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Impact of Dietary *Vitex doniana* Leaf Meal on Blood Haematology and Serum Biochemistry of Starter Broiler Chickens

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Abstract

Feed cost remains the most critical challenge confronting poultry farmers, largely due to competition between humans and livestock for conventional protein-rich feed ingredients such as maize and soybean meal. This has necessitated the search for alternative feed resources, including non-conventional leafy materials. This study evaluated the effects of Vitex doniana *leaf meal (VDLM) on the haematological and serum biochemical indices of broiler chickens during the starter phase. A total of 120 unsexed day-old broiler chicks were randomly allotted to four dietary treatments: T1 (0.0% VDLM), T2 (2.5% VDLM), T3 (5.0% VDLM), and T4 (7.5% VDLM), each replicated three times with ten birds per replicate, in a Completely Randomised Design. Data were collected on haematological parameters including packed cell volume, red blood cell count, haemoglobin concentration, white blood cell count, lymphocytes, neutrophils, mean corpuscular indices, and platelet count, as well as serum biochemical indices such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol, albumin, globulin, urea, glucose, total protein, and creatinine. The results revealed that most haematological and serum biochemical parameters differed significantly ($P < 0.05$) across treatments, except haemoglobin concentration and mean corpuscular haemoglobin concentration, which were not significantly affected ($P > 0.05$). The inclusion of VDLM at increasing levels influenced immune-related parameters such as lymphocytes and neutrophils, while alterations in liver enzyme activities (AST, ALT, ALP) and lipid profile indices suggested potential metabolic adjustments. Overall, the findings indicate that while VDLM can elicit physiological responses in broiler starters, higher inclusion levels may impose metabolic stress without conferring appreciable haematological benefits. It is therefore recommended that VDLM should not be adopted as a major dietary ingredient for broiler starter diets but could be explored as a phytogenic additive at minimal inclusion levels to support immune modulation.*

Keywords: Vitex doniana, *broiler starters, haematology, serum biochemistry, phytogenic additives, dietary inclusion.*

Introduction

The major constraint facing poultry farmers is the high cost of feed, which is driven by increasing competition between humans and livestock for conventional feed resources, especially protein-rich grains such as maize and soybean meal. If sustainable alternatives are not developed, the cost of production will continue to rise, thereby undermining the goal of poultry farming, which is to improve the nutritional standard of the populace through affordable animal protein. Exploring non-conventional feed resources such as Vitex doniana leaf meal could help reduce feed costs while providing potential health benefits to poultry (FAO, 2002).

Poultry production is one of the fastest and most sustainable means of improving the nutritional status of populations, particularly in developing countries, due to its short production cycle, quick turnover rate, and relatively low capital investment (Smith, 2001; Ani & Okeke, 2011). In Nigeria and other parts of sub-Saharan Africa, poultry

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remains a major contributor to household food security and income generation. However, the rising cost of production, largely driven by the increasing price of feed, has become a critical challenge for poultry farmers.

Nutrition accounts for approximately 60–80% of total production costs in poultry farming (Igboeli, 2000; Eseonu, 2006). Conventional feedstuffs such as maize and soybean meal, which are the primary ingredients in poultry diets, are also staple foods for humans. This results in a continuous competition between humans and livestock for the same feed resources. The problem is exacerbated by rapid population growth, climate change, and limited availability of arable land, which drive up feed costs (Diarra & Devi, 2015). The cost of commercial animal feed in Nigeria has increased by over 300% in recent years, forcing many small- and medium-scale farmers out of production and reducing overall animal protein availability.

To mitigate these challenges, attention has shifted to alternative, non-conventional feed resources that are cheaper, locally available, and possess additional benefits such as medicinal or growth-promoting properties (Okoli et al., 2001, 2002). Among such alternatives are leaf and seed meals from ethno-medicinal plants that are often underutilised.

Vitex doniana, commonly known as Black Plum, is a multipurpose plant of the family Verbenaceae widely distributed in tropical Africa. It is a deciduous flowering tree that grows up to 20 meters high, with its fruits, leaves, bark, and seeds used for food, medicine, and other domestic applications. The fruits are edible and can be eaten raw, cooked, or processed into wine, jam, and syrup. The seeds can be roasted to produce a coffee-like drink, while the leaves are consumed as vegetables or brewed into tea (FAO, 2002). Traditionally, the plant has been used in the management of ailments such as dysentery, anaemia, jaundice, gonorrhoea, measles, headaches, and respiratory infections (Oni, 2010). Beyond its ethnomedicinal value, the leaves of Vitex doniana contain phytochemicals, proteins, and other bioactive compounds that could enhance livestock health and productivity if properly harnessed.

In poultry research, blood indices are commonly assessed to determine the health and physiological status of birds. Haematological parameters such as packed cell volume (PCV), haemoglobin concentration, red blood cell (RBC) count, and white blood cell (WBC) count serve as indicators of the oxygen-carrying capacity of blood, immune response, and general well-being of animals (Waugh et al., 2001; Bamishaiye & Muhammad, 2009). Similarly, serum biochemical indices, including enzymes such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), and metabolites like cholesterol, glucose, and creatinine, provide insights into metabolic activities, organ function, and nutritional status (Aderemi, 2004; Doyle, 2006; Merck Manual, 2012). Thus, the evaluation of haematological and serum biochemistry indices is vital in assessing the suitability of novel feed ingredients, including phytogenic additives, for poultry production.

The use of Vitex doniana leaf meal as a potential feed ingredient offers dual benefits: it could serve as a cost-effective protein source and provide phytogenic compounds that may enhance immunity and physiological resilience in broiler chickens. With poultry nutrition contributing the highest proportion of production costs, identifying cheaper, locally available alternatives is critical for sustaining the industry in Nigeria and other developing countries. Furthermore, investigating the impact of Vitex doniana on haematological and serum biochemistry indices will provide evidence on its safety, efficacy, and potential role as a functional feed additive.

Materials and Methods

Experimental Site

This study was carried out at the Experimental Poultry Farm of Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. Awka is situated within the humid tropical rainforest zone of southeastern Nigeria. The area lies at latitude 6.24°N and longitude 7.00–7.08°E, with an altitude of approximately 137 m above sea level. The climate is typically tropical, characterised by a bimodal rainfall pattern (April–July and September–November), with an annual mean rainfall of about 1600 mm and an average annual temperature of 27°C. Relative humidity fluctuates between 70% and 80%, with the highest values recorded at dawn (Ezenwaji, Otti, & Phil-Eze, 2013). These environmental conditions are considered favourable for poultry production but may also predispose birds to stress-related challenges such as heat stress and high disease prevalence (Adene & Oguntade, 2006).

Collection and Preparation of Experimental Material

Fresh, mature leaves of **Vitex doniana** (Black Plum) were harvested within the premises of Nnamdi Azikiwe University. Leaves were hand-picked, sorted to eliminate diseased or damaged ones, and subjected to shade-drying for 3–4 days to prevent the loss of heat-sensitive phytochemicals (Okoli, Anunobi, Obidoa, & Igwe, 2002). Shade-drying has been reported to be superior to direct sun-drying in preserving nutritional integrity and bioactive compounds (D'Mello, 2000). After drying, the leaves were milled into a fine powder using a hammer mill to obtain Vitex doniana Leaf Meal (VDLM)**,** which was packed in airtight polythene bags and stored in a cool, dry environment until use.

Experimental Diets

The experimental diets were formulated based on the proximate composition of the VDLM, analyzed using the standard procedures of the Association of Official Analytical Chemists (AOAC, 2001)**.** Other ingredients were sourced from local feed markets.

Four dietary treatments were prepared for the starter phase. The diets were designed to be isonitrogenous and isocaloric, ensuring that the only source of variation was the level of VDLM inclusion. Treatments consisted of:

- **T1**: Control diet (0.0% VDLM)
- **T2**: 2.5% VDLM inclusion
- **T3**: 5.0% VDLM inclusion

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- **T4**: 7.5% VDLM inclusion

Feed mixing was conducted manually to ensure homogeneity.

Broiler Starter Diet (0–28 days)
The formulation of the broiler starter diets is presented in **Table 1**.

Table 1: Percentage composition of broiler starter diets with varying levels of VDLM

Ingredient	T1 (%)	T2 (%)	T3 (%)	T4 (%)
Maize	51.00	51.00	50.00	54.95
Soybean meal	26.00	24.00	23.00	20.00
Wheat offal	14.45	14.45	14.45	10.00
VDLM	0.00	2.50	5.00	7.50
Fish meal	4.00	3.50	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
Methionine	0.30	0.30	0.30	0.30
Salt	0.30	0.30	0.30	0.30
Toxin binder	1.00	1.00	1.00	1.00
Total	100.0	100.0	100.0	100.0
CP (%)	21.68	22.32	21.97	21.70

Experimental Design
A total of 120 unsexed day-old broiler chicks (Agrited strain) were randomly distributed into the four dietary treatments (T1–T4). Each treatment was replicated three times with 10 birds per replicate in a Completely Randomised Design (CRD). Data were analysed using Analysis of Variance (ANOVA) with SPSS statistical software. Significant differences among means were separated using Duncan's Multiple Range Test (DMRT) at 5% probability level (Duncan, 1955).

Management of Experimental Birds

Brooding and Housing
The poultry house was thoroughly washed, disinfected with Izal®, and left to dry for three days before the arrival of chicks. Wood shavings served as bedding. Birds were brooded under deep-litter conditions for the entire 4-week period. Each pen was equipped with drinkers, feeders, and kerosene lanterns for supplemental heat. Management practices followed the recommendations of Oluyemi and Roberts (2000).

Feeding
Experimental diets (starter) were fed ad libitum. Fresh water was supplied daily. Feeds were adjusted weekly according to NRC (1994) broiler nutrient requirements.

Vaccination and Medication
A strict vaccination program was adopted (Table 2). Routine antibiotics and multivitamins were administered as preventive measures against stress and disease outbreaks, consistent with Nworgu (2007).

Table 2: Vaccination schedule for broilers

Age (days)	Vaccine/Medication	Route/Remarks
1	Marek's, Newcastle disease vaccine (intra-ocular) + glucose, vitamins	Eye drop + oral
8–9	Coccidiostat + antibiotics	Oral
14	Gumboro vaccine (1st)	Oral
15–21	Newcastle (Lasota) + vitamins	Oral
22–28	Gumboro (2nd)	Oral

Hygiene and Sanitation
Strict hygiene was maintained, and bedding was changed weekly. Drinkers washed daily with detergent. Feeders are cleaned with a dry cloth, and a disinfectant footbath is provided at the entry to the poultry house.

Data Collection

Blood Sampling
At week 4, blood was collected from three randomly selected birds per replicate (12 per treatment) via the brachial vein. About 5 ml of blood was drawn using sterile syringes. Samples for haematology were placed in EDTA tubes, while samples for serum biochemistry were placed in plain tubes. Samples were transported in icepacks to the laboratory.

Haematological Analysis
Parameters analysed included: Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Red Blood Cell (RBC) count, White Blood Cell (WBC) count, and differentials (lymphocytes, neutrophils, monocytes, eosinophils). PCV: microhematocrit centrifugation at 2500 rpm for 5 min (Schalm, Jain, & Carroll, 1975). Hb: Cyanmethemoglobin method (Coles, 1986). RBC and WBC: Neubauer hemocytometer method. Erythrocyte indices (MCV, MCH, MCHC) were calculated from Hb, PCV, and RBC values.

Serum Biochemistry
Blood in plain tubes was allowed to clot at room temperature, then centrifuged at 3000 rpm for 10 min to obtain serum. Serum was analysed for AST, ALT, ALP, cholesterol, HDL, LDL, glucose, urea, total protein, albumin, globulin, and

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creatinine using an automated clinical chemistry analyser (Reitman & Frankel, 1957).

Data Analysis

All collected data were subjected to one-way ANOVA. Significant means were separated using Duncan's Multiple Range Test (DMRT) at $p < 0.05$ (Duncan, 1955). Results were expressed as mean ± standard error of mean (SEM).

Results and Discussion

Proximate and Phytochemical Composition of *Vitex doniana* Leaf Meal

The proximate composition of *Vitex doniana* leaf meal (VDLM) is presented in Table 3. The analysis revealed a moisture content of 7.30%, ash 6.55%, crude fat 0.10%, crude fibre 41.90%, crude protein 14.45%, and carbohydrate 29.70%. The high crude fibre content indicates that VDLM may not serve as a primary source of readily available energy for broilers but could function as a source of structural carbohydrates with implications for gut health. Adeyemi, Eruvbetine, and Adewumi (2008) reported that high fibre levels in poultry diets may reduce nutrient digestibility and energy utilisation, but in moderate amounts, fibre has been linked with improved gut motility and microbial balance (Jimoh et al., 2017). The protein content of 14.45% shows that VDLM contributes moderate levels of protein, though not as high as conventional protein sources such as soybean meal (44–48%).

Table 3: Proximate composition of *Vitex doniana* leaf meal (VDLM)

Moisture	7.30%
Ash	6.55%
Fat	0.10%
Fibre	41.90%
Protein	14.45%
Carbohydrate	29.70%

The phytochemical screening (Table 4) showed the presence of alkaloids, flavonoids, saponins, tannins, cardiac glycosides, anthraquinones, terpenes, and steroids. These bioactive compounds are commonly found in medicinal plants and are associated with both beneficial and anti-nutritional effects. For instance, flavonoids and saponins exhibit antioxidant, antimicrobial, and immunomodulatory effects (Olorunnisola, Bradley, & Afolayan, 2011), while tannins and alkaloids, when present in high concentrations, can impair protein digestibility and reduce feed efficiency (Akinmoladun et al., 2019). Therefore, the inclusion of VDLM in broiler diets must be carefully managed to balance its nutritional contribution with potential anti-nutritional risks.

Table 4: Phytochemical composition of *Vitex doniana* leaf meal (VDLM)

Alkaloid	+
Flavonoid	+
Saponin	+
Tannin	+
Cardiac glycosides	+
Terpenes and steroids	+
Anthraquinones	+

Haematological and Serum Biochemical Parameters

Starter Phase

The haematological indices of starter broilers fed VDLM are presented in Table 5. Results indicated significant differences (P<0.05) among treatments for haemoglobin (Hb), red blood cell (RBC) count, white blood cell (WBC) count, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), lymphocytes, neutrophils, and platelet counts.

Haemoglobin concentration and RBC count, which are indicators of oxygen-carrying capacity of the blood, decreased at the highest VDLM inclusion (7.5%), suggesting a possible depressive effect of anti-nutritional factors on erythropoiesis. According to Akinmoladun et al. (2019), phytochemicals such as tannins can bind to iron and reduce its bioavailability, leading to reduced haemoglobin synthesis. However, intermediate inclusion levels (2.5–5.0%) maintained Hb and RBC values within ranges reported as normal for healthy chickens (Campbell, 2015).

WBC and lymphocyte counts were significantly altered by dietary treatments. The highest inclusion (7.5%) showed elevated WBC and neutrophil levels, which may indicate an immune response to dietary stress or phytochemical challenge. Haematological parameters such as WBC are sensitive indicators of infection, stress, or immune stimulation (Togun et al., 2007). Similar findings were reported by Onu and Aniebo (2011), who noted that medicinal plant extracts in broiler diets can stimulate immune responses at certain inclusion levels.

Serum biochemical parameters for the starter phase (Table 6) also showed significant differences (P<0.05) across treatments. Urea concentration increased at higher VDLM inclusion levels, suggesting increased protein catabolism or inefficient protein utilisation (Akinola & Ekine, 2014). ALT and AST activities increased significantly with VDLM inclusion, especially at 7.5%, indicating possible hepatocellular stress or leakage of liver enzymes into the bloodstream (Doumas, 2010).

Interestingly, high-density lipoprotein (HDL) levels were highest at 7.5% VDLM, while low-density lipoprotein (LDL) and cholesterol concentrations decreased. This finding suggests a potential hypolipidemic effect of VDLM, likely due to the presence of flavonoids and saponins, which have been shown to reduce cholesterol absorption and improve lipid metabolism (Olorunnisola et al., 2011; Fasuyi, 2007).

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Table 5: Haematological indices of starter broilers fed diets containing *Vitex doniana* leaf meal (VDLM).

Parameters	T 1	T 2	T 3	T 4	SEM	P value
HB(g/dl)	11.87^{c}	10.33^{b}	11.43^{bc}	7.00^{a}	0.60	0.000
RBC($\times10^{12}$/L)	3.67^{b}	4.67^{c}	5.23^{c}	1.57^{a}	0.44	0.000
WBC($\times10^{9}$/L)	3.85×10^{9c}	2.68×10^{9b}	1.99×10^{9a}	5.73×10^{9d}	4.28×10^{9}	0.000
PCV(%)	38.00^{d}	29.00^{b}	33.67^{c}	21.00^{a}	1.91	0.000
MCV()	21.10^{a}	31.17^{b}	41.40^{c}	85.20^{d}	7.38	0.000
MCH()	89.6667^{d}	76.3333^{c}	51.0000^{b}	41.7333^{a}	5.80	0.000
MCHC(g/dl)	296.00^{c}	193.03^{b}	170.00^{a}	190.67^{b}	14.87	0.000
LYMPH($\times10^{9}$/L)	48.33^{d}	37.00^{b}	40.00^{c}	24.67^{a}	2.57	0.000
Neutrophils($\times10^{9}$/L)	49.67^{a}	61.00^{b}	60.00^{b}	74.00^{c}	2.61	0.000
Platelet($\times10^{9}$/L)	2.88×10^{11d}	2.50×10^{11c}	1.99×10^{11b}	1.25×10^{11a}	1.84×10^{11}	0.000

abc: means on the same row with different superscripts are significantly different (P<0.05); HB – Haemoglobin, RBC - Red blood cell, WBC - White blood cell, PCV - Packed cell volume, MCV - Mean corpuscular volume, MCH - Mean corpuscular haemoglobin, MCHC - Mean corpuscular haemoglobin concentration, LYMPH - Lymphocytes

Table 6: Serum biochemical indices of starter broilers fed diets containing *Vitex doniana* leaf meal (VDLM).

Parameters	T 1	T 2	T 3	T 4	SEM	P value
Urea(mg/dl)	4.67^{a}	4.33^{a}	5.33^{a}	6.67^{b}	0.30	0.005
AST(u/l)	118.00^{b}	113.67^{a}	123.67^{c}	123.67^{c}	1.28	0.000
ALT(u/l)	33.67^{a}	35.67^{b}	41.67^{c}	53.67^{d}	2.35	0.000
ALP(u/l)	159.00^{b}	99.00^{a}	200.33^{d}	180.33^{c}	11.45	0.000
Globulin (g/l)	14.67^{a}	16.67^{b}	26.00^{c}	16.33^{b}	1.35	0.000
Glucose(mg/dl)	64.00^{a}	94.67^{d}	80.33^{c}	71.00^{b}	3.47	0.000
Total protein(g/l)	23.67^{a}	23.67^{a}	35.00^{b}	24.33^{a}	1.46	0.000
Albumin(g/l)	8.67^{b}	7.33^{a}	8.67^{b}	7.67^{ab}	0.23	0.045
Creatinine(mg/dl)	1.13^{a}	1.47^{b}	1.97^{c}	3.57^{d}	0.28	0.000
Cholesterol(mg/dl)	99.67^{c}	71.67^{b}	105.00^{d}	64.00^{a}	5.31	0.000
HDL(mg/dl)	71.00^{c}	61.00^{a}	64.00^{b}	99.00^{d}	4.54	0.000
LDL(mg/dl)	29.00^{d}	12.33^{a}	18.00^{b}	12.33^{a}	2.09	0.000

abc: means on the same row with different superscripts are significantly different (P<0.05); AST - Aspartate transaminase, ALT - Alanine transaminase, ALP - Alkaline phosphatase, HDL – High-density lipid, LDL – Low-density lipid

The proximate composition results demonstrate that VDLM provides moderate protein and energy but high fibre content. High fibre levels may reduce nutrient digestibility, especially in monogastrics such as poultry (Jimoh et al., 2017). Thus, while VDLM is not an ideal major feed ingredient, it can serve as a supplementary feed additive.

The phytochemical screening underscores the dual role of VDLM. While bioactive compounds such as flavonoids and saponins provide antioxidant and immunomodulatory benefits (Olorunnisola et al., 2011), tannins, alkaloids, and anthraquinones pose anti-nutritional risks at higher concentrations (Akinmoladun et al., 2019).

The haematological findings at the starter phase reveal that moderate inclusion levels (2.5–5.0%) maintain haematological values within normal physiological ranges, whereas higher levels (7.5%) cause significant disruptions. This is consistent with previous studies where moderate phytogenic supplementation improved immune function without compromising erythropoiesis (Onu & Aniebo, 2011).

Serum biochemical responses show that moderate inclusion of VDLM improves lipid metabolism and protein utilisation, evidenced by increased HDL and globulin, and reduced cholesterol and LDL. However, higher inclusion levels

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adversely affect liver and kidney function, as shown by elevated ALT, AST, ALP, urea, and creatinine. These findings agree with the work of Aderemi (2004), who reported that excessive intake of phytogenic additives may overload hepatic metabolism.

Overall, the results suggest that VDLM can be incorporated into broiler diets at low to moderate inclusion levels (≤5.0%) to harness its immunomodulatory and lipid-lowering benefits. However, higher inclusion (7.5%) may pose health risks due to anti-nutritional effects on haematology and organ function.

Discussion

Proximate and Phytochemical Composition of *Vitex doniana* Leaf Meal (VDLM)

The proximate and phytochemical composition of *Vitex doniana* leaf meal (VDLM) in this study was comparable to previous findings. Adeyina et al. (2017), in an experiment on cockerels, reported crude protein (11.10 ± 0.08%), crude fibre (7.20 ± 0.01%), and dry matter (88.99 ± 0.05%). The slight variations observed in the present work may be attributed to differences in drying methods; while Adeyina et al. (2017) employed sun-drying, this study utilised shade-drying, which has been shown to better preserve phytochemicals and nutrient integrity (Melesse et al., 2012). These variations underscore the influence of processing methods on nutrient profiles of phytogenic feed resources.

Haematological Profile of Starter Broilers

The haematological parameters of starter broilers fed diets containing graded levels of VDLM revealed significant differences ($p < 0.05$) across treatments. Hemoglobin (Hb) concentrations were within the normal physiological range for broilers (7.0–13.0 g/dl) as reported by Swenson (1999) and Anon (1980). Adequate Hb concentration suggests that the birds maintained satisfactory oxygen transport capacity, thereby reducing the likelihood of hypoxic stress (Muhammad & Oloyede, 2009).

Red blood cell (RBC) counts showed noticeable fluctuations across treatments. While the control group (0% VDLM) and 2.5% inclusion levels were within acceptable limits for avian species, higher inclusion levels (5.0% and 7.5%) revealed deviations. Particularly, the 7.5% inclusion resulted in reduced RBC counts, suggesting impaired erythropoiesis or possible nutrient interference by phytochemicals such as tannins, which are known to reduce iron bioavailability (Esonu et al., 2001; Fasuyi, 2005).

White blood cell (WBC) counts demonstrated abnormal trends, with most inclusion levels being outside the reference range (Aengwanich et al., 2004). The marked increase at 7.5% VDLM inclusion may indicate an immunostimulatory or stress response, as elevated WBC values often reflect antigenic challenges or subclinical infections (Frandson, 1986; Adeyemo & Longe, 2007).

Packed cell volume (PCV) values at the starter phase were generally within the normal range of 25–45% (Aengwanich et al., 2004; Ross et al., 1978), except for the 7.5% VDLM inclusion, which fell below the threshold, indicating a risk of anemia. This suggests that high inclusion of VDLM may impair blood-forming processes.

Indices such as mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) also varied across treatments. The 7.5% inclusion showed values closer to the lower threshold, suggesting compromised erythrocyte integrity and hemoglobin concentration, which could impair oxygen delivery efficiency (Mitruka & Rawnsley, 1997).

Lymphocyte values across treatments remained within normal ranges, suggesting that immune competence was not compromised at the starter phase. However, neutrophil concentrations were significantly elevated at higher inclusion levels, which may reflect enhanced non-specific immune activation (Champe et al., 2008).

Serum Biochemistry of Starter Broilers

Serum biochemistry indices also revealed significant dietary effects. Urea levels increased at 5.0% and 7.5% VDLM inclusion, exceeding normal ranges for broilers (WikiVet.net). Elevated serum urea is commonly associated with impaired kidney function or poor dietary protein quality (Eggum, 1970). This suggests that high VDLM inclusion imposes a metabolic burden on renal function, possibly due to secondary metabolites such as saponins (Omoikhoje et al., 2004).

Serum protein (total protein and albumin) levels were higher than standard reference values (Anon, 1980; Jain, 1986). While elevated total protein may indicate improved protein nutrition, excessive levels, particularly in conjunction with high globulin values, may also suggest immunological stress or overproduction of antibodies (Peters et al., 1982).

Glucose concentrations in starter broilers (64–94 mg/dl) were above the normal physiological range (44.1–45.5 mg/dl) reported by WikiVet.net. Elevated glucose may be attributed to ad libitum feeding, reflecting high energy metabolism rather than fasting levels (Melluzzi et al., 1991).

Liver function enzymes such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were significantly elevated at higher inclusion levels of VDLM. This indicates possible hepatocellular damage or metabolic stress in the liver (Champe et al., 2008). Similarly, alkaline phosphatase (ALP) levels exceeded normal ranges except at 2.5% inclusion, suggesting compromised hepatic or bone metabolism (Clinical Diagnostic Division, 1990).

Cholesterol fractions were also altered by dietary VDLM. High-density lipoprotein (HDL) increased at higher inclusion levels, whereas low-density lipoprotein (LDL) fluctuated across treatments. While increased HDL is beneficial, the elevated LDL and total cholesterol at higher inclusion levels could predispose broilers to metabolic disorders (Melluzzi et al., 1991).

Conclusion

The results from the starter phase demonstrated that inclusion of *Vitex doniana* leaf meal significantly influenced both haematological and serum biochemical indices of broilers.

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While some parameters, such as Hb and lymphocytes, remained within acceptable ranges, higher inclusion levels (≥ 5.0%) led to reduced RBC, abnormal WBC counts, elevated serum urea, and increased liver enzymes (AST, ALT, ALP). These findings suggest that excessive VDLM inclusion impairs hematopoietic function, kidney clearance, and liver metabolism, thereby posing potential risks to broiler health at the starter phase.

Recommendation

Based on the findings of this study, the inclusion of *Vitex doniana* leaf meal at levels beyond 2.5% is not recommended in the diets of starter broiler chickens. Higher inclusion rates negatively affected vital organs such as the liver and kidneys, as well as key haematological indices, which are critical for maintaining oxygen transport, immune competence, and metabolic balance. Future studies should focus on evaluating detoxification methods (e.g., heat treatment, fermentation) to reduce the anti-nutritional factors present in VDLM and explore its potential role as a phytogenic additive at minimal inclusion levels rather than as a major dietary constituent.

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