

Effect of interval of feeding roughage and concentrate on the haematological and biochemical parameters of Sahelian does

Muhammad Sani Ibraheem

Department of Animal Health and Production, College of Agriculture, Hassan Usman Katsina Polytechnic, Katsina, Nigeria

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Abstract

This study was conducted to evaluate the effect of feeding roughage and concentrate at different intervals on the haematological and biochemical parameters of Sahelian does. Nine (9) Sahelian does aged 5–6 months were used in a Completely Randomized Design (CRD). The animals were divided into three treatments: T1, where roughage and concentrate were offered simultaneously; T2, where roughage was offered first and concentrate two hours later; and T3, where roughage was offered first and concentrate three hours later. The concentrate was composed of maize offal (40%), cottonseed cake (30%), bone meal (20%), and salt (10%), while groundnut haulms served as the sole roughage. Results showed that packed cell volume (PCV) ranged between 25.67% and 26.67%, haemoglobin (Hb) values between 8.50 g/dl and 8.87 g/dl, red blood cell (RBC) counts between $2.83 \times 10^{12}/L$ and $3.10 \times 10^{12}/L$, and white blood cell (WBC) counts between $10.80 \times 10^9/L$ and $14.10 \times 10^9/L$. Serum biochemical parameters revealed total protein values between 43.33 g/dl and 45.33 g/dl, albumin between 19.00 g/l and 21.67 g/l, cholesterol between 3.73 mmol/l and 5.00 mmol/l, AST between 124.00 iu/l and 143.33 iu/l, ALT between 35.33 iu/l and 46.00 iu/l, creatinine between 0.63 mg/dl and 1.07 mg/dl, and blood urea nitrogen (BUN) between 20.33 g/dl and 23.00 g/dl. None of the parameters was significantly ($P>0.05$) affected by feeding intervals. The integration of dietary composition, haematological indices, and biochemical markers confirms that Sahelian does can tolerate feeding delays of up to three hours without adverse effects on their physiological health. These findings provide evidence that flexible feeding schedules can be adopted in semi-arid regions without compromising animal welfare or productivity.

Keywords: Sahelian goats, feeding intervals, roughage and concentrate, haematological parameters, biochemical indices

Introduction

Goats are among the most important livestock species in Nigeria, contributing significantly to household nutrition, income, and cultural practices (Ademosun, 1994) [2]. Sahelian goats, also known as “Bornu White” or “West African Long-legged,” are widely distributed in the semi-arid northern belt of Nigeria. They are characterized by long legs, white coats, and adaptability to harsh climates (Wilson & Durkin, 1984) [13].

In Katsina State, goat production is a major livelihood activity. Morphometric studies have shown that chest girth is the most reliable predictor of body weight in Sahelian goats, with females averaging ~27 kg (Rotimi, Lamido & Aruwayo, 2024) [10]. Haematological studies indicate seasonal variations in blood indices, with PCV and Hb values fluctuating but generally remaining within healthy ranges (Habibu *et al.*, 2017) [7].

Nutritional constraints remain a challenge in semi-arid zones, where goats often rely on crop residues and low-quality roughages (Adugna *et al.*, 2000) [3]. Supplementation with concentrates improves productivity, but feeding strategies must be optimized to balance cost and efficiency. This study investigates whether feeding intervals of roughage and concentrate affect the physiological health of Sahelian does in Katsina.

Materials and Methods

Location of the Study

The experiment was conducted at the College of Agriculture, Hassan Usman Katsina Polytechnic, Katsina, situated in the Sudan Savanna ecological zone. Katsina lies at latitude $12^{\circ}59'N$ and longitude $7^{\circ}36'E$, with an elevation

of approximately 500–550 meters above sea level. The climate is semi-arid, classified as BSh under the Köppen system. The mean annual temperature is about $33^{\circ}C$, with daily highs often exceeding $40^{\circ}C$ during the hot dry season. Rainfall averages between 600 and 800 mm annually, concentrated between May and September, while the dry season extends from October to April, characterized by Harmattan winds, low humidity, and scarcity of green forage (Abaje, 2007) [1].

Experimental Animals and Design

Nine (9) Sahelian does aged 5–6 months were sourced from local markets in Katsina. The animals were quarantined for two weeks, dewormed with Albendazole, treated with Ivermectin for external parasites, and vaccinated against common infections. After quarantine, they were weighed and balanced for body weight before being randomly assigned to three treatments in a Completely Randomized Design (CRD). In Treatment 1 (T1), roughage and concentrate were offered simultaneously. In Treatment 2 (T2), roughage was offered first and concentrate two hours later. In Treatment 3 (T3), roughage was offered first and concentrate three hours later. The animals were housed in individual pens and fed at 4% of their live body weight daily, with a roughage-to-concentrate ratio of 70:30. Water was provided *ad libitum*.

Diets

The roughage consisted of groundnut haulms, while the concentrate was composed of maize offal, cottonseed cake, bone meal, and common salt.

Blood Sampling

Blood samples (10 ml) were collected via jugular venipuncture before feeding. Haematological parameters (Hb, PCV, RBC, WBC, lymphocytes, neutrophils) and biochemical indices (total protein, albumin, cholesterol, AST, ALT, ALP, creatinine, BUN) were analyzed following standard veterinary protocols (Coles, 1986; Daramola *et al.*, 2005) [4, 5].

Results

Table 2: Haematological Parameters of Sahelian Does Fed Roughage and Concentrate at Different Intervals

Parameters	T1 Simultaneous)	T2 (2 hrs delay)	T3 (3 hrs delay)	SEM	Significance
PCV (%)	26.00	26.67	25.67	0.87	NS
Hb (g/dl)	8.63	8.87	8.50	0.84	NS
RBC ($\times 10^{12}/L$)	2.83	3.07	3.10	0.76	NS
WBC ($\times 10^9/L$)	13.63	10.80	14.10	0.12	NS

Source: Field Experiment, 2025

Table 3: Biochemical Parameters of Sahelian Does

Parameters	T1	T2	T3	SEM
Total protein (g/dl)	43.33	44.33	45.33	0.91 NS
Albumin (g/l)	21.67	20.67	19.00	0.91 NS
Cholesterol (mmol/l)	3.73	4.83	5.00	0.56 NS
AST (iu/l)	127.33	143.33	124.00	0.84 NS
ALT (iu/l)	35.33	46.00	43.33	0.73 NS
Creatinine (mg/dl)	1.07	1.00	0.63	0.61 NS
BUN (g/dl)	20.33	23.00	21.00	0.88 NS

Source: Field Experiment, 2025

Discussion

The ingredient composition (Table 1) shows that the concentrate was formulated with maize offal (40%), cottonseed cake (30%), bone meal (20%), and salt (10%), while groundnut haulms served as the sole roughage. This balanced formulation provided sufficient energy, protein, and minerals, ensuring that all animals received a nutritionally adequate diet. Because the concentrate formulation was constant across treatments, the study effectively isolated the effect of feeding intervals rather than diet composition.

Haematological parameters (Table 2) revealed that PCV values (25.67–26.67%) and Hb levels (8.50–8.87 g/dl) were within the normal physiological ranges for goats, indicating adequate oxygen-carrying capacity and erythropoiesis. RBC counts ($2.83\text{--}3.10 \times 10^{12}/L$) were slightly lower than those reported for Red Sokoto goats, reflecting breed differences in haematological profiles (Tambuwal, Agale, & Bangana, 2002) [12]. WBC counts ($10.80\text{--}14.10 \times 10^9/L$) suggested adequate immune function, comparable to values reported by Njidda, Shu'aibu, and Isidahomen (2013) [8]. The absence of significant differences ($P>0.05$) across treatments demonstrates that feeding intervals did not compromise blood health or immune competence.

Biochemical parameters (Table 3) further support this conclusion. Serum protein values (43.33–45.33 g/dl) confirmed adequate dietary protein intake, while albumin levels (19.00–21.67 g/l) remained within acceptable ranges. Cholesterol values (3.73–5.00 mmol/l) were moderate, reflecting balanced lipid metabolism. Liver enzymes (AST and ALT) were stable across treatments, indicating no hepatic stress, while creatinine (0.63–1.07 mg/dl) and BUN (20.33–23.00 g/dl) confirmed proper kidney function.

Table 1: Ingredient Composition of Concentrates and Roughages (%)

Ingredient	Percentage (%)
Maize offal	40
Cottonseed cake	30
Bone meal	20
Common salt	10
Total Concentrate	100
Groundnut haulms	100

Source: Field Experiment, 2025

Taken together, these results highlight the physiological resilience of Sahelian does. Their ability to maintain stable haematological and biochemical values across feeding intervals suggests that the rumen buffering system and microbial adaptability effectively mitigate asynchronous nutrient supply. The moderate concentrate level (30% of the diet) may also have prevented metabolic disturbances. From a production standpoint, the findings imply that feeding management in semi-arid zones can be more flexible than traditionally assumed. Farmers who face constraints in labor or feed availability can delay concentrate feeding by up to three hours without adverse effects. This flexibility could reduce feeding stress, improve labor efficiency, and allow integration of feeding with other farm activities. Future research should investigate whether such feeding intervals influence growth performance, reproductive efficiency, and economic returns, thereby linking physiological stability to productivity outcomes.

Conclusion

This study demonstrated that the interval of feeding roughage and concentrate (simultaneous, two-hour, or three-hour delay) had no significant ($P>0.05$) effect on the haematological and biochemical parameters of Sahelian does. All measured values across the treatment groups were consistent with the normal physiological ranges reported for healthy goats, confirming that the different feeding schedules did not compromise their health or physiological homeostasis.

It is concluded that Sahelian does can tolerate a delay of up to three hours in concentrate feeding after offering roughage without adverse effects on their blood profile. This offers flexibility in feeding management systems in the semi-arid zone, where feed scarcity and labor constraints are common.

Further studies should focus on nutrient digestibility, growth performance, reproductive efficiency, and economic implications of such feeding strategies. This will help develop optimal feeding protocols that combine physiological stability with productivity and profitability for goat farmers in semi-arid regions.

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