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Effects of Dietary Sickle Senna (*Senna obtusifolia*) Leaf Meal Supplementation on Haematological Parameters and Testosterone Levels in Noiler Cocks

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Abstract

This study evaluated the effects of dietary supplementation with Sickle senna (*Senna obtusifolia*) leaf meal (SSLM) on the haematological parameters and testosterone levels of Noiler cocks. A total of thirty-six (36) Noiler cocks aged 28 weeks were randomly assigned to four treatment groups in a completely randomized design: T1 (control, 0% SSLM), T2 (0.5% SSLM), T3 (1.0% SSLM), and T4 (1.5% SSLM). Each treatment consisted of nine birds replicated three times with three birds per replicate. The experiment lasted for six weeks. Fresh Sickle senna leaves were harvested, shade-dried, milled, and incorporated into experimental diets. Blood samples were collected at the end of the experiment for haematological (Hb, PCV, RBC, WBC, MCV, MCH, MCHC) and hormonal (testosterone, LH, FSH) analyses. Results showed that dietary inclusion of SSLM significantly ($p < 0.05$) reduced red blood cell (RBC) counts across all supplemented groups compared to the control, with values declining from 4.55×10^6/µL (T1) to $3.20–3.51 \times 10^6$/µL in treated groups. White blood cell (WBC) counts increased significantly ($p < 0.05$) from 63.4×10^3/µL (T1) to $143.1–156.7 \times 10^3$/µL in supplemented groups. Mean corpuscular hemoglobin (MCH) was significantly elevated in T3 (55.19 pg), suggesting macrocytic changes. Testosterone levels were significantly reduced ($p < 0.05$) from 4.36 ng/mL (control) to 2.44–2.98 ng/mL in treated groups, while luteinizing hormone (LH) and follicle-stimulating hormone (FSH) remained unaffected. The observed reductions in RBC count and testosterone levels, coupled with marked leukocytosis, indicate that SSLM supplementation may impair erythropoiesis and reproductive function while stimulating immune responses. It is concluded that SSLM inclusion beyond 0.5% in the diet of Noiler cocks negatively impacts haematological parameters and testosterone

production. For optimal health and reproductive performance in Noiler breeding cocks, dietary SSLM inclusion should not exceed 0.5%.

Keywords: *Senna obtusifolia*, Sickle senna, phytogenic feed additive, Noiler cocks, haematology, testosterone, reproductive hormones

Introduction

The global poultry industry faces increasing pressure to reduce reliance on antibiotic growth promoters (AGPs) due to concerns over antimicrobial resistance and consumer demand for antibiotic-free products. This has stimulated considerable research into alternative feed additives, with phytogenic feed additives (PFAs) emerging as promising candidates. PFAs are plant-derived compounds that possess antimicrobial, antioxidant, anti-inflammatory, and immunomodulatory properties, making them suitable replacements for AGPs in poultry nutrition. Numerous studies have demonstrated that plant-derived substances can improve the health of internal organs, inhibit pathogenic microorganisms, and enhance feed utilization.

Senna obtusifolia, commonly known as Sickle senna or sicklepod, is a widely distributed tropical legume that has attracted research interest as a potential feed ingredient. The plant is abundant in many regions of Africa, Asia, and the Americas, and its leaves and seeds contain moderate levels of protein with an acceptable amino acid profile, especially essential amino acids. This nutritional profile, coupled with its availability, makes Sickle senna a potential protein supplement for poultry feeding. However, *Senna* species are also known to contain various antinutritional factors (ANFs), including oxalates, phytates, saponins, tannins, and haemagglutinins, which hinder their fullest use in poultry diets. Raw meal as low as 50 g/kg has been shown to exert antinutritional effects, while fermented seed meal may be included up to 200 g/kg without compromising performance.

Recent studies have investigated the effects of *Senna* species on poultry performance and health. Research on the proximate composition and anti-nutritive components has revealed that *Senna obtusifolia* has better nutritional value as livestock feedstuff compared to *Senna occidentalis*, though both contain significant levels of antinutritional factors. Studies on nutrient digestibility have demonstrated that processing methods such as fermentation significantly improve the digestibility of dry matter, crude protein, and ether extract compared to raw seed meal, with residual ANFs in processed meals still affecting performance. Augustine et al. (2020) reported that better hematological and biochemical status were observed in birds fed fermented *Senna obtusifolia* seed meal-based diets compared to raw meal diets.

The Noiler is a dual-purpose chicken breed developed in Nigeria, valued for its adaptability to local conditions and good meat and egg production potential. Reference ranges for Noiler chickens include hemoglobin (10.2 – 15.1 g/dL), PCV (30 – 49%), WBC (3 – 11 × 10⁹/L), and lymphocytes (40 – 70%). Understanding the physiological responses of Noiler cocks to dietary interventions is essential for optimizing their productivity and health. The hematological profile provides valuable insights into the health status of birds, as blood parameters reflect the physiological state and can indicate stress, nutritional deficiencies, or disease conditions. Hormonal parameters, particularly testosterone, are critical for reproductive function and overall productivity in male birds.

Recent research has demonstrated that Sickle senna leaf meal has a dose-dependent, biphasic influence on the reproductive performance of Noiler cocks. Nuhu et al. (2025) reported that semen pH, sperm motility, and sperm concentration were significantly higher in the control and lower SSLM groups compared to higher inclusion levels, with the 1.0% and 1.5% SSLM groups showing a significant reduction in sperm concentration and an increase in abnormal sperm morphology. Testicular morphometry was also significantly affected, with the 1.5% SSLM group recording the lowest paired testicular weight, volume, and gonadosomatic index. The study concluded that for optimal reproductive performance in Noiler breeding cocks, dietary SSLM inclusion should not exceed 0.5%.

Despite the growing interest in *Senna* species as feed additives, there is limited information on their integrated effects on the haematological and hormonal profiles of Noiler cocks. This study was therefore conducted to evaluate the effects of dietary supplementation with Sickle senna (*Senna obtusifolia*) leaf meal as a phytogenic feed additive on haematological parameters and testosterone levels of Noiler cocks.

Experimental Site

The experiment was conducted at the Poultry Unit of the Teaching and Research Farm, Federal Polytechnic, Bauchi, Nigeria. The location is situated within the Sudan Savanna ecological zone of Nigeria, characterized by a tropical climate with distinct wet and dry seasons. The experiment lasted for six weeks.

Experimental Birds and Management

A total of thirty-six (36) Noiler cocks aged 28 weeks were used for this study. The birds were obtained from a reputable commercial hatchery and were acclimatized to the experimental conditions for two weeks prior to the commencement of the study. During the acclimatization period, the birds were fed a standard commercial broiler starter diet and provided with clean drinking water *ad libitum*. The birds were vaccinated against Newcastle disease and infectious bursal disease (Gumboro) according to standard vaccination protocols.

The birds were housed in deep litter pens measuring 2 m × 1.5 m × 1.5 m, with wood shavings as litter material. Each pen was equipped with feeder troughs and drinker troughs. The pens were thoroughly cleaned and disinfected before the arrival of the birds. The birds were randomly assigned to four treatment groups (T1, T2, T3, and T4) using a completely randomized design (CRD), with each treatment comprising nine birds (three replicates of three birds per replicate). The experimental birds were managed under similar environmental conditions throughout the study period.

Collection and Preparation of Sickle Senna (*Senna obtusifolia*) Leaf Meal

Fresh leaves of Sickle senna (*Senna obtusifolia*) were collected from the wild vegetation around the Bauchi metropolis and its environs. The plant material was identified and authenticated by a taxonomist at the Department of Biological Sciences, Federal Polytechnic, Bauchi, Nigeria. The leaves were harvested at the flowering stage to ensure optimal phytochemical composition.

The collected leaves were thoroughly washed with clean water to remove dust, dirt, and other contaminants. The clean leaves were then spread on clean polythene sheets under a shade for drying. The leaves were dried at room temperature (25–30°C) for 7–10 days until a constant weight was achieved. The shade-drying method was employed to preserve heat-labile phytochemical constituents and prevent the degradation of bioactive compounds.

After complete drying, the leaf samples were milled using a laboratory hammer mill to obtain a fine powder (particle size ≤ 1 mm). The resulting Sickle senna leaf meal (SSLM) was stored in airtight plastic containers at room temperature until use.

Experimental Diets

Four experimental diets were formulated to meet the nutrient requirements of Noiler cocks. The diets were isonitrogenous and isocaloric to ensure that the observed effects were due to the phytogenic feed additive rather than nutritional differences. The Sickle senna leaf meal was incorporated into the diets at different inclusion levels as follows:

Treatment	Sickle Senna Leaf Meal Inclusion (%)	Description
T1	0.0%	Control diet (no SSLM)
T2	0.5%	SSLM at 0.5% inclusion
T3	1.0%	SSLM at 1.0% inclusion
T4	1.5%	SSLM at 1.5% inclusion

The diets were mixed thoroughly, pelleted using a feed pelleting machine, and stored in clean, dry containers at room temperature.

Blood Sample Collection

At the end of the experimental period (six weeks), blood samples were collected from three birds per replicate (nine birds per treatment) for hematological and hormonal analysis. Blood collection was done early in the morning before feeding to avoid postprandial effects. Approximately 5 mL of blood was collected from the wing vein (brachial vein) using sterile syringes and needles.

For hematological analysis, 2 mL of blood was dispensed into sterile sample tubes containing ethylene diamine tetra-acetic acid (EDTA) as anticoagulant. The remaining 3 mL of blood was dispensed into plain sample tubes without anticoagulant for serum separation, which was used for hormonal analysis. The blood samples were immediately transported to the laboratory in an ice-packed cooler for processing.

Hematological Analysis

Hematological parameters were determined using standard laboratory procedures. The following parameters were evaluated:

- **Hemoglobin (Hb)** was determined using the cyanmethemoglobin method.
- **Packed Cell Volume (PCV)** was determined using the microhematocrit centrifugation method.
- **Red Blood Cell (RBC) Count** was determined using the hemocytometer method with Hayem's diluting fluid.
- **White Blood Cell (WBC) Count** was determined using the hemocytometer method with Turk's diluting fluid.
- **Mean Corpuscular Volume (MCV)**, **Mean Corpuscular Hemoglobin (MCH)**, and **Mean Corpuscular Hemoglobin Concentration (MCHC)** were calculated using standard formulae.

Hormonal Analysis

For hormonal analysis, blood samples in plain tubes were allowed to clot at room temperature for 30 minutes. Serum was separated by centrifugation at 3,000 rpm for 15 minutes and stored at −20°C until analysis. The following hormonal parameters were evaluated:

- **Testosterone:** Serum testosterone concentration was determined using the Enzyme-Linked Immunosorbent Assay (ELISA) method.
- **Luteinizing Hormone (LH):** Serum LH concentration was determined using a commercial chicken-specific LH ELISA kit.
- **Follicle Stimulating Hormone (FSH):** Serum FSH concentration was determined using a commercial chicken-specific FSH ELISA kit.

All ELISA analyses were performed using an ELISA plate reader set at 450 nm wavelength. All samples were analyzed in duplicate, and the mean values were used for statistical analysis.

Statistical Analysis

All data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomized design using the General Linear Model (GLM) procedure of Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). The statistical model used was:

$$Yij = \mu + Ti + \varepsilon ij$$

Where:

- Yij = observed value
- μ = overall mean
- Ti = effect of treatment (i = 1, 2, 3, 4)
- εij = random error

Where significant treatment effects were observed ($p < 0.05$), means were separated using Tukey's Honest Significant Difference (HSD) post-hoc test. The results were presented as mean values with their respective standard errors (SEM). The level of significance was set at $p < 0.05$.

Haematological Parameters

The effects of Sickle senna supplementation on haematological parameters of Noiler cocks are presented in Table 1. Significant differences ($p < 0.05$) were observed for RBC, WBC, and MCH across treatments. No significant differences ($p > 0.05$) were observed for Hb, PCV, MCV, and MCHC.

Table 1. Effect of Sickle senna (*Senna obtusifolia*) Leaf Meal as Phytogenic Feed Additive on Haematological Parameters of Noiler Cocks

Parameter	T1 (0.0%)	T2 (0.5%)	T3 (1.0%)	T4 (1.5%)	SEM
Hb (g/dL)	16.20	14.60	14.70	16.45	1.37
PCV (%)	44.40	44.00	44.20	44.60	2.01
RBC (×10⁶/µL)	4.55^{a}	3.51^{b}	3.20^{b}	3.30^{b}	2.04
WBC (×10³/µL)	63.4^{a}	147.30^{b}	143.10^{b}	156.65^{b}	3.20
MCV (fL)	102.02	129.62	136.38	135.50	13.09

Parameter	T1 (0.0%)	T2 (0.5%)	T3 (1.0%)	T4 (1.5%)	SEM
MCH (pg)	36.31[b]	42.78[b]	55.19[a]	49.81[b]	40.39
MCHC (g/dL)	37.07	35.86	33.25	37.11	3.20

Note. [a],[b] Means in the same row having different superscripts are significantly different ($p < 0.05$). SEM = Standard Error of Means; NS = Not Significant; * = Significant ($p < 0.05$). Hb = Hemoglobin; PCV = Packed Cell Volume; RBC = Red Blood Cell; WBC = White Blood Cell; MCV = Mean Corpuscular Volume; MCH = Mean Corpuscular Hemoglobin; MCHC = Mean Corpuscular Hemoglobin Concentration.

Red Blood Cell (RBC) Count

The RBC count was significantly affected by dietary treatment ($p < 0.05$). The control group (T1, 0.0%) recorded the highest RBC count ($4.55 \times 10^6/\mu L$), which was significantly higher than all supplemented groups. Among the treated groups, T2 (0.5%) had the highest RBC count ($3.51 \times 10^6/\mu L$), while T3 (1.0%) recorded the lowest ($3.20 \times 10^6/\mu L$). T4 (1.5%) showed a value of $3.30 \times 10^6/\mu L$.

White Blood Cell (WBC) Count

There was a significant increase ($p < 0.05$) in WBC count with Sickle senna supplementation. T1 (0.0%) had the lowest WBC count ($63.4 \times 10^3/\mu L$), while T4 (1.5%) recorded the highest ($156.65 \times 10^3/\mu L$). T2 ($147.30 \times 10^3/\mu L$) and T3 ($143.10 \times 10^3/\mu L$) showed intermediate values, all significantly higher than the control.

Hemoglobin (Hb) and Packed Cell Volume (PCV)

No significant differences ($p > 0.05$) were observed in Hb and PCV values across treatments. Hb ranged from 14.60 g/dL (T2) to 16.45 g/dL (T4), while PCV ranged from 44.00% (T2) to 44.60% (T4). All values were within the normal reference ranges for Noiler chickens (Hb: 10.2 – 15.1 g/dL; PCV: 30 – 49%).

Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC)

No significant differences were observed for MCV (102.02–136.38 fL) or MCHC (33.25–37.11 g/dL).

Mean Corpuscular Hemoglobin (MCH)

MCH was significantly affected ($p < 0.05$), with T3 (1.0%) recording the highest value (55.19 pg). T1 (36.31 pg), T2 (42.78 pg), and T4 (49.81 pg) showed lower values.

Hormonal Profile

The effects of Sickle senna supplementation on the hormonal profile of Noiler cocks are presented in Table 2.

Table 2. Effect of Sickle senna (*Senna obtusifolia*) Leaf Meal as Phytogenic Feed Additive on Hormonal Profile of Noiler Cocks

Parameter	T1 (0.0%)	T2 (0.5%)	T3 (1.0%)	T4 (1.5%)	SEM
Testosterone (ng/mL)	4.36[a]	2.79[b]	2.98[b]	2.44[b]	0.22
LH (IU/mL)	0.03	0.03	0.03	0.03	0.25
FSH (IU/mL)	0.29	0.29	0.29	0.29	0.00

Note. [a],[b] Means within the same row bearing different superscripts differ significantly ($p < 0.05$). SEM = Standard Error of Means; LOS = Level of Significance; * = Significant difference ($p < 0.05$); NS = Not Significant. LH = Luteinizing Hormone; FSH = Follicle Stimulating Hormone.

Testosterone

Testosterone levels were significantly reduced ($p < 0.05$) in birds fed Sickle senna-supplemented diets. T1 (0.0%) recorded the highest testosterone level (4.36 ng/mL), while T4 (1.5%) recorded the lowest (2.44 ng/mL). T2 (2.79 ng/mL) and T3 (2.98 ng/mL) showed intermediate values.

Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH)

No significant differences ($p > 0.05$) were observed for LH (0.03 IU/mL) or FSH (0.29 IU/mL) across all treatments.

Red Blood Cell Count (RBC)

The significant reduction in RBC count across all Sickle senna-supplemented groups compared to the control is noteworthy. RBC counts declined from $4.55 \times 10^6/\mu L$ (control) to $3.20–3.51 \times 10^6/\mu L$ in treated groups, representing a reduction of approximately 23–30%. This finding suggests that Sickle senna supplementation may impair erythropoiesis. The reduction in RBC count could be attributed to the presence of antinutritional factors in Sickle senna. Diarra (2024) documented that *Senna obtusifolia* products contain oxalates, phytates, saponins, tannins, and haemagglutinins. The tannins and oxalates may interfere with iron absorption and utilization, thereby limiting hemoglobin synthesis and erythrocyte production. Additionally, the presence of saponins and haemagglutinins in Sickle senna may have direct hemolytic effects on red blood cells.

Previous studies have reported similar patterns. Augustine et al. (2020) observed that broiler chickens fed raw *Senna obtusifolia* seed meal-based diets recorded the lowest RBC values compared to control groups. The poor nutrient digestibility observed in broiler chickens fed raw *Senna obtusifolia* seed meal has been attributed to the adverse effects of tannins and other related polyphenols present in the raw seed meal. Research has shown that antinutritional factors can bind with dietary proteins, forming less digestible complexes, and may also combine with endogenous enzymes, thus depressing digestibility.

However, it is important to note that some studies have reported no significant effects of *Senna* species on RBC counts. Bababngida et al. (2025) found that toasted *Senna obtusifolia* seed meal did not significantly affect RBC values in broiler chickens, suggesting that processing methods such as toasting may reduce the antinutritional factors responsible for RBC reduction. Similarly, studies have shown that fermentation significantly improves nutrient digestibility compared to raw seed meal. The raw or unprocessed form of Sickle senna used in this study may have retained these antinutritional factors, leading to the observed RBC depression.

White Blood Cell Count (WBC)

The marked increase in WBC count from $63.4 \times 10^3/\mu L$ (control) to $143.1–156.7 \times 10^3/\mu L$ in supplemented groups is highly significant and suggests a strong leukocytic response. This leukocytosis indicates immune system activation, which could be interpreted as either a beneficial immunostimulatory effect or a stress/inflammatory response. The normal WBC range for Noiler chickens is $3 – 11 \times 10^9/L$ ($3.0–11.0 \times 10^3/\mu L$) , indicating that all treatment groups exceeded normal ranges.

The phytochemical compounds in *Senna* species, including flavonoids and phenolic compounds, are known to possess immunomodulatory properties. The elevated WBC count observed in this study may therefore indicate enhanced immune surveillance, potentially beneficial for disease resistance. However, the magnitude of the increase (more than double the control value) is substantial and may also suggest a stress response or inflammatory condition. Studies on transportation stress in Noiler chickens have shown that stress can significantly alter leukocyte profiles. Similar findings were reported by Augustine et al. (2020), who observed elevated WBC values in broiler chickens fed raw *Senna obtusifolia* seed meal-based diets.

Hemoglobin (Hb) and Packed Cell Volume (PCV)

The lack of significant differences in Hb and PCV values despite the significant reduction in RBC count is an interesting observation. All values were within the normal reference ranges for Noiler chickens (Hb: 10.2 – 15.1 g/dL; PCV: 30 – 49%). This suggests that despite reduced RBC numbers, the erythrocytes present may have adequate hemoglobin content to maintain oxygen-carrying capacity.

This pattern could be explained by the significantly elevated MCH values observed in treated groups, particularly T3 (55.19 pg). The increased MCH indicates that the red blood cells in supplemented groups had higher hemoglobin content per cell, compensating for the reduced RBC numbers. This macrocytic response may represent a compensatory mechanism to maintain normal Hb and PCV levels despite decreased erythrocyte production.

Mean Corpuscular Volume (MCV) and MCHC

The non-significant changes in MCV and MCHC suggest that the erythrocyte size and hemoglobin concentration were relatively stable across treatments. The numerical increase in MCV values in supplemented groups (102.02–136.38 fL compared to 102.02 fL in control) may indicate a trend toward macrocytosis, consistent with the elevated MCH values, but this was not statistically significant.

Testosterone

The significant reduction in testosterone levels in Sickle senna-supplemented groups is a critical finding. Testosterone, the primary male sex hormone, is essential for normal reproductive function, including spermatogenesis, libido, and secondary sexual characteristics. The decline from 4.36 ng/mL (control) to 2.44–2.98 ng/mL in treated groups represents a reduction of approximately 32–44%.

This reduction could be attributed to several factors. The antinutritional factors in Sickle senna, particularly phytates and tannins, may interfere with the absorption of zinc and other trace minerals essential for testosterone biosynthesis. Zinc is a critical cofactor for the enzyme 17β-hydroxysteroid dehydrogenase, which is involved in testosterone synthesis. Additionally, the stress response indicated by elevated WBC counts may have negatively affected the hypothalamic-pituitary-gonadal axis, leading to reduced testosterone secretion.

The lack of significant changes in LH and FSH levels is notable. LH stimulates testosterone production by the Leydig cells of the testes, while FSH is essential for spermatogenesis. The absence of changes in these pituitary hormones suggests that the reduction in testosterone may be due to direct effects on the testes rather than impaired pituitary function. This could indicate a direct toxic effect of Sickle senna phytochemicals on testicular steroidogenesis.

Recent research has demonstrated that Sickle senna leaf meal has a dose-dependent, biphasic influence on the reproductive performance of Noiler cocks. Nuhu et al. (2025) reported that semen pH, sperm motility, and sperm concentration were significantly higher in the control and lower SSLM groups

compared to higher inclusion levels, with the 1.0% and 1.5% SSLM groups showing a significant reduction in sperm concentration and an increase in abnormal sperm morphology. Testicular morphometry was also significantly affected, with the 1.5% SSLM group recording the lowest paired testicular weight, volume, and gonadosomatic index. The reduction of paired testicular weight at 1.5% (22.33g) indicates severe testicular weight loss, matching previous reports on Sickle senna's reproductive toxicity.

Comparative Analysis

The findings of this study align with previous research on *Senna* species in poultry. The marked leukocytosis observed is consistent with the immunostimulatory potential of *Senna* species documented by Augustine et al. (2020). The reduction in RBC counts is consistent with the presence of antinutritional factors documented by Diarra (2024). The reproductive toxicity observed, particularly the reduction in testosterone levels and testicular morphometry, is consistent with the findings of Nuhu et al. (2025).

However, the non-linear dose-response observed in some parameters (particularly RBC, where the lowest value was at 1.0% rather than at the highest inclusion level of 1.5%) suggests a complex interaction between Sickle senna phytochemicals and physiological processes.

Implications for Poultry Production

The findings of this study have several implications for the use of Sickle senna as a phytogenic feed additive:

Positive Implications:

1. **Immune stimulation:** The elevated WBC counts suggest that Sickle senna supplementation may enhance immune function, potentially improving disease resistance in poultry.
2. **Natural alternative:** As a widely available plant, Sickle senna could serve as a cost-effective alternative to antibiotics for immune enhancement.

Negative Implications:

1. **Erythropoiesis impairment:** The significant reduction in RBC count raises concerns about the potential negative effects on blood formation and oxygen transport.
2. **Reproductive toxicity:** The reduction in testosterone levels and the documented negative effects on semen quality and testicular morphometry are significant concerns for breeding flocks.
3. **Stress response:** The magnitude of WBC elevation may indicate a stress or inflammatory response rather than beneficial immune stimulation.

Processing and Safe Utilization

The literature suggests that processing methods can significantly reduce the antinutritional factors in *Senna* species. Studies have shown that fermentation significantly improves the digestibility of dry matter, crude protein, and ether extract compared to raw seed meal. Depending on bird age, fermented *Senna* seed meal may be included in the diet of broilers and cockerels up to 200 g/kg without compromising performance, but raw meal as low as 50 g/kg exerts antinutritional effects. For optimal reproductive performance in Noiler breeding cocks, dietary SSLM inclusion should not exceed 0.5%.

The findings of this study underscore the importance of appropriate processing methods to reduce antinutritional factors and improve the safety of *Senna* species as feed additives. The inclusion levels tested in this study (0.5–1.5%) may have been suboptimal or insufficiently processed, leading to the observed negative effects.

Conclusions

The administration of Sickle senna (*Senna obtusifolia*) leaf meal as a phytogenic feed additive to Noiler cocks at inclusion levels of 0.5–1.5% produced the following haematological and hormonal effects:

1. **Significant reduction in RBC count:** Sickle senna supplementation reduced RBC counts by 23–30% compared to the control, indicating impaired erythropoiesis possibly due to antinutritional factors interfering with iron absorption and utilization.
2. **Marked leukocytosis:** WBC counts increased by more than twofold in supplemented groups, suggesting immune stimulation but also potentially indicating stress or inflammation.
3. **Compensatory erythrocyte changes:** Despite reduced RBC counts, Hb and PCV remained stable within normal reference ranges (Hb: 10.2 – 15.1 g/dL; PCV: 30 – 49%) due to compensatory increases in MCH, indicating larger, hemoglobin-rich erythrocytes.
4. **Significant testosterone reduction:** Testosterone levels declined by 32–44% in supplemented groups, suggesting potential reproductive toxicity, while LH and FSH remained unaffected, indicating a direct effect on testicular steroidogenesis.
5. **Consistency with reproductive toxicity literature:** The findings align with recent research demonstrating that Sickle senna at inclusion levels ≥1.0% negatively impacts semen quality, sperm concentration, and testicular morphometry in Noiler cocks.

Recommendations:

Based on these findings, the use of Sickle senna as a phytogenic feed additive at the tested concentrations in Noiler cocks should be approached with caution. While the plant may offer immunostimulatory benefits, the negative effects on RBC count and testosterone production may outweigh these benefits, particularly for breeding flocks. For optimal health and reproductive performance in Noiler breeding cocks, dietary SSLM inclusion should not exceed 0.5%. Further studies with processed Sickle senna and lower inclusion levels are recommended to identify a safe and effective dosage.

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