

Clinical Investigations and Research

Research Article

Effect of Feeding Different Levels of Terminalia Arjuna Stem Bark Extract on The Hematological and Serum Biochemical Parameters of Guinea Fowl

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Abstract

A total of 300 one-day old guinea fowl chicks of mixed sex (Lavender variety) were randomly assigned to five treatments with six replicates per treatment and ten birds per cage. The control group (treatment 1) received a standard basal diet while the others (treatment 2, 3, 4 and 5) were fed same diet supplemented with varying doses of Terminalia arjuna stem bark extract at 5.0 mL, 10.0 mL, 15.0 mL and 20.0 mL per liter of water. The standard basal diet used in this experiment was corn-soya based meal which was in line with the Nutritional Research Council's requirement in 1994. They had free access to fresh clean water and feed and the experiment lasted for 90 days. Screening of phyto-components in Terminalia arjuna stem bark extract revealed the presence of phenols, flavonoids and triterpenoids in significant concentration while alkaloids, tannins and glycosides were the other compounds. Haemoglobin, hematocrit, total erythrocytes, total leucocytes, total platelet count, mean platelet count, eosinophils and lymphocytes values were influenced ($p < 0.05$) by the treatment except for basophil count ($p > 0.05$). Total protein, glucose, cholesterol, calcium, phosphorus, sodium, chloride values were affected ($p < 0.05$) except for creatinine, urea and activities of alanine transaminase, aspartate amino transferase and alkaline phosphatase. However, all values obtained were within the normal reference range for a healthy guinea fowl suggesting that birds can be fed Terminalia arjuna stem bark extract up to 20.0 mL per liter without compromising their health status.

Keywords: Guinea fowl, Phytocomponents, Haematology, Serum, Terminalia arjuna.

Introduction

The use of medicinal plants has been significantly gaining global interest due to the increasing awareness on the health dangers on the indiscriminate use of antibiotics, antimicrobial resistance as well as the possibility of toxic chemicals or substance in animal's product which have been reported to be the major cause of serious ailments in human being (Alagbe et al., 2024; John, 2024c). Herbal plants have also been reported to be safe and identified to be loaded with nutritional and medicinal compounds (phytochemicals) making them potential feed additives for birds and other livestock

(Alagbe, 2024; John, 2024b). These phytochemicals can be used as natural growth promoters and improve animal health and sustainability (Alagbe and Anuore, 2024; John, 2024a). Terminalia arjuna is a potential medicinal plant classified under the family Combretaceae. The tree is deciduous, evergreen and can grow up to 30 meters in height with over 150 species widely dispersed throughout tropical and subtropical regions of the world (Oberoi et al., 2011; Filipiak-Szok et al., 2018). Phytochemical evaluation of Terminalia arjuna stem bark revealed the presence of wide number of bioactive

compounds including, phenols, alkaloids, tannins, saponins, flavonoids, triterpenoids and glycosides (Khatkar et al., 2019; Kumar et al., 2017) which contributes to their relevant therapeutic or pharmacological properties viz: anti-inflammatory (Parveen et al., 2011; Bachaya et al., 2009), antioxidant, anti-helminthic, antiviral (Desai and Chanda, 2014; Kumar et al., 2017), antifungal, antidiarrheal (Moulisha et al., 2011; Gopinath et al., 2014), cytotoxic, antioxidant, anti-tumor, anticancer, gastro-protective (Pawar, R.S.; Bhutani, 2005; Gholipour et al., 2018), immune-stimulatory, hypolipidemic, hepato-protective, antidiabetic amongst others (Omokore and Alagbe, 2019).

The ethno medicinal usage of *Terminalia arjuna* stem bark includes the treatment of stomach disorders, heart failure, skin diseases, fever, pains, asthma, tumors, ischemia, atherosclerosis amongst others (Gaikwad and Jadhav, 2018; Kasote et al., 2015). Methanolic and ethanolic extracts from *Terminalia arjuna* stem bark have also been reported to inhibit the growth of some pathogenic organisms including, *Escherichia coli*, *Pseudomonas* spp, *Salmonella* spp, *Staphylococcus* spp, *Proteus mirabilis*, *Bacillus subtilis*, *Klebsiella pneumoniae* amongst others (Sarveswaran et al., 2006; Subramaniam et al., 2011). Previous report had also established that *Terminalia arjuna* stem bark is rich in antioxidants thus helping to promote health by neutralizing the activities of free radicals in the body (Goswami et al., 2020; Amalraj and Gopi, 2017). Gas Chromatography-Mass Spectrometry (GC-MS) analysis of *Terminalia arjuna* stem bark revealed the presence of 2a,3b-dihydroxyurs-12,18-oic acid, 28-O- b-D-glucopyranosyl ester, 2a,3b,23-trihydroxyurs- 12,18-dien-28-oic acid, 28-O-b-glucopyranosyl ester, Qudranoside VIII, 2a,3b,23-trihydroxyurs-23- trihydroxyurs-12,19-dien-28-oic acid 28-O-b-D- glucopyranosyl ester, Olean-3b, 22b-diol-12-en-28 b- D-glucopyranoside-oic acid, Oligomeric proanthocyanidins, Arjunetoside (3-O-b-D- glucopyranosyl-2a, 3b, 19a-trihydroxyolean-12-en- 28-oic acid, Pyrocatechols, Punicallin, 2a, 19a- Dihydroxy-3Oxo-Olean-12-En-28-Olic acid 28-O-b-D- glucopyranoside at different concentrations (Singh et al., 2002; Singh et al., 2002).

Previous studies have shown that feeding plant extracts to birds can promote a healthy gut (Daniel et al., 2023; Shittu et al., 2021), enhance feed consumption (Shittu et al., 2024; Aliyu et al., 2024), nutrient digestibility (Adewale et al., 2021; Alagbe, 2021), increase digestive secretion and enzymatic activities at different optimum rates (Musa et al., 2020; Singh et al., 2021). However, there is little or no information on the effect of feeding extracts from *Terminalia arjuna* stem bark on the haematological and serum biochemical parameters of guinea fowl. This research will help to establish standard rates that is no deleterious to the health of birds, promote the use of natural growth promoter and environmental sustainability.

Materials and Methods

Experimental Location, Ethical Approval and Periods

The study was carried out at Sumitra Research Institute's Poultry Unit in Gujarat, India. The experimental procedures and management were approved by the Research and Ethics Committee at the department of Animal Production and Health of Sumitra Research Institute, India. The whole experimental period was 90 days.

Preliminary Preparation Before the Arrival of Guinea fowl

A galvanized battery cage was used for the experiment, before the commencement of the experiment, cages were thoroughly washed and disinfected. Feeders were properly cleaned and the nipple drinker pipes were flushed with Polidine® at 1 ml to 5 liters of water to kill all hidden bacteria or pathogens in the pipes. Electrical bulbs were fixed in each cage to supply heat and illumination to birds. Newspaper was laid in the cage to absorb fecal droppings from birds and for easy movement in the cage.

Collection of *Terminalia arjuna* stem bark and preparation

Fresh and mature *Terminalia arjuna* stem bark was collected from within Sumitra Research Institute's premises in Gujarat. Samples were collected into a clean plastic bucket and taken to the department of Agronomy in Sumitra Institute for proper assessment and approval before it was assigned an entry number AD/009/2-4C. Collected samples were rinsed with clean water and cut into smaller pieces with sharp knife, thereafter, 500 g was taken out of the sample into a clean labeled bucket and soaked in 5 liters of water for 5 days. Samples was stirred thrice daily at different interval. On the sixth day, the resulting extracts were passed through chifon cloth for filtration. After filtration, the extracts were then stored in a refrigerator set at 4°C, awaiting further laboratory examination. Qualitative evaluation of phytochemicals in *Terminalia arjuna* stem bark extract was carried out according to techniques specified by Harbone (1999). In brief, to test for alkaloids, 2 mL of *Terminalia arjuna* stem bark extract was added to 1 mL diluted hydrochloric acid followed by 2 drops of Dragendorff's reagent. The formation of orange brown precipitate is an indication of alkaloids. For flavonoids, 2 mL of *Terminalia arjuna* stem bark extract plus 2 drops of concentrated sulfuric acid. The presence of a pale yellow colour suggest the presence of flavonoids. The presence of tannins was identified when a deep yellowish precipitate was formed after 2 mL of *Terminalia arjuna* stem bark extract was added to 3 drops of 1% lead acetate. The formation of bluish green colour and foam suggest the presence of glycosides and saponins respectively. To screen for triterpenoids, 2 mL of *Terminalia arjuna* stem bark extract was added to concentrated sulfuric acid and the mixture is heated to 70 °C for 5 minutes. The formation a grey colouration indicated the presence of triterpenoids. To test for phenolic compounds, 2 mL of Ter-

Terminalia arjuna stem bark extract was mixed with 1.00 mL of 1.00 percent of sodium hydroxide was added and mixed for 1 min. development is instantaneous. The development of a red colouration indicated the presence of phenols.

Experimental Diet, Design and Animal Management

A total of 300 one-day old guinea fowl chicks of mixed sex (Lavender variety) were purchased from a commercial farm in Gujarat and on arrival to Sumitra Research Institute, birds were weighed with automated digital scale to determine their average initial body weight. Thereafter, it was randomly assigned to five treatments with six replicates per treatment and ten birds per cage. The control group (treatment 1) received a standard basal diet while the others (treatment 2, 3, 4 and 5) were fed same diet supplemented with varying doses of Terminalia arjuna stem bark extract at 5.0 mL, 10.0 mL, 15.0 mL and 20.0 mL per liter of water. The standard basal diet used in this experiment was corn-soya based meal which was in line with the Nutritional Research Council's requirement in 1994. The composition and nutrient levels of basal diet is presented in Table 1. Feed was provided thrice a day (5:30, 12:00 and 15:00 H). Detailed vaccination program used for this study is also displayed in Table 2. Supervis-tress® (anti-stress) was administered in the first one week on the chick's arrival and they had free access to fresh clean water and feed. Performance parameters such as average daily weight gain, average daily feed consumption, gain to feed ratio and mortality were further monitored for 90 days.

Blood Collection and Evaluation

On the 90th day of the experiment, blood samples were collected from the wing vein of ten randomly selected birds per treatment for haematological and serum biochemical evaluation. A total of 4 mL blood sample was collected from each bird; 2mL for haematology into sterile labeled sample bottle with ethylene di-amine tetraacetic acid (anticoagulant) and the remaining for serum analysis was collected into bottles free from anticoagulant. Samples were kept in an ice pack immediately after collection to maintain their quality before they were sent to the biochemistry laboratory at Sumitra Research Institute, Gujarat India for further examination. Haematological parameters were evaluated using an advanced automatic haematological analyzer LHTA - A10, Triangle laser scatter, flow cytometry method, impedance method for hematocrit, red blood cell and platelets counting. Cyanide free method for haemoglobin analysis and 3 D holographic scattergram to display accurate count of leucocytes and its differentials. Serum biochemical parameters were examined using KHB ZY -400 fully automated serum analyzer which works by the principle of colorimetric method - LEDS 340 MM - 900 nm wave length and an adjustable temperature and humidity of 10-32°C /5 to 90 % respectively.

Laboratory Assessment of Experimental Diet

Assessment of experiment diet was done using standard laboratory procedures described by Association of Analytical Chemist in 2000.

Statistical technique employed

Data obtained on haematology and serum biochemical indices were subjected to one -way analysis of variance using SPSS (version 25). Significant differences among the groups were subjected to comparisons using the Duncan multiple range test of the same software. All differences were considered to be statistically significant when $p < 0.05$.

Results and Discussion

The gross composition of standard basal diet is displayed in Table 1. The result showed that starter mash, grower's and finisher's mash contained crude protein (23.61 %, 20.02 %, 18.55 %), crude fibre (3.02 %, 4.21 %, 4.51 %), crude fat (4.15 %, 5.06 %, 5.13 %), calcium (1.28 %, 1.46 %, 1.60 %), phosphorus (0.55 %, 0.62 %, 0.74 %) and energy [(2862.6, 2533.9 and 2775.5 Kcal/kg)] respectively. The nutrient composition of the experimental diet used in this study is in consonance with the recommendation for birds specified by Nutritional Research Council (1994).

Qualitative screening of phyto-components in Terminalia arjuna stem bark extract (Table 3) showed that triterpenoids, flavonoids and phenols are the most prominent compounds in the sample. Other minor compound includes, saponins, tannins, alkaloids and glycosides. These compounds have a wide array of medicinal or pharmacological qualities i.e., they may perform antioxidant (Singh et al., 2022), antifungal (Muritala et al., 2022), gastro-protective (Ojediran 2024a), antiulcer, cyto-protective, anti-helminthic (Ojediran et al., 2024b), chemo- preventive, immune-stimulatory, anti-inflammatory, anticonvulsant, cardio-protective, hypoglycaemic, antibacterial, anti-carcinogenic, antidiabetogenic (John, 2024d), antimicrobial (Omokore and Alagbe, 2019), hepto-protective, anti-diarrhoeal (Shittu et al., 2024), antiviral and analgesics (Muritala et al., 2022). (John, 2024e) reported that the presence of high phenolics, flavonoids and triterpenoids content in medicinal plants showed a positive linear correlation with antioxidant activity of Terminalia arjuna stem bark extract. The result recorded for Terminalia arjuna stem bark extract in this study is in agreement with the reports of Purnimajayaree and Arunkumar (2023); Mandal et al. (2013); Gupta et al. (2018). Fatema et al. (2014) reported that stem bark of Terminalia arjuna possess anti-dysenteric, cardiogenic, lithotriptic, anti-pyretic and astringent properties while the powder of the bark acts as a diuretic in cirrhosis of liver and gives relief in symptomatic hypertension.

Haematological parameters of guinea fowl fed diet supplemented with Terminalia arjuna stem bark extract (Table 4). Haemoglobin, hematocrit, total erythrocytes and total leuco-

cytes count of birds fed treatment 3 (10 mL Terminalia arjuna stem bark extract/liter of water) [(13.69 g/dL, 34.50 %, 6.11 ($\times 10^{12}/L$), 11.59 ($\times 10^9/L$)], treatment 4 (15 mL Terminalia arjuna stem bark extract/liter of water [(13.90 g/dL, 34.07 %, 6.15 ($\times 10^{12}/L$), 11.72 ($\times 10^9/L$)], and treatment 5 (20 mL Terminalia arjuna stem bark extract/liter of water [(14.05 g/dL, 34.84 %, 6.20 ($\times 10^{12}/L$), 12.04 ($\times 10^9/L$)] were statistically comparable ($p>0.05$) while haemoglobin, hematocrit, total erythrocytes and total leucocytes count in treatment 1 (without Terminalia arjuna stem bark extract) [(7.08 g/dL, 25.53 %, 3.00 ($\times 10^{12}/L$), 6.76 ($\times 10^9/L$)] were significantly lower ($p<0.05$). Result obtained in this study was within the reference values haemoglobin (6.69 - 15.22 g/dL), hematocrit (25.50 - 36.00 %), total erythrocytes [(3.30 - 11.00 ($\times 10^{12}/L$)] and total leucocytes [(5.50 - 21.00 ($\times 10^9/L$)] count described by Christev et al. (2011); Baudouin et al. (2021). The result on red blood cell and haemoglobin count suggests the absence of oxygen depletion in the tissues of birds (Daniel et al., 2023). A low hematocrit concentration is a sign of renal disease or anaemia (Alagbe, 2024). Total leucocytes can boost or improve immune defense in birds by enhancing the production of antibodies (Musa et al., 2020). Total platelet count, mean platelet, monocytes, eosinophils and lymphocytes levels of birds fed treatment 1 [(97.47 ($\times 10^9/L$), 7.92 fl, 2.97 %, 4.63 % and 45.56 %)] was significantly ($p<0.05$) lower than those on treatment 2 [(110.5 ($\times 10^9/L$), 9.03 fl, 3.14 %, 5.00 % and 62.12 %)], treatment 3 [(111.2 ($\times 10^9/L$), 9.08 fl, 3.52 %, 5.06 % and 63.08 %)], treatment 4 [(111.6 ($\times 10^9/L$), 9.11 fl, 3.61 %, 5.15 % and 63.11 %)] and treatment 5 [(111.9 ($\times 10^9/L$), 9.13 fl, 3.73 %, 5.28 % and 64.08 %)] respectively. Total platelet count and mean platelet was within baseline values [(90.06 - 130 ($\times 10^9/L$)] and [(6.09 - 10.16 fl)] suggested by Ali et al. (2019); Kawu et al. (2016). Low platelet count can be caused as a result of chronic inflammation or iron deficiency (John, 2024a). Monocyte and lymphocytes play predominant role in defense mechanisms (phagocytosis) (John, 2024e). Their values was within the recommended values 1.92 - 4.00 % and 45.00 - 75.00 % cited by King et al. (2010). Basophils plays predominant role in allergic reactions (John, 2024c) and the values recorded in this study was within the reference rates (0.08 - 1.15 %) reported by Olayemi (2009); Uko and Ataja (1996).

Serum biochemical indices of guinea fowl fed diet supplemented with Terminalia arjuna stem bark extract (Table 5). Total protein, albumin and globulin levels of birds fed treatment 3 (4.96 g/dL, 2.56 g/dL and 2.40 g/dL) treatment 4 (4.89 g/dL, 2.33 g/dL and 2.56 g/dL) and treatment 5 (5.02 g/dL,

2.52 g/dL and 2.50 g/dL) were significantly ($p<0.05$) higher than those which received treatment 2 (4.16 g/dL, 2.07 g/dL and 2.09 g/dL) and treatment 1 (3.95 g/dL, 2.00 g/dL and 1.95 g/dL) respectively. However, values recorded for total protein, albumin and globulin were within 3.00 - 5.65 g/dL, 2.00 - 2.50 g/dL and 1.88 - 3.50 g/dL reported by Harr (2006). These result suggests that the absence of renal, hepatic failure as well as malnutrition among birds (Omokore and Alagbe, 2019). Creatinine [(0.80 - 0.96 $\mu\text{mol}/L$)] and urea [(5.00 - 5.60 mmol/L)] levels were not different ($p>0.05$) among the treatments suggesting that feeding Terminalia arjuna stem bark extract to guinea fowl did not compromise the function of the liver and kidneys (John, 2024c). The urea and creatinine values were within the baseline range [(3.40 - 6.00 ($\mu\text{mol}/L$)] and [(0.20-1.00 mmol/L)] reported by Nikolov et al. (2017). Glucose and cholesterol values which varied from 75.08 - 98.54 mmol/L and 90.07 - 109.32 mmol/L was significantly higher ($p<0.05$) in treatment 1 compared to the other groups. Glucose and cholesterol levels recorded in this study was comparable to the reference values of 80.40 - 110.5 mmol/L and 80.60 - 120.5 mmol/L cited by Obinna et al. (2011). High cholesterol level in the serum of birds can cause damage to their arteries (Alagbe, 2024). Elevated levels in glucose level could occur during periods of stress due to poor management, malnutrition or infections (Alagbe, 2024). Calcium, phosphorus, sodium and chloride levels of birds in treatment 2 [(2.09 mmol/L, 2.31 mmol/L, 131.4 mmol/L and 105.3 mmol/L)], treatment 3 [(2.56 mmol/L, 2.46 mmol/L, 135.6 mmol/L and 109.4 mmol/L), treatment 4 [(2.77 mmol/L, 2.85 mmol/L, 136.3 mmol/L and 110.3 mmol/L) and treatment 5 [(2.96 mmol/L, 2.92 mmol/L, 140.9 mmol/L and 111.7 mmol/L) were similar ($p>0.05$) but higher ($p<0.05$) than those fed to treatment 1[(1.94 mmol/L, 1.72 mmol/L, 112.5 mmol/L and 98.24 mmol/L). Values calcium, phosphorus, sodium and chloride obtained in this experiment was similar to those recorded by Hrubec et al. (2002); Onyeausi (2007). Alanine transaminase, aspartate amino transferase and alkaline phosphatase values which varied from 67.33 - 68.59 (U/L), 45.15 to 47.05 (U/L) and 20.80 to 23.74 (U/L) were not influenced ($p>0.05$) by the treatments suggesting the absence of hepato-cellular damage due to feeding Terminalia arjuna stem bark extract to guinea fowl (Onasanya et al., 2015). Values obtained for alanine transaminase, aspartate amino transferase and alkaline phosphatase recorded in this study is within the reference range of [(41.23 to 70.80 U/L)], [(29.00 - 50.04 U/L)] and [(19.11 - 30.53 U/L)] reported by Keçeci and Çöl (2011); Kerr (2002).

Items	1-4 weeks (starter mash)	5-8 weeks (growers mash)	9-12 weeks (finisher mash)
	Inclusion (%)	Inclusion (%)	Inclusion (%)
Maize	53.00	42.00	50.00
Wheat bran	2.00	16.00	13.00

Soya bean meal	34.00	30.00	27.0
Fish meal	2.50	1.50	2.00
Limestone	2.50	3.00	2.00
Bone meal	5.00	6.00	4.00
Lysine	0.25	0.20	0.25
Methionine	0.25	0.20	0.25
*Mineral and Vitamin Premix	0.25	0.25	0.30
Common salt	0.35	0.40	0.40
Total	100.0	100.0	100.0
Determined analysis			
Crude protein (%)	23.61	20.02	18.55
Crude fibre (%)	3.02	4.21	4.51
Crude fat (%)	4.15	5.06	5.13
Calcium (%)	1.28	1.46	1.60
Phosphorus (%)	0.55	0.62	0.74
Metabolizable energy (Kcal/kg)	2862.6	2533.9	2775.5

Table 1: Gross composition of standard basal diet fed to Guinea fowl

Days	Vaccines	Administration method
6	Lasota (First dose)	Water
12	Gumboro (First dose)	Water
19	Lasota (Second dose)	Water
22	Gumboro (Second dose)	Water
40	Fowl typhoid (First dose)	Intramuscular
65	Fowl pox (First dose)	Wing web

Table 2: Vaccination program for Guinea fowl fed diet supplemented with Terminalia arjuna stem bark extract

Phyto-components	Outcome
Triterpenoids	++
Flavonoids	++
Alkaloids	+
Tannins	+
Phenols	++
Saponins	+
Glycosides	+

Table 3: Qualitative screening of phyto-components in Terminalia arjuna stem bark extract

+ Present, ++ abundantly present

Variables	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	SEM
Haemoglobin (g/dL)	7.08c	10.64b	13.69a	13.90a	14.05a	0.69

Hematocrit (%)	25.53c	30.06b	34.50a	34.07a	34.84a	0.21
Total erythrocytes (×10 ¹² /L)	3.00c	4.04b	6.11a	6.15a	6.20a	0.03
Total leucocytes (×10 ⁹ /L)	6.76c	9.38b	11.59a	11.72a	12.04a	0.05
Total platelet count (×10 ⁹ /L)	97.49b	110.5a	111.2a	111.6a	111.9a	35.71
Mean platelet volume (fl)	7.92b	9.03a	9.08a	9.11a	9.13a	0.04
Monocytes (%)	2.97b	3.14a	3.52a	3.61a	3.73a	0.02
Eosinophils (%)	4.63b	5.00a	5.06a	5.15a	5.28a	0.02
Basophils (%)	1.02	1.13	1.15	1.20	1.29	0.01
Lymphocytes (%)	45.56b	62.12a	63.08a	63.11a	64.08a	15.92

Table 4: Haematological parameters of guinea fowl fed diet supplemented with Terminalia arjuna stem bark extract

Values followed by different letters were significantly different ($p < 0.05$); Treatment 1: standard basal diet without Terminalia arjuna stem bark extract; treatment 2, 3, 4 and 5 received standard basal diet with Terminalia arjuna stem bark extract at 5.0, 10.0, 15.0 and 20.0 mL per liter of water; SEM: standard error of mean

Variables	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	SEM
Total protein (g/dL)	3.95c	4.16b	4.96a	4.89a	5.02a	0.05
Albumin (g/dL)	2.00c	2.07b	2.56a	2.33a	2.52a	0.21
Globulin (g/dL)	1.95c	2.09b	2.40a	2.56a	2.50a	0.20
Creatinine (μmol/L)	0.96	0.88	0.89	0.80	0.82	0.02
Urea (mmol/L)	5.00	5.21	5.30	5.54	5.60	0.06
Glucose (mmol/L)	98.54a	76.43b	75.32b	75.21b	75.08b	16.83
Cholesterol (mmol/L)	109.32a	95.66b	90.70b	90.50b	90.07b	20.40
Calcium (mmol/L)	1.94b	2.09a	2.56a	2.77a	2.96a	0.02
Phosphorus (mmol/L)	1.72b	2.31a	2.46a	2.85a	2.92a	0.01
Sodium (mmol/L)	112.5b	131.4a	135.6a	136.3a	140.9a	34.65
Chloride (mmol/L)	98.24b	105.3a	109.4a	110.3a	111.7a	30.21
ALT (U/L)	67.33	68.07	68.33	68.50	68.59	13.49
AST (U/L)	45.15	46.26	46.45	46.73	47.05	9.72
ALP (U/L)	20.80	23.05	23.11	23.64	23.74	3.85

Table 5: Serum biochemical indices of guinea fowl fed diet supplemented with Terminalia arjuna stem bark extract

Values followed by different letters were significantly different ($p < 0.05$); Values followed by different letters were significantly different ($p < 0.05$); Treatment 1: standard basal diet without Terminalia arjuna stem bark extract; treatment 2, 3, 4 and 5 received standard basal diet with Terminalia arjuna stem bark extract at 5.0, 10.0, 15.0 and 20.0 mL per liter of water; SEM: standard error of mean, ALT; alanine transaminase, AST; aspartate amino transferase and ALP; alkaline phosphatase

Conclusion

Terminalia arjuna stem bark extract revealed the presence of numerous phytochemicals such as tannins, flavonoids, glycosides, triterpenoids, alkaloids, saponins amongst others which contributes to the plants usefulness as therapeutic agent. Outcome on haematology and serum biochemical indices of guinea fowl showed that feeding Terminalia arjuna stem bark extract up to 20.0 mL per liter had no deleterious effect on their blood performance and health status.

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