VOL. 10 NO. 9,
NOVEMBER, 2025
E-ISSN 3026-958X
P-ISSN 3027-1169

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Science Innovation & Technology Research (JSITR)

Growth Performance and Hemato-Biochemical Responses of Broiler Chickens Fed Diets Supplemented with Varying Levels of *Senna obtusifolia* Leaf Meal

Nuhu, S. H.; Mohammed, A.; & Sani, A.
Tetfund Centre of Excellence for Integrated Farming System and Department of Animal Health and Production Federal Polytechnic, Bauchi.
Corresponding Author: hussainisn@fptb.edu.ng
DOI: https://doi.org/10.70382/ajsitr.v10i9.068

Abstract
This study evaluated the effects of dietary inclusion of *Senna obtusifolia* (Sickle Senna) leaf meal (SSLM) on the growth performance and hematological parameters of broiler finisher chickens. A total of eighty (80), four-week-old Arbor Acres broilers were randomly allotted to four dietary treatments in a Completely Randomized Design (CRD). The treatments consisted of a basal diet supplemented with SSLM at 0.0% (T1, control), 0.5% (T2), 1.0% (T3), and 1.5% (T4). Each treatment was replicated four times, with five birds per replicate. The experiment lasted for four weeks. Results indicated that final weight gain was significantly ($p<0.05$) higher in the control group (6700 g/bird) compared to the SSLM-supplemented groups. The Feed Conversion Ratio (FCR) was significantly poorer in the 1.0% SSLM group (2.35) compared to the control (1.57). Hematological analysis revealed a significant ($p<0.05$) reduction in red blood cell count, hemoglobin concentration, and packed cell volume in birds fed SSLM, coupled with a marked elevation in white blood cell count. It was concluded that the inclusion of *Senna obtusifolia* leaf meal beyond 0.5% in broiler finisher diets adversely affects growth performance and induces physiological stress, likely due to antinutritional factors, and is therefore not recommended.

Keywords: *Senna obtusifolia*, Broiler chickens, Growth performance, Hematology,

Introduction

The global poultry industry is perpetually seeking sustainable strategies to enhance productivity and meet the rising demand for animal protein. In this context, the exploration of non-conventional, phytogenic feed additives as alternatives to antibiotic growth promoters and synthetic supplements has gained significant momentum (Dhama *et al.*, 2014). These plant-derived substances are valued for their potential to improve growth performance, modulate immune function, and contribute to overall animal health due to the presence of bioactive compounds like flavonoids, alkaloids, and tannins (Windisch *et al*., 2008). *Senna obtusifolia* (commonly known as Sickle Pod or Sickle Senna) is a leguminous plant widely distributed in tropical regions. Its leaves are a potential source of protein, vitamins, and minerals for livestock (Oluwafemi et al., 2014). Historically, various parts of the plant have also been used in traditional medicine, suggesting the presence of compounds with physiological activity (Yadav et al., 2010). However, the application of many leguminous plants in monogastric nutrition is often limited by the presence of antinutritional factors (ANFs), such as anthraquinones, which can interfere with nutrient digestion, absorption, and metabolism (Mézes *et al*., 2010). While some studies have investigated the nutritive value of *Senna obtusifolia*, there is a paucity of conclusive data on its safe and effective inclusion level in broiler diets. The balance between its nutritional benefits and potential adverse effects due to ANFs remains unclear. Therefore, this study was designed to critically evaluate the effects of graded dietary levels of *Senna obtusifolia* leaf meal (SSLM) on the growth performance, nutrient utilization, and key hematological parameters of broiler chickens during the finisher phase. The findings will help delineate the tolerance threshold and provide crucial insights for its potential use as a functional feed ingredient in poultry production.

Study Area

The study was conducted at the Poultry Teaching and Research Unit of the Department of Animal Health and Production, Federal Polytechnic Bauchi, Bauchi State, Nigeria. The area is in the northeastern region of Nigeria, characterized by a tropical climate. The experiment was carried out under a controlled deep-litter system.

Experimental Birds and Management

A total of eighty (80), four-week-old Arbor Acres broiler chickens with uniform body weight were used for the four-week study. Before the experiment, the birds were acclimatized for one week. Standard management practices, including vaccination and biosecurity measures, were strictly followed throughout the experimental period.

Experimental Design and Diet Formulation

The birds were randomly distributed into four dietary treatment groups in a Completely Randomized Design (CRD). Each treatment was replicated four times, with five birds per replicate, making a total of 20 birds per treatment.

The four iso-nitrogenous and iso-energetic finisher diets were formulated as follows

- **T1 (Control):** Basal diet with 0.0% Sickle Senna Leaf Meal (SSLM).
- **T2:** Basal diet + 0.5% SSLM.
- **T3:** Basal diet + 1.0% SSLM.
- **T4:** Basal diet + 1.5% SSLM.

Feed and clean water were provided *ad libitum* throughout the 4-week experimental period.

Sourcing and Preparation of Sickle Senna Leaf Meal (SSLM)

Fresh leaves of *Senna obtusifolia* were harvested from the surroundings of the School of Agriculture, Federal Polytechnic Bauchi. The leaves were authenticated, cleaned, and shade-dried for two weeks. The dried leaves were milled into a fine powder and stored in airtight containers until diet formulation.

Growth Performance Parameters

The following data were collected:

- **Initial Body Weight (IBW):** Recorded at the start of the experiment.
- **Final Body Weight (FBW):** Recorded at the end of the 4-week period.
- **Total Weight Gain (TWG):** Calculated as FBW - IBW.
- **Total Feed Intake (TFI):** Measured weekly as the difference between feed offered and refused.
- **Feed Conversion Ratio (FCR):** Calculated as Total Feed Intake / Total Weight Gain.

Hematological Parameters

At the end of the 4-week experimental period, one bird was randomly selected from each replicate (totaling 4 birds per treatment). Blood samples (2 ml per bird) were collected from the wing vein using a sterile syringe and needle and dispensed into EDTA bottles for hematological analysis. The following parameters were determined using an automated hematology analyzer (Sysmex KX-21N, Japan): Hemoglobin (Hb), Packed Cell Volume (PCV), Red Blood Cell count (RBC), White Blood Cell count (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC).

Statistical Analysis

Data on growth performance and hematology were analyzed using one-way Analysis of Variance (ANOVA) in SAS software. Treatment means were separated using Duncan's Multiple Range Test. Results were presented as mean ± Standard Error of the Mean (SEM), and statistical significance was declared at $p < 0.05$.

Results and Discussions

The results of the present study demonstrate that the dietary inclusion of *Senna obtusifolia* leaf meal (SSLM) exerts a significant, dose-dependent influence on both the growth performance and the physiological status of broiler chickens.

Growth Performance Metrics

The data on growth performance (Table 1) reveal a paradoxical initial advantage that gives way to a clear negative trend. Birds on SSLM-supplemented diets (T2-T4) exhibited a significantly higher initial weight, which may suggest a carry-over effect from the earlier growth phases or an initial stimulatory effect of bioactive compounds. However, this initial benefit was not sustained. The significantly lower overall weight gain and the poorer Feed Conversion Ratio (FCR) in these groups, particularly at the 1.0% and 1.5% inclusion levels, indicate a pronounced negative impact on metabolic efficiency.

Critically, the fact that feed intake remained consistent across all treatments strongly suggests that the reduced performance was not due to palatability issues but rather to a post-ingestive metabolic effect. This is a classic indicator of the presence and activity of antinutritional factors (Mézes et al., 2010). Bioactive compounds like anthraquinones, known to be present in *Senna* species, can form complexes with dietary proteins and digestive enzymes, or directly irritate the intestinal mucosa, thereby impairing nutrient digestibility and absorption (Yadav et al., 2010). The metabolic energy expended by the bird to detoxify or cope with these compounds may also be diverted from growth processes, explaining the higher FCR despite similar feed consumption (Castanon, 2007).

Hematological Indices as Health Indicators

The hematological results (Table 2) provide a compelling physiological explanation for the observed growth depression. The significant reduction in key oxygen-transporting parameters—Red Blood Cell (RBC) count, Hemoglobin (Hb) concentration, and Packed Cell Volume (PCV)—in all SSLM groups points towards a condition of mild anemia or compromised erythropoiesis (red blood cell production). This hypoxic state at the tissue level can severely limit energy metabolism and protein synthesis, directly contributing to stunted growth (Khan et al., 2012).

Concurrently, the dramatic elevation in White Blood Cell (WBC) count is a clear hematological signature of an activated immune system. This leukocytosis strongly implies that the birds perceived the SSLM, particularly at higher inclusion levels, as an immunological challenge or a source of physiological stress (Fulton, 2015). The body's resources were likely being allocated to mount an inflammatory or detoxification response, a process that is energetically expensive and competes with the nutrients available for growth, thereby exacerbating the poor FCR (Klasing, 2007).

Furthermore, the alterations in red blood cell indices (increased MCV, MCH, and MCHC) suggest a morphological change in the erythrocytes. Such a profile can be indicative of regenerative anemia or other underlying metabolic disturbances, reinforcing the conclusion that SSLM introduced a significant physiological stressor that disrupted normal homeostatic mechanisms (Thrall et al., 2012).

Conclusion

In conclusion, the findings from this study indicate that while *Senna obtusifolia* leaf meal may possess nutritional potential, its inclusion in broiler finisher diets at levels exceeding 0.5% induces significant adverse effects. These effects manifest as reduced growth performance,

inefficient feed utilization, and altered blood profiles indicative of physiological stress and immune activation, likely due to its antinutritional components.

Therefore, it is not recommended to include SSLM at levels of 0.5% or higher in broiler diets. Future research should focus on:

1. Identifying and quantifying the specific antinutritional factors in the leaf meal used.
2. Exploring processing techniques (e.g., heat treatment, fermentation) to detoxify these ANFs.
3. Investigating much lower inclusion rates (<0.25%) to determine if a beneficial, sub-therapeutic threshold exists.

Table 1: Performance of Broiler Finisher Fed Levels of Sickle Senna Leaf Meal

	Treatments				
Parameters	T_1 (0.0%SS)	T_2 (0.5% SS)	T_3 (1.0% SS)	T4(1,5%)	SEM
Feed Intake (g/bird/ week)	791.7	750.0	750.0	750.0	21.0
Initial Weight (g/bird/week)	7900.0[b]	9100.0[a]	9283.3[a]	9100.0[a]	100.0
Final Weight (g/bird/week)	14600.0	14400.0	14150.0	14400.0	210.0
Weight Gain (g/bird/week)	6700.0[a]	5300.0[b]	4816.7[b]	5300.0[b]	290.0
Feed Conversion Ratio (FCR)	1.57[b]	1.98[ab]	2.35[a]	1.98[ab]	0.19

[ab]Means in the same row with different superscripts are significantly different ($p < 0.05$) SS=Sickle senna. SEM = Standard Error of the Mean. FCR = Feed Conversion Ratio.

Table 2. Effect of Sickle Senna leaf Meal on Broiler finisher Blood Parameters

	Parameters						
Treatment	Hb	PCV	RBC	WBC	MCV	MCH	MCHC
0.0%	17[a]	56.00a	6.41[a]	185.00[a]	87.56[d]	26.30[d]	30.36[b]
0.5%	17[a]	51.00b	5.01[b]	97.50[b]	101.80[c]	34.41[a]	33.33[a]
1.0%	16.2[b]	49.0	4.71	118.00[b]	103.18[b]	33.93[b]	33.33[a]
1.5%	16.2[b]	48.60	4.14	119.30[b]	119.87	33.86[a]	33.33[a]
SEM	0.34	0.41	0.01	19.88	0.03	0.01	0.01

[ab]Means in the same row with different superscripts are significantly different ($p < 0.05$) SS=Sickle senna. SEM = Standard Error of the Mean.

Acknowledgement

We appreciate the contribution and support of Tetfund center of excellence for integrated farming systems Federal polytechnic towards ensuring the success of this research.

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