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## Research Article

### Gut nutrient absorptive potential and blood profile of isa-brown-laying birds fed varying inclusion levels of sida acuta leaf meal

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#### Abstract

Residual effect of many synthetic drugs and additives has created serious search for useful alternatives such as plant-based substance from plants, to improve animal nutrition, health and general performance. Therefore, a 70-day-feeding-trial was conducted to evaluate the effect of dietary inclusion of varying levels of *Sida acuta* leaf meal-SALM as an additive in ISA brown laying birds-IBLH. Two-hundred and ten point-of-laying birds were randomly divided into six dietary treatments of 35 birds per treatment with five replicates. They were fed six experimental diets containing 1g-T1, 2g-T2, 3g-T3, 4g-T4, 5g-T5, 0g-T6 each of SALM per 1000g of the layer's feed. Data collected were subjected to ANOVA. Result showed that average daily feed intake-ADF and average egg weight-AEW showed no significant difference among the treatment means while weight different, feed conversion ratio-FCR, cost per egg-CPE, hen day production-HDP, average egg/bird/40days, average egg/day, gain per egg-GPE showed significant difference among the treatment means. The highest GPE (N20.48) was recorded under T2, this proved the economic gain in using 2g/Kg feed of SALM in layer's industry. Control had the highest FCR, shows that the control birds ate more feed to produce an egg consequently higher cost of production while T1–T5 had similar lower cost of production. T3 performed better in the production performance of the birds in terms of HDP and CPE. PCV, WBC, Haemoglobin, Red Blood Cell-RBC, Mean Corpuscular Volume-MCV, Mean Corpuscular Haemoglobin Concentration-MCHC, Total Protein-TP, Cholesterol-CHO, alkaline phosphatase, aspartate transaminase-AST showed significant difference ( $p < 0.05$ ) among the treatment means. Treatment 1, 2 and 6 had similar crude protein digestibility. Health wisely, birds on phytoadditive had high PVC compared to control group while control group had highest WBC per microliter of blood. It was concluded that SALM can be included as a feed-additive to boost performance and improve health of IBLH.

**Keywords:** Phytogetic, Haematology, Serum, Layers, *Sida acuta*, leaf meal.

#### Introduction

Feed additives are commonly used in the poultry industry to improve the efficiency of growth and/or laying, prevent diseases, and improve feed utilization [1], this include synthetic and phytogetic feed additives. Phytogetic additives are plants with medicinal properties that can be used against various ailments affecting man and animals. According to [2,3] the inclusion of these phytogetic additives in animal feed can enhance productivity through the enhancement of digestibility, nutrient assimilation and elimination of pathogens resident within the animal digestive system. According to [4,5] herbs, spices, and other natural plant-derived compounds have demonstrated efficacy as alternatives to antibiotics by promoting growth, eradicating harmful microbes, and offering additional health benefits. These additives pos-

sess antimicrobials, antioxidants, emulsifiers, toxin binders, pH control agents, enzymes, and other natural products [6]. Plant-based feed additives, also known as phytogetic feed additives, are increasingly being used in the poultry industry to improve health and production. These additives are derived from herbs, spices, and other plant materials and are considered as nutraceutical feed additives. They contain phytobiotics, phenols, flavonoids, tannins, and essential oils, which have been shown to improve digestion, promote health, and positively influence poultry performance [7]. Various plant parts has been used and different phytoadditive has been utilized as well, these include *Xylopiya aethiopia* [8], ginger, garlic etc [9], knowledge of these and many more led to the utilization of *Sida acuta*. *Sida acuta* is a plant with potential medicinal properties that can be used as a replacement for antibiotics in the diet of poultry birds, with positive effects on productive performance, caeca microbial population, and immune modulatory activity [10]. *Sida acuta* are considered as phytogetic feed additives for poultry birds to improve egg weight and ovary characteristics, thereby enhancing poultry health and production [7]. These findings suggest that *Sida acuta* holds promise as a nutraceutical for poultry, potentially offering a natural and alternative solution to support poultry health and performance.

Feed additives have been studied to have effect on haematological and serum biochemical parameters of chickens. It has been observed that dietary feed additives can have effect on haematological and serum biochemical parameters of chickens [11]. The use of feed additives, such as phytogetic feed additives, has been found to influence the state of carbohydrate and lipid metabolism in hens, manifested by an increase in glucose concentration and triglycerides) [12]. Additionally, the inclusion of feed additives in the feeding schemes has contributed to the correction of mineral absorption, providing more complete absorption of calcium by the poultry, and preventing the development of hepatocyte cytolysis. The introduction of feed additives into the diet of laying hens has been found to stimulate the immune system, as indicated by an increase in the activity of hepatoindicatory enzymes such as aspartate transaminase and alanine transaminase [12].

Therefore, the use of natural phyto-additive can be seen to affect production positively and also proved effective health supports for the animal, therefore this research work was design to investigate the potential of *Sida acuta* on nutrient digestibility, production performance and health status of the ISA Brown laying birds fed varying inclusion levels of *Sida acuta* leaf meal additive.

## Materials and Methods

### Experimental Site

The experiment was conducted at the Poultry Unit, Ladoke Akintola University of Technology, Ogbomoso, Oyo State Ni-

geria. Ogbomoso is located in the derived savannah that lies on longitude 40101 East of Greenwich Meridian and latitude 80 101 North of equator. The altitude ranges from 300m to 600m above sea level and the mean temperature and annual rainfall are 270C and 1247mm, respectively [13].

### Experimental birds and management

Prior to the arrival of the experimental birds, the pens and cages were cleaned and disinfected properly and left to dry for five days. A total number of 210 birds were purchased from a reputable source. The birds were weighed on arrival and allotted on weight equalization to six dietary treatments in a completely randomized design (CRD). Each shell consist three (3) birds and each shell was demarcated such that the birds in shell A did not have access to the feed of the birds in shell B. The birds were served with cool, clean and fresh water through nipple drinkers. During egg collection periods, hands were used to turn the feed available in the feeding troughs to make a fresh feed available to the birds.

### Experimental test ingredient and diets

Fresh and matured leaves of *Sida acuta* was collected within the farm premises and was air dried until it forms crispy, to keep the nutrients in the leaves intact. After which it was milled, then added to the feed as an additive. Six experimental diets were formulated using various commercial layers ingredients and *Sida acuta*. Treatment 1 contains 1g of the additive in 1kg of feed, Treatment 2 contains 2g of *Sida acuta* in 1kg of feed, Treatment 3 contains 3g of *Sida acuta* in 1kg of feed, Treatment 4 contains 4g of *Sida acuta* in 1kg of feed, Treatment 5 contains 5g of *Sida acuta* in 1kg of feed while treatment 6 is the control which contain 0g of *Sida acuta*. Each treatment was replicated five times with 7 birds per replicate. The feeding trial lasted for 8weeks after the production percentage of the birds reached 80%.

Ingredient	Amount kg
Maize	53.00
Soyabean Meal	25.00
Corn Bran	5.00
Wheat Offal	7.00
Vitamin Premix	0.50
Iodized Salt	0.50
Methionine	0.50
Lysine HCl	0.50
Bone meal	3.00
Limestone	5.00
Total	100.00
<b>Determined analysis</b>	
Nutrient	Value

Metabolizable energy	2881.00Kcal/kg
Crude Protein	17.22%
Crude Fibre	4.19%
Calcium	3.29%
Phosphorus	1.08%

**Table 1** Feed Composition for Layers mash

### Data collection

During this period, Eggs were collected twice daily, by 12noon and 2pm. The number of eggs laid by birds in each replicate was recorded daily. Data were collected on the production performance of the birds which include weight differences which was calculated by using the difference between the final weight taken at the end of the experiment and the initial weight taken at the commencement of the experiment, the total feed intake which was gotten by deducting the total left over feed from the total feed given. The feed conversion ratio (FCR) was determined by the ratio between total feed consumed and total number of eggs laid by each birds [14]. The Hen Day Production was determined by the ratio of the total number of eggs produced divided by the total number of birds multiply by hundred.

On the last day of the experiment, three birds per replicate were randomly selected, starved overnight and slaughtered. The bloods were collected into two different bottles, one with EDTA while the other one did not contain EDTA. The bottles were stored in cooler with ice pack and taken to the laboratory for both haematology and serum assessment. The haematological indices examined include Red blood cell (RBC), white blood cell (WBC), packed cell volume (PCV), leucocytes differential count (monocytes, lymphocytes, basophil, neutrophil eosinophil etc.) and haemoglobin concentration (Hb) as described by [15]. The MCV, MCH and MCHC were calculated using standard formulae as described by [16].

The serum total protein was determined by Biuret method of [17] using a commercial kit (Randox Laboratory Ltd, U.K), while albumin value was obtained by bromocresol green method [18]. The urea nitrogen was estimated by deproteinization and Urease-Berthelot colorimetric methods respectively using commercial test kit (Quimica Clinical Aplicada, USA), while the serum enzyme alanine amino transferase (ALT) and aspartate amino transferase (AST) were obtained using the Randox Laboratory Ltd, UK test kits.

### Statistical Analysis

The data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomized design using SPSS computer software while significant mean differences were separated using Duncan Multiple Range Test of the same package at 5% probability level.

## Results and Discussions

### Production performance of ISA Brown laying birds fed varying inclusion level of *Sida acuta* leaf meal additive

The production performance (Table 2) of layers fed varying inclusion level of *Sida acuta* leaf meal presented showed significant difference ( $p < 0.05$ ) in the final weight, feed conversion ratio, cost/egg, hen day production, average egg/bird, average egg/day, gain/egg and Weight difference. There was no significant differences ( $p > 0.05$ ) in the result of the average daily feed intake/bird because birds were fed on similar feed quantity per day and egg weight. Treatment 2 recorded the highest value in final weight (1.63Kg), hen day production (103.85%), average egg/bird (34.61), Average egg/day (0.86) and gain/egg (₦20.48) while Treatment 6 recorded the highest in feed conversion ratio (154.42), cost/egg (₦56.28) and Treatment 3 recorded the highest in weight difference (0.20g). The production performance of layer bird fed varying inclusion level of *Sida acuta* leaf meal additive shows a significant variation among most of the production parameters of the birds. The final weight varied with Treatment 2 (2g of *Sida acuta* leaf meal additive) showing the highest and Treatment 5 and 6 following the trend. This increase observed can be due to the nutritive and medicinal properties of *Sida acuta* which may enhance nutrient absorption and overall health [10]. Layer birds are not expected to gain weight due to egg production but weight gain can be desirable as they can be converted to meat type after reaching their egg production limit. This high value in Final weight can also be linked with the value of the average daily feed intake/bird where Treatment 2 also recorded the highest. Treatment 2 had the lowest value in FCR (126.72) and cost/egg (₦46.19) which means that it takes 126.72g at ₦46.19 of feed to produce 1 egg. This is better than the other treatments especially the control which shows a high value in FCR (154.42) and cost/egg (₦56.28). The improved FCR, cost per egg of the birds and consistency in the high daily feed intake across treatments with inclusion of *Sida acuta* shows that *Sida acuta* has the ability to increase nutrient absorption and conversion which can increase the profitability of the layer enterprise. This in line with the report of [19] who stated that phytogetic additives can improve palatability of feed in birds which can in turn influence performance of the birds. [20] also noted that phytogetic additives can improve performance of birds by enhancing gut health and nutrient absorption.

The variability in hen day production with the treatments with varying inclusion of *Sida acuta* leaf meal significantly outperforming the control likely reflects enhanced overall health and reproductive function due to the additive. The range gotten for Hen day Production (HDP) (96.00 – 99.85) is greater than the report of [21] who reported a range of (66.97 – 72.14) for HDP of laying hen fed cassava based meal diet. Enhanced hen day production can be linked to

better nutrition and stress reduction as stated by [22] who studied similar effects using plant extracts. The enhanced hen day production recorded in this study can be due to the presence of phytochemical like flavonoid and alkanoid which

has been reported to perform stress reducing antioxidant activity by scavenging free radicals that causes stress in Layer birds [23].

Parameters	T1	T2	T3	T4	T5	T6(Control)	SEM
IW(g)	1.62	1.62	1.65	1.55	1.56	1.72	-
ADFI/Bird(g)	108.56	109.28	108.57	108.57	108.28	97.77	2.86
FW(Kg)	1.59 <sup>a</sup>	1.63 <sup>a</sup>	1.44 <sup>b</sup>	1.49 <sup>b</sup>	1.62 <sup>a</sup>	1.62 <sup>a</sup>	0.01
FCR in g	135.62 <sup>b</sup>	126.72 <sup>b</sup>	131.91 <sup>b</sup>	134.28 <sup>b</sup>	127.95 <sup>b</sup>	154.42 <sup>a</sup>	2.53
FCR in Kg	0.13 <sup>b</sup>	0.12 <sup>b</sup>	0.13 <sup>b</sup>	0.13 <sup>b</sup>	0.12 <sup>b</sup>	0.15 <sup>a</sup>	0.00
COST/ EGG(N)	49.43 <sup>b</sup>	46.19 <sup>b</sup>	48.08 <sup>b</sup>	48.94 <sup>b</sup>	46.64 <sup>b</sup>	56.28 <sup>a</sup>	0.92
HDP(%)	96.00 <sup>ab</sup>	99.85 <sup>a</sup>	98.71 <sup>ab</sup>	96.71 <sup>ab</sup>	99.42 <sup>ab</sup>	79.33 <sup>b</sup>	3.00
AE/B	32.00 <sup>ab</sup>	34.61 <sup>a</sup>	32.90 <sup>ab</sup>	32.23 <sup>ab</sup>	33.80 <sup>ab</sup>	26.44 <sup>b</sup>	1.00
AE/D	0.80 <sup>ab</sup>	0.86 <sup>a</sup>	0.82 <sup>ab</sup>	0.80 <sup>ab</sup>	0.84 <sup>ab</sup>	0.66 <sup>b</sup>	0.02
EW(g)	59.74	58.47	59.65	58.53	60.56	61.21	0.42
GAIN/EGG(N)	17.23 <sup>a</sup>	20.48 <sup>a</sup>	18.58 <sup>a</sup>	17.72 <sup>a</sup>	20.02 <sup>a</sup>	10.38 <sup>b</sup>	0.92
WD(g)	0.02 <sup>c</sup>	-0.01 <sup>cd</sup>	0.20 <sup>a</sup>	0.05 <sup>b</sup>	-0.06 <sup>d</sup>	0.09 <sup>b</sup>	0.01

<sup>abcd</sup>: Mean along the same row with different subscript are significantly different (p<0.05), SEM: Standard Error Of Mean, T1 = 1g of Sida acuta in 1kg of feed, T2 = 2g of Sida acuta in 1kg of feed, T3 = 3g of Sida acuta in 1kg of the feed, T4 = 4g of Sida acuta in 1kg if the feed, T5 = 5g of Sida acuta in 1 kg of the feed, T6 = Control, IW= Initial Weight, FCR= Feed Conversion Ratio, ADFI = Average Daily Feed Intake/Birds, HDP= Hen Day Production, AE/B= Average Egg/Birds/40 days, AE/D = Average Egg/Day, WD = Weight Difference, FW = Final Weight, EW = Egg Weight

**Table 2:** Production Performance of ISA Brown Laying Birds fed varying inclusion level of Sida acuta leaf meal additive

**Nutrient digestibility of ISA Brown layers fed varying inclusion levels of Sida acuta leaf meal**

Nutrient Digestibility (Table 3) of ISA Brown layers fed varying inclusion levels of Sida acuta leaf meal additive revealed significant variations (p<0.05) in nutrient digestibility indices, including crude protein digestibility (CPD), crude fiber digestibility (CFD), ether extract digestibility (EED), ash digestibility (ASHD), dry matter digestibility (DMD), and nitrogen-free extract digestibility (NFED). Treatment 6 (control) had the highest CPD (94.50%) and ASHD (96.35%), while Treatment 4 exhibited superior NFED (90.89%). Treatment 1 showed the highest CFD (90.86%) and EED (91.82%). Treatment 2 recorded the lowest value in NFED (67.70%) and ASHD (93.37%) while treatment 3 recorded the lowest value for CPD (89.73%) and Treatment 5 recorded the lowest value in EED (85.43%). The Nutrient digestibility of ISA brown laying

birds fed Sida acuta leaf meal showed an enhanced digestibility values in the treatments with inclusion level of Sida acuta. The enhanced digestibility in treatments with Sida acuta inclusion suggests that its bioactive compounds, such as alkaloids and flavonoids, optimize nutrient utilization. Improvements in crude protein digestibility and crude fibre digestibility reflect the role of Sida acuta in enhancing protein and fiber breakdown, critical for physiological processes. Increased ether extract digestibility values suggest better lipid digestion, facilitating energy production. Enhanced dry matter digestibility values in moderate treatments highlight the additive's role in maximizing nutrient extraction, supported by nitrogen free extract digestibility findings. These findings are consistent with the work of [24], who reported that phyto-genic feed additives optimize nutrient digestibility and reduce feed costs.

Parameters	T1	T2	T3	T4	T5	T6(Control)	SEM
%DMD	92.30 <sup>a</sup>	92.97 <sup>a</sup>	88.95 <sup>a</sup>	79.71 <sup>b</sup>	89.28 <sup>a</sup>	91.58 <sup>a</sup>	0.93
%CPD	93.99 <sup>ab</sup>	93.38 <sup>ab</sup>	89.73 <sup>c</sup>	90.80 <sup>c</sup>	92.61 <sup>b</sup>	94.50 <sup>a</sup>	0.33
%CFD	90.86 <sup>a</sup>	84.76 <sup>d</sup>	87.55 <sup>b</sup>	86.47 <sup>c</sup>	84.98 <sup>d</sup>	82.77 <sup>e</sup>	0.44
%EED	91.82 <sup>a</sup>	90.83 <sup>a</sup>	87.90 <sup>b</sup>	88.68 <sup>b</sup>	85.43 <sup>c</sup>	87.82 <sup>b</sup>	0.38
%ASHD	94.18 <sup>b</sup>	93.37 <sup>b</sup>	96.19 <sup>a</sup>	96.33 <sup>a</sup>	95.70 <sup>a</sup>	96.35 <sup>a</sup>	0.23

%NFED	85.18 <sup>c</sup>	67.70 <sup>e</sup>	83.38 <sup>b</sup>	90.89 <sup>a</sup>	84.65 <sup>c</sup>	74.20 <sup>d</sup>	1.41
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<sup>a,b,c,d,e</sup> mean along the same row with different subscript are significantly different (p<0.05). T1= 1g of *Sida acuta* in 1kg of feed, T2 = 2g of *Sida acuta* in 1kg of feed, T3 = 3g of *Sida acuta* in 1kg of the feed, T4 = 4g of *Sida acuta* in 1kg if the feed, T5 = 5g of *Sida acuta* in 1 kg of the feed, T6 = Control. SEM = Standard Error of the Mean. CPD = Crude Protein Digestibility, CFD = Crude Fibre Digestibility, EED = Ether Extract Digestibility, ASHD = Ash Digestibility, DMD = Dry Matter Digestibility, NFED = Nitrogen Free Extract Digestibility

**Table 3:** Nutrient digestibility of ISA Brown layers fed varying inclusion levels of *Sida acuta* leaf meal

**Haematological Parameters of ISA Brown Laying Birds fed varying inclusion levels of *Sida acuta* leaf meal**

The haematological parameters (Table 4) of ISA Brown laying birds fed varying inclusion levels of *Sida acuta* showed a significant difference (p<0.05) in all the haematological parameters among the treatment means. Treatment 1 recorded the highest in haemoglobin (10.45g/dl), red blood cell (3.50 x 10<sup>6</sup>U/l). Treatment 2 recorded the highest in the packed cell volume (32.00%), mean corpuscular haemoglobin (91.35pg), mean corpuscular volume (30.25fl), basophil (2.50%), eosinophil (2.50%) and monocyte (5.50%). Treatment 3 recorded the highest in lymphocyte (74.00%) while Treatment 6 recorded the highest in white blood cell (18000 x 10<sup>3</sup>ul), mean corpuscular haemoglobin concentration (33.25g/dl), heterophils (27.00%) and platelet (252 x 10<sup>4</sup>/mm<sup>3</sup>). The haematological assessment of ISA Brown laying hens fed varying levels of *Sida acuta* inclusion revealed that birds fed 2 g *Sida acuta*/kg feed (Treatment 2) demonstrated superior performance in packed cell volume (32.00%), mean corpuscular hemoglobin (91.35 pg), mean corpuscular volume (30.25 fl), and white blood cell differentiation (basophil, eosinophil, and monocyte counts). These results suggest enhanced erythropoiesis and immune function, likely due to the synergistic effects of *Sida acuta*'s flavonoids, alkaloids,

and saponins, which possess antioxidant and antimicrobial properties. The observed PCV values (27.50–32.00%) fall within the normal physiological range for layers, indicating effective oxygen-carrying capacity and stable haematological function. However, higher inclusion levels (4–5 g/kg feed) led to reduced PCV and haemoglobin values, possibly due to tannin interference with iron absorption, as noted in previous studies [25,24].

Overall, moderate inclusion of *Sida acuta* (particularly at 2 g/kg feed) optimized animal health by maintaining balanced erythrocyte indices (MCHC: 33.10–33.25 g/dL; MCV: 29.75–30.25 fl) and stable immune parameters. The relatively lower white blood cell counts in this group suggest reduced physiological stress and improved immune stability compared to the control, which exhibited elevated WBC levels indicative of immune strain. Enhanced basophil, eosinophil, and monocyte activities in Treatment 2 further reflect improved immune responsiveness, aligning with findings by [26] that phyto-genic feed additives can strengthen immune modulation. Thus, the results demonstrate that *Sida acuta* inclusion at moderate levels supports efficient erythropoiesis, oxygen transport, and immune competence in laying hens, while excessive inclusion may introduce anti-nutritional effects that compromise haematological balance.

Parameters	T1	T2	T3	T4	T5	T6(Control)	SEM
PCV %	31.50 <sup>a</sup>	32.00 <sup>a</sup>	29.00 <sup>bc</sup>	27.50 <sup>c</sup>	30.00 <sup>ab</sup>	27.50 <sup>c</sup>	0.40
WBC(106 ul)	14.75 <sup>d</sup>	11.50 <sup>e</sup>	15.50 <sup>cd</sup>	17.25 <sup>ab</sup>	16.25 <sup>bc</sup>	18.00 <sup>a</sup>	0.39
Hb (g/dl)	10.45 <sup>a</sup>	10.00 <sup>a</sup>	9.65 <sup>c</sup>	9.15 <sup>c</sup>	9.95 <sup>ab</sup>	9.15 <sup>c</sup>	0.13
RBC (106 ul)	3.50 <sup>a</sup>	3.50 <sup>a</sup>	3.20 <sup>bc</sup>	3.05 <sup>c</sup>	3.30 <sup>ab</sup>	3.05 <sup>c</sup>	0.42
MCH (pg)	90.05 <sup>bs</sup>	91.35 <sup>a</sup>	90.60 <sup>ab</sup>	90.10 <sup>b</sup>	90.90 <sup>ab</sup>	90.10 <sup>b</sup>	0.13
MCV(fl)	29.75 <sup>b</sup>	30.25 <sup>a</sup>	30.15 <sup>a</sup>	29.95 <sup>ab</sup>	30.05 <sup>ab</sup>	29.95 <sup>ab</sup>	0.04
MCHC(g/dl)	33.10 <sup>b</sup>	33.10 <sup>b</sup>	33.25 <sup>a</sup>	33.25 <sup>a</sup>	33.10 <sup>b</sup>	33.25 <sup>a</sup>	0.01
Hete (%)	19.50 <sup>b</sup>	20.00 <sup>b</sup>	19.50 <sup>b</sup>	20.50 <sup>b</sup>	21.50 <sup>b</sup>	27.00 <sup>a</sup>	0.52
Lymph(%)	73.00 <sup>a</sup>	69.50 <sup>b</sup>	74.00 <sup>a</sup>	72.50 <sup>ab</sup>	74.00 <sup>a</sup>	69.50 <sup>b</sup>	0.51
Baso(%)	2.00 <sup>ab</sup>	2.50 <sup>a</sup>	2.00 <sup>ab</sup>	2.00 <sup>ab</sup>	1.50 <sup>b</sup>	2.00 <sup>ab</sup>	0.10
Eosin(%)	2.00 <sup>ab</sup>	2.50 <sup>a</sup>	2.50 <sup>a</sup>	2.00 <sup>ab</sup>	2.00 <sup>ab</sup>	1.00 <sup>b</sup>	0.15
Mono(%)	3.50 <sup>b</sup>	5.50 <sup>a</sup>	2.00 <sup>bcd</sup>	3.00 <sup>bc</sup>	1.00 <sup>cd</sup>	0.50 <sup>d</sup>	0.37
Platelet (104/mm <sup>3</sup> )	232.50 <sup>a</sup>	195.00 <sup>b</sup>	167.50 <sup>c</sup>	235.00 <sup>a</sup>	160.00 <sup>c</sup>	252.50 <sup>a</sup>	6.62

abcd Means on the same row followed by different superscript are significantly different (P<0.05). SEM- Standard Error of Mean, T1= 1g of *Sida acuta* in 1kg of feed, T2 = 2g of *Sida acuta* in 1kg of feed, T3 = 3g of *Sida acuta* in 1kg of the feed, T4 = 4g of *Sida acuta* in 1kg if

the feed, T5 = 5g of *Sida acuta* in 1 kg of the feed, T6 = Control. PCV = Packed cell volume, WBC= White blood cell, HGB = Hemoglobin, RBC= Red blood cell, MCV = Mean corpuscular volume, MCH = Mean corpuscular hemoglobin, MCHC= Mean corpuscular hemoglobin concentration, Hete = Heterophil, Lymph = Lymphocytes, Baso = Basophil, Eosin = Eosinophils, Mono = Monocyte

**Table 4:** Haematological Parameters of ISA Brown Laying Birds fed varying inclusion levels of *Sida acuta* leaf meal

#### Serum biochemical indices of ISA Brown Laying Birds fed varying inclusion levels of *Sida acuta* leaf meal

The result of the serum biochemical indices of ISA Brown laying birds fed varying inclusion levels *Sida acuta* leaf meal showed a significant effect ( $p < 0.05$ ) in total protein, albumin, cholesterol, alkaline phosphatase, urea, aspartate transaminase values among the treatment means. Treatment 2 recorded the highest value in total protein (50.50g/dl), albumin (29.50g/dL), globulin (21.00g/dL) and cholesterol (mg/dL). Birds in Treatment 2 recorded the highest total protein indicating improved protein synthesis and nutrient utilization. Except treatment 5 and 6, other treatments recorded statistically similar values in blood albumin and globulin content. According to [27], total protein levels are affected by preparation received by patient, which include diet. Also excess protein in the body may be due to frequent consumption of feeds containing either animal or vegetable protein that has potential to increase total protein levels of blood serum, while protein insufficiency in the body may be due to insufficient consumption of feeds containing protein that can also decrease total protein levels in the blood. Additive which happen to be the only source of variation might have responsible for the varied serum protein differences, since it has been es-

tablished that protein assessment through serum has 3-5% reduction in protein result when compared to assessment through plasma. [28] stated that sample preparation factors affected total protein levels, such as examination using plasma samples can cause total protein levels to be 3–5% higher due to the influence of fibrinogen in plasma.

Also, treatment 4 shows statistical variation among the other treatment in the value of Alkaline phosphatase while similar value of alanine transaminase was recorded across the treatments. The serum biochemical analysis of ISA Brown laying hens fed varying levels of *Sida acuta* revealed that moderate inclusion (2 g/kg feed) significantly enhanced metabolic and liver function indicators compared to other treatments. These results suggest that the bioactive compounds in *Sida acuta* notably flavonoids, alkaloids, and saponins contributed to enhanced enzymatic efficiency and hepato-protection. In contrast, the control group (Treatment 6) exhibited reduced albumin and ALT levels, signifying weaker metabolic performance. While the slight increase in cholesterol under moderate inclusion may reflect improved lipid metabolism, excessive inclusion levels ( $\geq 4$  g/kg feed) led to elevated aspartate aminotransferase (AST) values, suggesting mild hepatic stress.

Parameters	T1	T2	T3	T4	T5	T6	SEM
Total Protein (g/dl)	45.00 <sup>abc</sup>	50.50 <sup>a</sup>	46.50 <sup>ab</sup>	49.00 <sup>a</sup>	38.00 <sup>c</sup>	39.00 <sup>bc</sup>	1.25
Albumin (g/dl)	28.50 <sup>a</sup>	29.50 <sup>a</sup>	29.50 <sup>a</sup>	28.00 <sup>a</sup>	22.00 <sup>b</sup>	19.50 <sup>b</sup>	0.92
Globulin (g/dl)	16.50 <sup>a</sup>	21.00 <sup>a</sup>	17.00 <sup>a</sup>	21.00 <sup>a</sup>	16.00 <sup>b</sup>	19.50 <sup>b</sup>	0.81
Cholesterol (mg/dl)	37.00 <sup>d</sup>	71.50 <sup>a</sup>	68.00 <sup>ab</sup>	65.00 <sup>b</sup>	60.00 <sup>c</sup>	58.00 <sup>c</sup>	1.96
ALP (I.U/L)	40.00 <sup>b</sup>	42.50 <sup>b</sup>	39.50 <sup>b</sup>	48.50 <sup>a</sup>	41.50 <sup>b</sup>	38.50 <sup>b</sup>	0.77
UREA (mg/dl)	5.63 <sup>b</sup>	4.24 <sup>c</sup>	5.19 <sup>b</sup>	8.23 <sup>a</sup>	8.29 <sup>a</sup>	7.43 <sup>a</sup>	0.29
ALT (I.U/L)	26.00	25.50	26.00	23.50	23.00	23.00	2.22
AST (I.U/L)	143.00 <sup>c</sup>	148.50 <sup>bc</sup>	152.00 <sup>b</sup>	163.00 <sup>a</sup>	160.00 <sup>a</sup>	150.00 <sup>b</sup>	1.42

a,b,c = means within the same rows bearing different superscripts differ significantly ( $p < 0.05$ ). T1= 1g of *Sida acuta* in 1kg of feed, T2 = 2g of *Sida acuta* in 1kg of feed, T3 = 3g of *Sida acuta* in 1kg of the feed, T4 = 4g of *Sida acuta* in 1kg if the feed, T5 = 5g of *Sida acuta* in 1 kg of the feed, T6 = Control, TP= Total Protein, ALB= Albumin, CHOL= Cholesterol, ALP= Alkaline phosphatase, ALT= Alanine transaminase, AST= Aspartate transaminase, CREAT= Creatinine

**Table 5** Serum indices of ISA Brown laying birds fed varying inclusion levels of *Sida acuta* leaf meal

## Conclusion

The study concluded that the production performance data demonstrated that moderate levels (2g/kg) of *Sida acuta* inclusion improved feed conversion efficiency, hen-day production, and egg quality, while excessive inclusion (5g/kg)

resulted in reduction of weight gain and egg production. Similarly, nutrient digestibility analysis revealed significant differences among treatment groups, with improved crude protein digestibility and nitrogen-free extract digestibility observed

at optimal inclusion levels. Haematological and serum biochemical analyses further supported the potential benefits of *Sida acuta* as a feed additive. Birds receiving moderate inclusion exhibited improved red blood cell counts, haemoglobin concentration, and total protein levels, suggesting enhanced oxygen transport and immune function.

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