polyalthia longifolia* aqueous extracts. The improved daily weight gain of broilers given 45 g *Polyalthia longifolia* aqueous extracts per litre of water might have been aided by the many phytonutrients in the leaf extract. According to Ojewuyi et al. (2014), the nutritional composition of each medicinal plant is of huge importance. Each medicinal plant species has its own nutrient composition, which is unique among plants. These nutritional compositions are essential for the physiological functions of the body. According to Ojewuyi et al. (2014), nutrients and biomolecules present in phytobiotics, such as carbohydrates, fats and proteins, play an important role in satisfying human needs for energy and life processes. Minerals and vitamins are also very important constituents. The body usually contains small amounts of these minerals, which are components of many enzymatic processes and metabolic mechanisms, thus contributing to the growth of living organisms (Ormsbee et al., 2014; Muhammad et al., 2020).

Table 2

Growth performance of broiler chickens given varied concentrations of *Polyalthia longifolia* aqueous extract

Parameters	T1	T2	T3	T4	T5	SEM	P-value
Initial weight (g)	46,00	46,00	45,00	45,00	45,00	-	-
Final weight (kg)	2,21	2,22	2,22	2,20	2,18	4,72	0,25
DWG (g)	44,99	45,29	45,28	49,87	44,57	0,95	0,25
DFI (g)	92,44^{b}	94,38^{a}	94,38^{a}	93,92^{ab}	93,75^{ab}	0,14	0,00
ATFI (kg)	4,53^{b}	4,63^{a}	4,63^{a}	4,60^{a}	4,59^{b}	4,99	0,00
FCR (g)	2,08	2,08	2,08	2,09	2,10	0,05	0,17
CWG (₦)	225,98	239,42	222,75	221,60	224,11	4,50	0,17
Mortality (%)	33,33	5,55	2,75	5,55	5,55	-	-

a, b - means with different superscripts in the same row are significantly different at P ≤ 0,05. T1 – Treatment 1 (negative control), T2 – Treatment 2 (positive control), T3 – Treatment 3 (15 g *Polyalthia longifolia*/L of water), T4 – Treatment 4 (30 g *Polyalthia longifolia*/L of water), T5 – Treatment 5 (45 g *Polyalthia longifolia/*L of water), price/kg feed = ₦ 108,16; DWG – daily weight gain, DFI – daily feed intake, ATFI – average total feed intake, FCR – feed conversion ratio, CWG – cost/kg weight gain (₦), SEM – standard error of mean

Exploitation of the antibacterial properties of the tested plant extract may be a good way to precondition the gut of the broiler against many pathogenic organisms. Pharmacological studies by various researchers have shown that *Polyalthia longifolia* possesses significant biological and pharmacological activity, including antibacterial, antifungal, antitumor, anti-ulcer and antioxidant properties (Jothy et al., 2013; Chandaka et al., 2018). Likewise, Sumitra et al. (2011) reported antimicrobial activity of *Polyalthia longifolia* against 18 microorganisms, including gram-positive and gram-negative bacteria. Also, about 33.33% mortality was recorded in the negative control, while birds offered *Polyalthia longifolia* had lower mortality of 5,55%, which is comparable to the level obtained in the positive control (T2). The high death rate recorded in the negative control (NC) may be due to management challenges during the rearing of the birds without antibiotics. This finding supports the report of Subramanion et al. (2013) that *Polyalthia longifolia* is an ancient remedy worth exploring for novel therapeutic agents.

Apparent nutrient digestibility in the broiler chickens receiving varied concentrations of *Polyalthia longifolia* leaf aqueous extract is presented in Table 3. The results show significant ($p \leq 0,05$) differences in all nutrient digestibility parameters. Nutrient digestibility improved with the administration of *Polyalthia longifolia* leaf extract. *Polyalthia longifolia* may contain valuable phytonutrients that are easily digestible for broiler chickens and may improve the digestibility of the feed ingredients. According to Ronald et al. (2014), phytochemicals or phytonutrients are compounds present in food that have the capacity to alter biochemical reactions and consequently affect health. This might have helped the chickens to digest the nutrients or triggered the secretion of digestive enzymes, further improving digestion. In contrast, according to Egbuna and Ifemeje (2015), phytochemicals help in the overall maintenance of the health of an organism, but in excess some phytochemicals may reduce nutrient intake. This suggests that the concentrations of the *Polyalthia longifolia* leaf extract used in this experiment were appropriate. Ifemeje et al. (2014) established that while phytonutrients help to strengthen the body's defence mechanisms by acting as antioxidants, moderate consumption should be recommended so that they will not act as anti-nutrients.

Table 3

Nutrient digestibility in broiler chickens given varied concentrations of *Polyalthia longifolia* extract

Treatments (%)	T1	T2	T3	T4	T5	SEM	P-value
Crude protein	$79,83^{ab}$	$80,95^{a}$	$71,05^{b}$	$86,42^{a}$	$86,39^{a}$	1,67	0,00
Ether extract	$71,81^{b}$	$84,44^{a}$	$77,69^{ab}$	$78,42^{ab}$	$83,74^{a}$	1,56	0,04
Crude fibre	$79,06^{ab}$	$88,96^{a}$	$75,84^{b}$	$79,77^{ab}$	$85,68^{ab}$	1,62	0,00
Ash	$67,31^{b}$	$68,34^{ab}$	$59,99^{c}$	$79,60^{ab}$	$83,32^{a}$	2,49	0,00
NFE	$86,23^{b}$	$86,23^{b}$	$87,34^{a}$	$86,54^{b}$	$87,90^{a}$	0,16	0,01

a, b - means with different superscripts in the same row are significantly different at $P \leq 0,05$. T1 – Treatment 1 (negative control), T2 – Treatment 2 (positive control), T3 – Treatment 3 (15 g *Polyalthia longifolia*/L of water), T4 – Treatment 4 (30 g *Polyalthia longifolia*/L of water), T5 – Treatment 5 (45 g *Polyalthia longifolia*/L of water), NFE – nitrogen-free extract, SEM – standard error of mean

Table 4 shows the results of the haematological response of broiler chickens offered varied levels of *Polyalthia longifolia* extract. There were significant differences ($p \leq 0,05$) in the packed cell volume, red blood cell, white blood cell, lymphocyte, neutrophil, and platelet counts, mean cell volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration, while there were no significant differences ($p > 0,05$) in haemoglobin and basophils. Treatment 3 (broilers given 15 g/litre of *Polyalthia longifolia* extract) had higher packed cell volume (PCV) and higher WBC, lymphocyte, neutrophil, and RBC counts compared to other treatments. The lowest mean values for WBC, lymphocyte and neutrophil counts were recorded in treatment 2. Haematological parameters help to understand the health status of the broiler chickens receiving different concentrations of *Polyalthia longifolia* aqueous extract. Apart from growth and nutrient digestibility, there is a need to establish the health status of animals, so the farmer will know how they respond to different dietary treatments. According to Khan and Zafar (2005), haematological parameters are good indicators of the physiological status of animals. They have been described as a pathological reflector of the status of animals exposed to toxins and other conditions (Olafedehan et al., 2010). As established by Isaac et al. (2013), animals with good blood composition are likely to show good performance. The packed cell volume obtained in T1 (negative control) and in chickens receiving 15 g *Polyalthia longifolia*/L of water (T3) was similar. The reduction in PCV at higher concentrations may be a serious signal indicating the maximum level of *Polyalthia longifolia*/L of water that can be tolerated by broilers.

Table 4

Haematological results of broiler chickens given varied levels of *Polyalthia longifolia* extract

Parameters	T1	T2	T3	T4	T5	SEM	P-value
PCV	27,00[a]	27,00[a]	28,62[a]	25,50[b]	25,50[b]	0,00	0,01
WBC (x10^6/L)	9,75[b]	5,45[c]	10,75[a]	11,65[a]	10.70[a]	0,54	0,00
Heterophils (%)	32,00[ab]	38,00[a]	22,50[b]	34,00[ab]	22,00[b]	2,02	0,02
Lymphocytes (%)	50,50[a]	34,50[b]	51,50[a]	40,00[ab]	42,50[ab]	2,25	0,03
Neutrophils (%)	1,00[a]	1,00[b]	2,50[a]	0,50[a]	1,00[b]	0,16	0,00
Basophils (%)	9,00	4,00	7,50	15,00	9,00	1,26	0,08
Platelets (%)	4,50[c]	22,50[a]	14,50[b]	10,50[b]	25,00[a]	0,22	0,00
Haemoglobin (g/dL)	8,40	8,70	8,40	8,40	8,90	0,08	0,16
Mean cell volume (f1)	80,00[a]	79,50[b]	77,50[c]	79,00[b]	78,00[a]	0,20	0,00
MCH (pg)	24,85[c]	25,60[b]	24,30[c]	26,15[b]	27,35[a]	0,22	0,00
MCHC (g/dL)	31,05[b]	32,20[b]	30,90[c]	32,90[b]	34,90[a]	0,30	0,00
Red blood cell (x10^6/L)	3,37[ab]	3,39[ab]	3,45[a]	3,19[c]	3,25[bc]	0,02	0,01

a,b,c - means with different superscripts along the same row are significantly different at $P \leq 0,05$. MCH – Mean corpuscular haemoglobin, MCHC – Mean corpuscular haemoglobin concentration, T1 – Treatment 1 (negative control), T2 – Treatment 2 (positive control), T3 – Treatment 3 (15 g *Polyalthia longifolia*/L of water), T4 – Treatment 4 (30 g *Polyalthia longifolia*/L of water), T5 – Treatment 5 (45 g *Polyaltha longifolia* /L of water), PCV – packed cell volume, WBC – white blood cell count, SEM – standard error of mean

Haematological parameters are valuable in monitoring feed toxicity, especially in the case of feed constituents that affect the blood as well as the health status of farm animals (Amusa et al., 2015). T3 had a significantly ($p \leq 0,05$) higher count of red blood cells (erythrocytes), which serve as a carrier of haemoglobin. This haemoglobin reacts with oxygen carried in the blood to form oxyhaemoglobin during respiration (Chineke et al., 2006). Red blood cells are also actively involved in the transport of oxygen and carbon dioxide in the animal body (Isaac et al., 2013). Thus, a reduction in the red blood cell count implies a reduction in the level of oxygen carried to the cells/tissues (Soetan et al., 2013) which was observed at higher concentrations of the *Polyalthia longifolia* extract.

Polyalthia longifolia was once regarded as a cure-all because of its numerous medicinal benefits. According to Subramanion et al. (2013), the Greek word *polyalthia* is composed of *poly*, meaning much or many, and *althia* from *àltheo*, meaning to cure, indicating its multiple health benefits. The genus *Polyalthia* comprises about 120 species occurring mainly in South Africa, Southeast Asia, Australia, and New Zealand (Katkar et al., 2010). *P. longifolia* is one of the most common and important local plants in India and is widely used in traditional medicine as a febrifuge and a tonic (Subramanion et al., 2013).

Table 5 shows the serum biochemistry of broiler chickens offered *Polyalthia longifolia* extract in different concentrations. All serum parameters were significantly different ($p \leq 0{,}05$) except alkaline phosphatase and albumin, although they remained within the recommended values according to Mitruka and Rawnsley (1977). The results show that aspartate aminotransferase (AST) and alanine transaminase (ALT) were significantly ($P < 0{,}05$) affected by varied concentrations of *Polyalthia longifolia* leaf extract compared to both the positive and negative controls. The similar alkaline phosphatase values recorded in all treatments shows that both industrial antibiotics and *Polyalthia longifolia* leaf aqueous extract triggered alkaline phosphatase production in the same way or at the same level, which encouraged a similar alkaline environment. According to Kirti et al. (2012), alkaline phosphatase is a metalloenzyme which exhibits optimal catalytic activity in an alkaline environment. The highest AST was observed in broilers receiving 45 g/L of *Polyalthia longifolia* (146.33 IU/L), while the lowest AST value was recorded in birds given conventional antibiotics (126,53 IU/L). Therefore changes in AST may be a signal of damage to the liver and other organs as well. According to Lu (2017), alkaline phosphatase activity is present in the liver, bone, kidney, small intestine and other organs of the body, while ALT activity originates mainly in the liver, with most of the remainder coming from the skeleton. The main function of ALP is to hydrolyse inorganic pyrophosphate to generate phosphate, which is used in the formation of calcium hydroxyapatite (calcium hydroxyapatite helps bone structure to support and fortify existing skeletal structure). Its significant increase is a sign of liver or bone disease. ALP is the preferred marker for bone turnover because its clearance does not depend on glomerular filtration (Lu, 2017). The ALT values obtained for all the treatments were higher than the values reported by Anigboro et al. (2018) following administration of *Polyalthia longifolia* extracts to Alloxan-induced diabetic rats. The differences may be due to species variation.

Table 5
Serum biochemical indices in broilers given *Polyalthia longifolia* leaf extract

Parameter	T1	T2	T3	T4	T5	SEM	P-value
AP (IU/L)	46,90	48,09	48,00	47,90	48,04	7,27	0,12
AST (IU/L)	129,83[b]	126,53[b]	140,04[a]	141,35[a]	146,33[a]	1,95	0,00
ALT (IU/L)	5,72[b]	6,20[b]	8,60[a]	9,12[a]	8,16[a]	0,32	0,00
Total protein (mg/l)	30,76[b]	27,84[b]	34,96[b]	30,00[b]	46,24[a]	1,72	0,00
Albumin (mg/l)	14,17	17,17	18,38	15,98	16,46	0,51	0,11
Globulin (mg/l)	16,59[b]	10,67[b]	16,35[b]	14,02[b]	29,77[a]	1,54	0,00
Cholesterol (mg/dl)	90,65[c]	94,73[b]	100,46[b]	95,98[b]	102,33[a]	1,68	0,00
Urea (mg/dl)	6,90[b]	6,45[b]	13,42[a]	5,81[b]	6,58[b]	0,61	0,00
Creatinine (mg/dl)	0,29[b]	0,26[c]	0,24[d]	0,26[c]	0,34[a]	0,00	0,00

a,b,c,d - means with different superscripts in the same row are significantly different at $P \leq 0,05$. T1 – Treatment 1 (negative control), T2 – Treatment 2 (positive control), T3 – Treatment 3 (15 g *Polyalthia longifolia*/L of water), T4 – Treatment 4 (30 g *Polyalthia longifolia*/L of water), T5 – Treatment 5 (45 g *Polyalthia longifolia*/L of water), AP – alkaline phosphatase, AST – aspartate aminotransferase, ALT – alanine transaminase, SEM – standard error of mean

A significantly increased level of cholesterol in all the treated groups compared to both the positive and negative controls indicated a hypercholesterolaemic effect of the *Polyalthia longifolia* extract on broiler chickens. Thus this study revealed that *Polyalthia longifolia* extract may alter the lipid profile of broiler chickens. The results here were in line with the report of Jayaraman and Christina (2013), who administered methanolic extract of *Polyalthia longifolia* to rats.

CONCLUSION AND RECOMMENDATION

Conclusion

The extract of *Polyalthia longifolia* leaf in broiler production resulted in a similar growth rate as in the case of conventional antibiotics and also increased nutrient digestibility.

Recommendation

Polyalthia longifolia leaf extract can be administered at concentrations up to 45 g/litre of water in broiler chicken production, but the farmer must be careful to monitor the organ response, since the serum parameters of the broiler chickens were greatly influenced. *Polyalthia longifolia* leaf extract can be recommended to farmers to improve growth rate in broiler chickens and reduce the costs of medication, as it has been shown to boost the immune system.

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