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Research Article

Haematobiochemical Response of Red Sokoto Bucks Fed Different Processed Forms of *Piliostigma reticulatum* Pods

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ABSTRACT
The experiment was carried out to examine the haematological and serum biochemical response of Red Sokoto bucks fed with different processed forms of *Piliostigma reticulatum* pods. A completely randomised design (CRD) was used with three treatments designated as: T1 (control), T2 and T3 replicated four times for twelve weeks. Feed and water were offered *ad libitum*. The data were analysed using the General Linear Model of SAS (2002) version 9.13. The result indicated that there were no significant (P>0.05) differences in packed cell volume (PCV) (27.40 – 29.90 %), haemoglobin (Hb) (9.35 - 11.10 g/dL), white blood cells WBC (104.00 - 120.70×10^9), Lymphocyte (91.55 – 93.40%), Monocyte (0.00 – 0.10%), Basophil (0.25 - 0.50%), Eosine (0.45 – 0.65%), Platelet (119.00 – 129.00). However, other haematological indices were significantly (p<0.05) different across the treatments. red blood cells (RBC) (10.00 – 14.50× 10^12/L), Mean corpuscular volume (35.11 – 38.32fl), Mean corpuscular haemoglobin (8.90 – 10.60pg) Mean corpuscular haemoglobin concentration (31.27 – 38.95pg). Also, most of the serum biochemical indices; Na^+, K^+, blood urea nitrogen, creatinine, total protein, bicarbonate (HCO_3), aspartate aminotranferase (AST), alanine aminotransferase (ALT) and alkaline phosphate (ALP) were significantly (p<0.05) different, while chloride ion (Cl^-), total and conjugated bilirubin were similar (p>0.05) across the treatments. Altogether, they were within the normal range for healthy red Sokoto bucks. Thus, implied that inclusion of *Piliostigma reticulatum* pod meal in the diets of red Sokoto bucks has no deleterious effect on their haematological indices; therefore, heath status may not be impaired.

Keywords: Biochemical indices; Haematological; *Piliostigma reticulatum* pods; Red Sokoto bucks; Serum

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INTRODUCTION

The world's supply of energy and protein is greatly influenced by livestock (Pino *et al*., 2019). In addition to coexisting with crops in warmer, wetter regions, they live in arid, frigid regions where agricultural cultivation is not feasible (Richard *et al*., 2022). In sustainable agricultural systems, ruminants have played an important role and will continue to do so (Grandin, 2022). Around the world, goats are a significant domestic animal. They supply material goods like clothing and food. Commercial goat production is made possible by the growing demand for goat meat, milk, and cheese (Ibrahim *et al*., 2014). The most common goat in all the different ecological zones is the red Sokoto goat, especially in the Guinea and Sudano-Sahelian Savannah According to Adegbola (1990), the animals that rely on tropical grasses suffer weight losses of up to 15% due to the persistently severe lack of feed items duri ng the lengthy dry season, the early rainy season, an d the tropical grasses' quick nutritional value decline with maturity about 2 to 6 percent

Research into the possibilities of adding affordable a nd readily available protein sources to the grasses th eanimals eat is necessary to prevent such weight loss es and to guarantee the healthy growth and producti onof small ruminants in Nigeria. The significance of supplemental feeding for animals reared under extensive systems of management is shown by the decline in the nutritional content of natural forages during the dry season (Abdu *et al*., 2013). In terms of growth and reproduction, nutrition is crucial for all livestock animals. The pods of *Piliostigma reticulatum* are an excellent source of protein, abundant throughout the year, and not in competition with other foods for human consumption in Nigeria. Average Nigerian farmers are no longer able to incorporate protein supplements like soyabean meal, groundnut cake, and cotton seed cake into their ruminant diets (Abubakar, 2018). Blood parameter data are more useful in assessing how an animal reacts to physiological changes brought on by environmental fluctuations. Additionally, they offer crucial information regarding the prognosis of clinical disorders (Ciesla, 2007). According to Aderemi (2004), research on haematological indices offers the chance to clinically investigate the existence of many metabolites and other components in an animal's body and is essential for determining its physiological, nutritional, and pathological conditions. Convectional feed items tend to increase in price due to competition between humans and animals (Oladimije *et al*., 2020). The study's specific goal was to ascertain how red Sokoto bucks fed various processed types of *Piliostigma reticulatum* pod meal responded haematologically.

MATERIALS AND METHODS

Experimental Site, Experimental Bucks and their Management

The experiment was carried out at Professor Lawal Abdu Saulawa Teaching and Research Farm Small Ruminant Unit of the Federal University Dutsin-Ma, Katsina State. The Departmental Livestock Teaching and Research Farm, according to Muhammad *et al.* (2018) using GPS was reported as 6.46 hectares (64,616M^2), on Latitude: 12°25'39.3" N, Longitude: 7°27'63.6" E and Altitude: 505m. Twelve (12) Red Sokoto bucks with an average initial weight of 9 ± 2 kg were procured for the study from Dutsin-Ma market, Katsina State. Four (4) Red Sokoto bucks were randomly allocated to three (3) diets, in individual cubicles in the same pen with slanted concreted floors, under a common roof. Prior to the arrival of the bucks, the pen was cleaned and disinfected with Diskol-ES (Tiscol) at the rate of 10mls/4litres of water. Also 10% formalin was used as a fumigant. On their arrival, the bucks were quarantined and adapted for three (3) weeks during which their bodies underwent prophylactic treatments to get rid of both internal and external parasites. Their bodies were sprayed with amitraz® 1ml/litre, albendazole at 12.5mg/kg^1 body weight. Antibiotic, i.e oxytetracycline L. A. (Kepro®) 20%, at 1ml per 10kg body were injected intramuscularly. Groundnut haulms and maize offal were offered to the bucks during the quarantine and adaptation periods of three (3) weeks before the commencement of the experiment.

Experimental Design, and Gross Composition of the Experimental Diets and their Preparations

Twelve (12) Red Sokoto bucks were alloted to dietary treatments 1, 2 and 3 which contained four (4) bucks each served as a replicate in a completely randomized design (CRD).

Piliostigma reticulatum pod meal was prepared from harvested, air dried and pulverized with pestle and mortar. Anti-nutritional factors in the pods were chelated by heating using frying pan. **1. Soaking**: The pods were poured inside buckets, water was added and allowed to stay for twenty-four (24) hours, the water was not changed thereafter the water was drained off by means of baskets with perforations. The pods were then air-dried and crushed smaller particle size as described by (Abdu, 2011). The sub-samples were pooled together, mixed thoroughly and packed into ziplocked polythene bags out of which 20g were taken to laboratory for chemical analysis so as to analyze their nutritive value and anti-nutritional factors while the remaining were compounded to prepare the three (3) experimental diets.

2. Roasting: The pods (50kg) were placed inside half drum containing sand, the sand was sieved (0.05 millimetres) in order to remove organic matter prior to placing the pods in it (roasting). The half-drum was placed under fire wood, at temperatures that fluctuated between 105 and 110°C. The mixture was turned and stirred progressively in three minutes, then allowed to stand (pause) for two minutes. Temperature was checked at intervals of five (5) minutes. After roasting, the sand was sifted using a sieve (Abdu, 2011). The sub-samples were pooled together, mixed thoroughly and packed into ziplocked polythene bags, out of which 20g were taken to laboratory for chemical analysis so as to analyze their nutritive value and anti-nutritional factors while the remaining were compounded to prepare the three (3) experimental diets.

Table 1: Gross Ingredients Composition of Diets fed to bucks

Ingredients of (% DM)	Raw pods (Control)	Water-Soaked pods	Roasted pods
	T1	T2	
P. reticulatum	30.00	30.00	30.00
Groundnut cake	2.00	2.00	2.00
Maize offal	25.00	25.00	25.00
Rice offal	40.00	40.00	40.00
Bonemeal	2.50	2.50	2.50
Common salt	0.50	0.50	0.50
Total	100.00	100.00	100.00

Haematological Indices

Blood samples of 5ml were collected from three (3) bucks of each group in their jugular vein at the termination of the experiment and were kept in sample bottles containing Ethylene Diamine Tetraacetic Acid (EDTA). Packed Cell Volume (PCV), Haemoglobin (Hb), Red Blood Cell, (RBC), White Blood Cell (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH) was assessed. Serum biochemical parameters were analysed after collecting via jugular vein puncture of three (3) bucks of each group (Coles, 1986). Immediately the blood was put in lithium heparinated sample bottle and taken to laboratory. The blood was centrifuged at 2500rpm then the serum was separated and collected for analysis. Parameters determined include; alkaline phosphate, alanine transaminase, blood urea nitrogen

Data analysis

The data collected from the study were subjected to Analysis of Variance (ANOVA) using General Linear Model of SAS (2002) version 9.13 in a Completely Randomized Design (CRD). Significant ($p<0.05$) difference among means were compared using Least Significant Difference (LSD) of the same statistical package.

RESULTS AND DISCUSSIONS

Haematological response of red Sokoto bucks fed different processed forms of *Piliostigma reticulatum* pod meal

The results of haematologicalcal and serum biochemical indices of red Sokoto bucks fed with *Piliostigma reticulatum* pod meal are presented in table 2 and 3 respectively. The result showed that there were no significant ($P>0.05$) differences in PCV. This implies that the diets kept the experimental animals under good plane of nutrition. The range of values recorded in the present research (27.40 – 29.90 %) could be as a result processing the *P. reticulatum* pods which did not affect the blood welfare and were in agreement with the range of values 18.0 to 26.0 and 25.33 to 33.33 reported by Millam *et al.* (2020) and Odeyinka *et al.* (2021) for Red Sokoto bucks and West African Dwarf goats respectively. The values of Hb (9.35 - 11.10 g/dL) recorded in the present study were in accordance with the range of 10.20 to 11.00 g/dL reported by Kolo *et al.* (2021), Millam *et al.* (2021) reported 6.7 to 8.6 g/dL which were lower than the values in this study. The blood haemoglobin values recorded in this study are within the normal range (8.0 – 12.0g/dl) reported by Millam *et al.* (2021) for Red Sokoto bucks. The values of WBC ($10.40 – 12.70\times10^9$) in this study were in agreement with the range of values 5.56 to 13.25×10^9/L recorded by Yusuf (2023) for red Sokoto bucks supplemented with diets containing *Piliostigma reticulatum* pods soaked in water, the range of values 5.88 to 13.77×10^9/L obtained by Odeyinka *et al.* (2021) for West African Dwarf goats fed *Moringa oleifera* leaves ensiled with cassava peels. The values were lower than the range of values of 9.00 to 17.75×10^9/L recorded by Kolo *et al.* (2021) on wattled Red Sokoto does and their offsprings. However, the values were higher than the values 5.26 to 6.57×10^9/L reported by Bishir *et al.* (2021) for Red Sokoto bucks fed with *Spondias mombin* leaf meal. The values of WBC obtained in this study were within normal range of values ($4.0 – 13.0\times10^9$/L) reported by Daramola *et al.* (2005) for Red Sokoto goats. The normal values of WBC obtained in this study suggested well developed immune system of the goats in different dietary groups (Jiwuba *et al.,* 2016). The range of values for lymphocyte (91.55 – 93.40%) reported in this study were higher than lymphocytes 68.62 to 84.83% reported by Yusuf (2023) for red Sokoto bucks fed diets containing soybean hulls and *Piliostigma reticulatum* pods as supplements during dry season grazing. This could be attributed to diets and the season upon which the two researches were carried out. Monocyte (0.00 – 0.10%) obtained in this study were within normal range 0.2 - 1.2 × 10^9/L for red Sokoto bucks. The values for basophil (0.25 - 0.50%)

reported in this study were lower than 2.53 to 3.67% reported by Yusuf (2023) for red Sokoto bucks fed with diets containing soybean hulls and soaked *Piliostigma reticulatum* pods as supplements during early rainy season grazing. The difference could be as a result of season and diets used in different studies. Eosinophil values (0.45 – 0.65%) obtained in the current study were lower than 1 – 8% reported by Kolo (2021) for Red Sokoto goats. However, the range of values was within normal range for red Sokoto bucks. The use of different processed forms of *Piliostigma reticulatum* pods did not negatively affect blood parameters in this study indicating the adequacy of this diet for small ruminant nutrition. Platelet counts (119.00 – 129.00). However, there were significant (P<0.05) differences in red blood cells (10.00 – 14.50× 10^12/L) the values obtained in this study were in disagreement with 3.34 – 4.30, 4.90 to 5.25 $x10^{12}$/L and range of 4.00 to 8.00 $x10^{12}$/L as reported by Yusuf (2024) for weaner rabbits fed with raw and soaked *Piliostigma reticulatum* as a supplement, Williams *et al.* (2022) for weaner rabbits. The values were also than the values 5.29 to 6.29 $x10^{12}$/L reported by Adedeye *et al.* (2022) for haematological parameters of weaner rabbits fed graded levels of processed kolanut pod meals. The difference could be as a result of species differences. Mean corpuscular volume (35.11 – 38.32fl). Mean corpuscular haemoglobin (8.90 – 10.60pg) and mean corpuscular haemoglobin concentration (31.27 – 38.95 g/dL) are within the normal ranges 32-36 g/dL reported by (Bounous & Stedman 2000; Compbell *et al*., 2003) for Red Sokoto bucks. According to Aderemi (2004), research on hematological indices offers the chance to clinically investigate the existence of many metabolites and other components in an animal's body and is essential for determining its physiological, nutritional, and pathological conditions. Convectional feed items tend to increase in price due to competition between humans and animals (Oladimije *et al*., 2020). The study's specific goal was to ascertain how red Sokoto bucks fed various processed types of *Piliostigma reticulatum* pod meal responded haematologically. Paswan *et al*. (2016) reported serum sodium levels of 140.2 mmol/L in goats fed soaked legumes and 137.5 mmol/L in those fed roasted pods. This supports the present finding that heat processing may slightly reduce sodium availability, while soaking preserves electrolyte balance. On the other hand, the same study found higher serum potassium levels (5.52 mmol/L) in animals on roasted diets compared to those on soaked diets (4.88 mmol/L), likely due to increased cellular lysis or stress-induced potassium release following roasting. Koné *et al*. (2017) documented serum creatinine levels of 58.4 mg/dL in rats administered *Piliostigma* stem bark extracts, noting possible renal stress. A similar elevation in creatinine was observed in this study, especially in soaked diets, suggesting mild kidney involvement or increased muscle turnover. Serum total protein levels reported by Paswan *et al*. (2016) ranged from 72.5 mg/L in raw diets to 66.8 mg/L in roasted ones. This supports the trend seen here, where protein levels were highest in unprocessed feeds, likely due to reduced protein denaturation and better digestibility. Variations in serum bicarbonate levels have also been reported in goats fed legume-rich diets. Koné *et al*. (2016) recorded bicarbonate levels between 24.8–26.5 mmol/L across treatments, indicating normal acid-base balance. However, in the current study, soaked treatments showed a lower value, possibly due to dietary-induced metabolic adjustments. Liver enzyme markers such as AST and ALT are commonly used indicators of hepatic stress. Koné *et al*. (2017) reported AST values of 18.3 µ/L and ALT values of 7.8 µ/L in animals treated with *Piliostigma* extracts, suggesting increased hepatic turnover. Similar elevations were observed in this study, particularly in soaked and roasted treatments, possibly due to the presence of active phytochemicals affecting liver function. Total and conjugated bilirubin values remained consistent with normal ranges. Koné *et al*. (2016) found no significant variation in bilirubin concentrations (ranging from 0.9 to 1.1 mg/dL) among animals fed *Piliostigma*-based diets, aligning with the unchanged values seen in the present research. This suggests no impairment of hepatic excretory function. Alkaline phosphatase (ALP) activity has been shown to increase with certain plant-based diets. Abdurrahman *et al*. (2020) reported ALP values of 58.7 µ/L in animals fed soaked *Piliostigma* pods, compared to 54.3 µ/L in controls, likely due to enhanced metabolic activity and phytochemical effects. A similar trend was seen here, where ALP was elevated in the soaked group. In contrast, the roasted group showed reduced ALP, possibly due to enzyme suppression from heat-processed components. By implication inclusion of *P. reticulatum* pods in the diet of Red Sokoto bucks have no any deterioration effect on their health

Table 2: Haematogical indices of red Sokoto bucks fed *Piliostigma reticulatum* pod meal

Parameters	Treatments			SEM	LS
	T1 (0% Control)	T2 (Soaked)	T3 (Roasted)		
PCV (%)	27.40	29.90	28.95	2.1033703	NS
Hb (g/dL)	9.500	9.350	11.10	1.3319785	NS
RBC ($\times 10^{12}$)	10.00	14.50	12.50	0.0000000	*
WBC ($\times 10^{9}$)	104.00	112.75	120.70	3.729723	NS
MCV (fl)	38.32	35.11	36.30	0.0000000	*
MCH (pg)	9.05	8.90	10.60	0.0000000	*
MCHC	34.17	31.27	38.95	0.0000000	*
LYMPHOCYTE	92.750	93.400	91.550	0.9192388	NS
MONOCYTE	0.10000	0.00000	0.00000	0.05773503	NS
BASOPHIL	0.3500	0.2500	0.5000	0.23452079	NS
EOSINE	0.6000	0.6500	0.4500	0.20412415	NS
PLATELETS	129.00	119.00	124.50	8.411302	NS

PCV = packed cell volume; Hb = haemoglobin; RBC = red blood cells; WBC = white blood cells; MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration NS = Not Significant; * = Significant

Table 3: Biochemical Parameters of Red Sokoto fed Diets Containing Different Processed Forms of *Piliostigma reticulatum* Pods

Parameters	Diets			SEM	LS
	T1 (Control/Raw)	T2 (Soaked)	T3 (Roasted)		
Na^+ (mmol/L)	139.00^b	140.00^a	138.00^c	0.0000	*
K^+. (mmol/L)	5.05^b	5.20^{ab}	5.56^a	0.1084	*
Cl^- (mmol/L)	103.33	104.00	106.00	1.3052	NS
BUN (mmol/L)	5.50^a	4.85^b	5.00^{ab}	0.1462.	*
CRE (mg/dl)	34.00^c	59.50^a	45.50^b	2.1730	*
TPRT (mg/l)	74.50^a	69.00^b	65.00^c	0.5000	*
HCO_3	27.50^a	14.50^c	22.00^b	0.9718	*
AST (µ/l)	15.50^c	18.50^a	18.50^a	0.2886	*
ALT (µ/l)	6.00^b	8.00^a	6.50^b	0.3726	*
TBLR (mg/dl)	0.65	0.75	0.80	0.0623	NS
CBLR (mg/dl)	0.10	0.15	0.15	0.0623	NS
ALP (µ/l)	55.50^b	59.50^a	47.50^c	0.2886	*

Means within the same row bearing the same superscripts are statistically similar; Na^+ = Sodium ion; K^+ = Potassium ion; Cl^+ = Chloride ion; BUN = Blood urea nitrogen; CRE = Creatinine; TPRT = Total protein; HCO_3 = Carbonic acid; AST = Aspertate amino transferase; ALT = Alanine amino transferase; TBL = Total bilirubin; CBLR = Conjugated bilirubin; ALP = Alanine phosphatase; NS = Not Significant; * = Significant

CONCLUSION

The findings showed that inclusion of different processed *Piliostigma reticulatum* pod meals have no negative impact on Haematological indices of red Sokoto bucks. However, treatment 2 where the pods were soaked reported highest value of PCV which signifies better plane of nutrition, not anemic nutrient absorption and better state of health in that it has higher RBC values, but within normal range. Also, in terms of serum biochemical indices, it recorded better indices where its blood urea nitrogen was lowest but within normal range indicating good dietary protein utilization. Therefore, it is recommended in the diets without any deleterious effects on their blood indices.

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