Haematology and Serum Biochemistry of West African Dwarf (Wad) Goats Fed Selected Tropical Browse Plants

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Abstract— *The study explored the effect of feeding different tropical browse plants on the haematology and serum biochemistry of West African Dwarf (WAD) goats under different management system, namely: intensive and semi-intensive system. Bucks in T_2 had the highest Pack cell volume and Haemoglobin mean values of 28.17% and 9.37g/dl. Bucks in T_1 recorded highest mean value in Platelets and Lymphocyte as 238.33x10^3/ul and 58.83% respectively. Under intensive system, pack cell volume and Haemoglobin recorded high mean values of 28.08% and 9.33g/dl. Whereas highest value of Platelets 225.25(x10^3/ul) was reported under intensive system. PCV recorded high mean value of 34.33% and 29.33% in bucks of T_2 and T_3 under intensive and semi-intensive system respectively. Lymphocyte (L) recorded high mean value of 62.67% in bucks of T_1 under intensive system unlike semi-intensive system that recorded 60.00% in bucks of T_4 as its high mean value. Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT) are statistically significant ($P<0.05$) even with lower mean values of T_1 (18.17u/l), T_2 (20.83u/l), T_3 (21.50u/l), T_4 (21.50u/l) and T_1 (4.45u/l), T_2 (5.89u/l), T_3 (5.77u/l), T_4 (6.67u/l) respectively. Total protein was noted with high mean value in all the treatments with corresponding values of 64.50g/l, 71.00g/l, 70.33g/l and 72.67g/l. AST, ALT, TP and Globulin recorded high mean values of 25.25u/l, 7.16u/l, 72.00g/l and 27.00g/dl respectively under semi-intensive system, while their low mean values were revealed under intensive system. AST recorded high mean value of 29.00(u/l) in bucks of T_3 under semi-intensive system followed by bucks in T_4 having mean value of 28.00(u/l). Consequently, ALB and GLO in bucks of T_4 and T_2 under semi-intensive system recorded high mean values of 49.00g/l and 29.00g/dl respectively. The study recommends that WAD goats managed intensively to supplementation of bitter leaf (Vernonia amygdalina) should be adopted since they showed more stability in the haematological and biochemical serum for maximum production.*

Keywords— Tropical browse plants, West African Dwarf (WAD) goats, Serum biochemistry, Aspartate aminotransferase (AST), Alanine aminotransferase (ALT).

I. INTRODUCTION

The West African Dwarf Goat (WAD) is the most important small ruminant breed in West African wetlands, accounting for approximately 38 percent of the region's 38 million goats. (Gall, 1996). This variety has good environmental adaptability and an innate ability to "resist the effects of trypanosome infections. and quot; (Steele, 1996). The feeding behavior of West African Dwarf Goats (WAD) is typically representative of traditional husbandry techniques and these goats forage for their daily nutritional needs. (Daramola *et al*., 2005). Traditional goat farming in Nigeria is mostly practiced in traditional ways, which leads to poor nutrition and encourages the search for alternative cheap feeds that are in less demand. (Amaefuru, 2002). Smallholders in rural Nigeria are highly dependent on goats due to their socio-economic importance and an integral part of the cultural existence and fabric of Nigeria (Ajala, 2004; Anaeto et al., 2009). Ruminants, including goats, play an important role in improving low consumption of animal proteins in Nigeria and other developing countries. Despite the importance of goats, their production continues to be hampered by the scarcity of fodder quantity and quality at certain times of the year. Nigeria continues to suffer from inadequate quality and quantity of ruminant feed supplies resulting in low ruminant productivity. The problem of lack of fodder can be solved by providing high-quality fodder, but in dry times, when the quality of fodder deteriorates, this is not practical. In addition, traditional forages such as grains and oilseeds available at that time of year are too expensive to feed ruminants. Therefore, there is an urgent need for researchers to find alternative and sustainable food

sources that do not compete with human food. This underlines the need to develop innovative solutions to meet the challenges posed by feed shortages.

Maintaining the nutritional status and physical well-being of goats is extremely important and requires careful monitoring and thorough blood analysis. (Ibhaze and Fajemisin, 2017). Hematological parameters are important indicators used in the monitoring and evaluation of animal welfare and nutritional status, which Babatunde et al. (1992). Analyzing the "hematological and biochemical parameters of WAD goats" can be a means of obtaining valuable information about their potential for productive performance. (Taiwo and Ogunsanmi, 2003). Therefore, analysis of blood samples is a quick and readily available method to evaluate the clinical and nutritional results of nutritional trials. (Babatunde et al., 1992). Ibhaze (2015) stated that there are several factors that cause variations in blood parameters in animals such as “nutrient levels, age, sex, breed and physiological state of the animal”. "Blood chemistry parameters such as glucose, total protein, blood urea nitrogen and cholesterol" have been used to assess the nutritional value of cattle (Gleen et al., 2006). Blood chemical profiles, which include parameters such as glucose, lipids and proteins, change in goats when feed or protein is reduced (Irkham et al., 2016). Aletor et al. (2012), "the effect of food on blood and serum chemistry must be extremely important because blood transports gases, nutrients and excretory products in the body". Bawala et al. (2008) emphasized that nutritional research should not be limited to "performance, carcass quality and protein intake" but should also consider effects on blood components. Conducting hematological and biochemical studies is crucial for accurate evaluation of various procedures, feeding habits and medical conditions of animals (Ahmed et al., 2009; Hassan et al., 2012; Okoruwa and Ikhimioya, 2014). However, data on the hematology and serum biochemistry of West African pygmy goats fed a selected tropical plant diet of Vernonica amygdalina, Spondias mombins, Alchornia cordifolia and Newbouldia are insufficient. As a result, this study is conducted to address this knowledge.

II. MATERIALS AND METHODS

2.1 Research Design:

The study involved the use of twenty-four WAD goats, which were kept in individual pens and randomly assigned to one of eight dietary treatment groups, with three animals per treatment for the Intensive system and one treatment each for T1, T2, T3, and T4 in the semi-intensive system, using a Factorial Design.

2.2 Study Area:

The study was carried out at the Goat unit of the University of Port Harcourt Teaching and Research Farm, Abuja campus, Choba, Rivers State. Rivers Stateis in the south-south of Nigeria. The school is “situated on latitude 4^{o} 53’ 14’’ North through 4^{o} 54’’42’’N and longitude 6^{o} 54’’00 East through 6^{0} 55’50’’East of the equator” (Ijeomah *et al*., 2013; Aiyeloja and Adedeji, 2015). It falls within “the humid rain forest of West Africa with a long duration of rainfall (March-November) and a very short dry season. Precipitation occurs in September with an average of 367mm of rain in 182 days and temperature of 25^{o}C-28^{o}C and a very high relative humidity (above 80%)”.

2.3 Population for the study:

A total of twenty-four male West African Dwarf weaner goats, aged between six and seven months, were procured from the open market for the purposes of this research. Their housing comprised of well-ventilated individual pens, featuring an open-sided system with corrugated aluminum roofing sheets, block walls, and a cemented floor. The latter was disinfected with Izal solution two weeks prior to the beginning of the research work. Quarantined for two weeks, the animals received vaccination against peste des petit Ruminant (PPR), were dipped in acaricide solution to control endo and ecto-parasites, dewormed using Abendazole suspension and weighed before the commencement of the research work.

2.4 Sample and Sample Techniques:

The plants that were available for browsing were harvested each evening, and subsequently cleared of any potential insects or caterpillars before being weighed. The animals were then provided with the freshly harvested plants the following morning, at approximately 8:00 am, after the pens and troughs had been properly cleaned. The daily feed intake was monitored by calculating the difference between the feed that had been served and the amount that was refused. *Ad libitum* access to fresh and clean water was also provided. The experimental animals were weighed at the outset of the experiment and on a weekly basis throughout the study period, utilizing a hanging measuring scale. The weight gain of the animals was calculated by subtracting their initial body weight from their final body weight at the conclusion of the study. The feed conversion ratio was then determined by dividing the feed intake by the body weight gain.

2.5 Nature/sources of Data

For the intensive system, the browse plants were cut fresh every evening cleaned of any possible insects/caterpillars and the weight obtained before offering them to the animals in the morning. Treatments T_2– T_4 was placed on 75% browse plants and 25% basal diet while T_1 was the control having zero inclusion of the browse plant.

T_1 = conventional feed (Control)

T_2 = *Panicum maximum + Vernonia amygdalina*

T_3 = *Panicum maximum + Newbouldia leavis*

T_4 = *Panicum maximum + Alchornea cordifolia*

For the semi-intensive system, treatment G_1 to $G_4$was placed on 75% browse plants and 25% basal diet while G_0 was the control having zero inclusion of the browse plant. The browse plants were placed in each of the paddocks where the experimental animals grazed.

G_1 = Conventional feed (Control)

G_2= *Panicum maximum + Vernonia amygdalina*

G_3 = *Panicum maximum + Newbouldia leavis*

G_4 = *Panicum maximum + Alchornea cordifolia*

2.6 Method of Data collection and Instrumentation:

At the end of the field work, all animals underwent jugular venipuncture using a disposable sterile 10-ml syringe and 20-gauge x 1.5-ml needle to extract two sets of blood samples. Each animal's 10ml blood sample was divided into two equal parts, with one part (3ml) being collected into properly labeled plastic tubes containing ethylene diamine tetra-acetic acid (EDTA) anticoagulant for haematological analysis. This analysis was conducted to determine Packed Cell Volume (PVC), Haemoglobin (HB), White Blood Cell (WBC), Red Blood Cell (RBC), Platelet (PLT), Neutrophil (N), Lymphocytes (L), Eosinophils (E), Monocyte (M), Basophils (B) in accordance with the methods described by Joshi et al., (2002).

The remaining 7ml of blood sample was collected into labeled plastic tubes without anticoagulant and used to analyze the serum biochemical profiles. The serum metabolites Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), Alkaline phosphatase (ALP), Total protein (TP), Albumin (ALB), Globulin (GLO), Gamma-glutamyl Transpeptidase (GGT), Total cholesterol (TC), Triglycerides (TG), High density Lipoprotein (HDL), and Low density Lipoprotein (LDL) were determined by spectrophotometry following centrifugation. The values for all these parameters were analyzed using the routine laboratory procedures as described by Ogunsami et al., (2002).

2.7 Method of Data Analysis:

The entirety of the acquired data was subjected to a thorough statistical analysis of variance (ANOVA) with the aid of the Statistical Package for Social Science (SPSS). In cases where the means differed, they were separated through the utilization of the Duncan multiple range test of the aforementioned package.

III. RESULTS

3.1 Treatment effect on the Haematological indices of WAD goats fed some Tropical browses under Intensive and Semi-intensive system

The effects of treatment on hematological parameters of WAD goats fed some tropical leaves in intensive and semi-intensive systems are shown in Table 1. It is noted that Pack cell volume, hemoglobin, platelets, neutrophils, lymphocytes and monocytes were significantly (Pandlt; 0, 05).), which is affected by the treatment. The result showed that T2 had the highest Pack cell volume and average hemoglobin content of 28.17% and 9.37 g/dL, respectively, followed by T4 with an average Pack cell volume of 27.33% and 9.08 g/dL. while Bucks T1 recorded the highest average of 238.33 x 103/ul and 58.83% for platelets and lymphocytes. No significant (Pandgt;0.05) difference was observed between red blood cells, white blood cells and eosinophils.

TABLE 1
TREATMENT EFFECT ON THE HAEMATOLOGICAL INDICES OF WAD GOATS FED SOME TROPICAL BROWSES UNDER INTENSIVE AND SEMI-INTENSIVE SYSTEM

Blood parameters	Normal range	T1	T2	T3	T4	SEM
PCV (%)	21 – 35	21.50^{b}	28.17^{a}	24.17^{ab}	27.33^{a}	1.43
HB (g/dl)	7 – 15	7.17^{b}	9.37^{a}	7.98^{ab}	9.08^{ab}	0.65
RBC($x10^{6}$/ul)	3.5 - 13.5	3.27	4.32	3.78	3.27	0.53
WBC($x10^{6}$/ul)	6.8 - 20.1	4.85	4.83	5.33	6.1	0.53
PLT ($x10^{3}$/ul)	150 – 230	238.33^{a}	178.17^{b}	218.67^{a}	212.67^{a}	8.24
N (%)	17 – 52	36.50^{b}	43.33^{a}	36.83^{b}	35.67^{b}	1.62
L (%)	47 – 82	58.83^{a}	51.33^{b}	56.83^{ab}	56.33^{ab}	1.86
E (%)	1 – 7	1.33	1.5	1.83	2.5	0.54
M	0 – 10	3.33^{b}	3.83^{ab}	4.00^{ab}	5.50^{a}	0.63
B	0	0	0	0	0	0

^{abc}Means in the same row with different superscript differ significantly (P<0.05). Sources (Normal range): Tambuwal et al., 2002. Where PCV= Packed cell volume, HB=Haemoglobin, RBC= Red blood cell, WBC=White blood cell, PLT= Platelet, N= Neutrophil, L=Lymphocytes, E=Eosinophil, M=Monocytes

3.2 System effect on the Haematological parameter of WAD goats fed some Tropical browses under Intensive and Semi-intensive system

As recorded in Table 2, this was the result of systemic effects on hematological parameters in WAD goats fed tropical intensive and semi-intensive systems. In addition to packed cell volume, hemoglobin and platelets, which were significantly affected by the system (Pandgt; 0.05), other hematological parameters such as red blood cells, white blood cells, (N) neutrophils, (L) lymphocytes, (E) eosinophils. and (M) There were no significant differences in the systemic effects of monocytes (Pandlt; 0.05). Packed cell volume and hemoglobin recorded high average values of 28.08% and 9.33 g/dl in the intensive system, while low average values of 22.50% and 7.48 g/dl were recorded in the semi-intensive system. While in the semi-intensive system, the high average value of platelets was 225.25 (x103/ul), while in the intensive system, the low average value was 198.67 (x103/ul).

TABLE 2
SYSTEM EFFECT ON THE HAEMATOLOGICAL PARAMETER OF WAD GOATS FED SOME TROPICAL BROWSES UNDER INTENSIVE AND SEMI-INTENSIVE SYSTEM

Variables	Intensive	Semi-intensive	SEM
PCV (%)	28.08^{a}	22.50^{b}	1.01
HB (g/dl)	9.33^{a}	7.48^{b}	0.46
RBC ($x10^{6}$/ul)	4.33	3.45	0.38
WBC($x10^{6}$/ul)	5.16	5.4	0.38
PLT($x10^{3}$/ul)	198.67^{b}	225.25^{a}	5.83
N (%)	36.17	40	1.14
L (%)	57.17	54.5	1.32
E (%)	2.08	1.5	0.38
M (%)	4.33	4	0.44
B	0	0	0

^{abc} Means in the same row with different superscript differ significantly (P<0.05). Where PCV= Packed cell volume, HB=Haemoglobin, RBC= Red blood cell, WBC=White blood cell, PLT= Platelet, N= Neutrophil, L=Lymphocytes, E=Eosinophils, M=Monocytes

3.3 Treatment effect on the biochemical indices of WAD goats fed some Tropical browses under Intensive and Semi-intensive system.

The result of treatment of serum biochemical indicators of West African pygmy goats fed with tropical browsing in intensive and semi-intensive systems is shown in Table 3. The result revealed that aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase were significantly. affected by the treatment. (Pandlt; 0.05) (ALP), total protein (TP), albumin, globulin and gamma-glutamyl transpeptidase (GGT). Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are statistically significant (Pandlt; 0.05) even with lower mean values T1 (18.17 u/l), T2 (20.83 u/l), T3 (21.50 u/l), T4 (21.50 u/l) and T1 (4.45 u/l), T2 (5.89 u/l), T3 (5.77 u/l) and T4 (6.67 u/l l). The average total protein content was found high in all treatments with respective values of 64.50 g/l, 71.00 g/l, 70.33 g/l and 72.67 g/l. Alkaline phosphatase recorded the highest mean with T3 (18.00 u/L) followed by T4 (17.33 u/L) and T1 (15.50 u/L) but the lowest in dollars with T2 (14.00 exercise). There were no significant differences (Pandgt;0.05) in (TC) total cholesterol, (TG) triglycerides, (HDL) high density lipoprotein and (LDL) low density lipoprotein as shown in the table below.

TABLE 3
TREATMENT EFFECT ON THE BIOCHEMICAL INDICES OF WAD GOATS FED SOME TROPICAL BROWSES UNDER INTENSIVE AND SEMI-INTENSIVE SYSTEM

Blood parameters	Normal range	T_1	T_2	T_3	T_4	SEM
AST (u/l)	58-90	18.17^{b}	20.83^{a}	21.50^{a}	21.50^{a}	0.87
ALT (u/l)	30-Oct	4.45^{b}	5.89^{ab}	5.77^{ab}	6.67^{a}	0.65
ALP (u/l)	Dec-34	15.50^{ab}	14.00^{b}	18.00^{a}	17.33^{a}	1.04
TP (g/l)	30-65	64.50^{b}	71.00^{a}	70.33^{a}	72.67^{a}	1.45
Albumin (g/l)	20-42	41.33^{c}	45.17^{b}	42.50^{c}	47.83^{a}	0.79
Globulin (g/dl)		23.17^{b}	25.83^{ab}	27.83^{a}	24.83^{ab}	0.98
TC (m/mol)	1 – 5	2.8	3.34	2.8	3.1	0.49
TG (m/mol)	0.2-0.8	1.45	1.46	1.34	1.49	0.49
HDL (m/mol)	1.0-3.2	1.77	1.67	1.69	1.74	0.49
LDL (m/mol)	1.0-3.2	1.75	2.39	1.72	2.05	0.49
GGT		14.97^{c}	19.93^{a}	15.02^{c}	17.38^{b}	0.5

^{abc} means in the same row with different superscript differ significantly (P<0.05). Source (Normal range): RAR, 2009. Where AST= Aspartate aminotransferase, ALT= Alanine aminotranferase, ALP= Alkaline phosphatase, TP= Total protein, TC= Total cholesterol, TG= Triglycerides, HDL= High density lipoprotein, LDL= Low density lipoprotein, GGT= Gamma-glutamyl Transpeptidase

3.4 System effect on the Biochemical indices of WAD goats fed some tropical browses under intensive and semi-intensive system.

As shown in Table 4, system effect on the biochemical and haematological indices of WAD goats fed some tropical browse plants under intensive and semi-intensive systems the various parameters that recorded significant differences (P<0.05) include AST, ALT, TP and Globulin. The listed parameters all recorded high mean values of 25.25u/l, 7.16u/l, 72.00g/l and 27.00g/dl respectively under semi-intensive system, while their low mean values were revealed under intensive system. Other parameters not significantly (P>0.05) affected by system are ALP, Albumin, GGT, TC, TG, HDL and LDL.

TABLE 4
SYSTEM EFFECT ON THE BIOCHEMICAL INDICES OF WAD GOATS FED SOME TROPICAL BROWSES UNDER INTENSIVE AND SEMI-INTENSIVE SYSTEM

Variables	Intensive	Semi-intensive	SEM
AST (u/l)	15.75[b]	25.25[a]	0.61
ALT (u/l)	4.21[b]	7.16[a]	0.46
ALP (u/l)	15.42	17	0.73
TP (g/l)	67.25[b]	72.00[a]	1.03
Albumin (g/l)	43.42	45	0.56
Globulin (g/dl)	23.83[b]	27.00[a]	0.69
GGT	16.25	17.43	0.41
TC (m/mol)	2.97	3.05	0.35
TG (m/mol)	1.33	1.54	0.34
HDL (m/mol)	1.72	1.72	0.34
LDL (m/mol)	1.9	2.06	0.34

[ab] means in the same row with different superscript differ significantly (P<0.05). Where AST= Aspartate aminotransferase, ALT= Alanine amimotranferase, ALP= Alkaline phosphatase, TP= Total protein, TC= Total cholesterol, TG= Triglycerides, HDL= High density lipoprotein, LDL= Low density lipoprotein, GGT= Gamma-glutamyl Transpeptidase

IV. DISCUSSION

Packed cell volume (PCV) was used to measure toxicity and differences in composition were observed between breeds. As Ahamefule et al. (2005), PCV values were found to vary between 21-35%, which is within the 22-38% range considered physiological in goats by Krammer (2000). This finding suggests that the treatment diets were nutritious and non-toxic, contributing to adequate blood flow, as reported by Peter-Damian et al. (2016). Hemoglobin (Hb) values recorded in this study ranged from 7 to 15 g/dL, which is consistent with the findings of Daramola et al. (2005), but higher than the reported values of 5 to 6 g/dL... Belewu and Ogunsola (2010) in goats fed Jatropha curcas kernel cakes treated with mushrooms. The relatively high Hb concentration observed in the goats indicates that the nutritional treatment given in the study can promote the development of blood with a high oxygen carrying capacity. The study also showed that neutrophil and lymphocyte values corresponded to 47-82% and 17-52% respectively, as reported by Daramola et al. previously reported. (2005) and Tambuwal et al. (2002). These results indicate a skilled immune system in West African pygmy goats with sufficient numbers of immune cells to promote favorable health, as Daramola et al. (2005). These results further emphasize the ethnoveterinary properties of seed plants as emphasized by Fahey (2005). Ultimately, the study provides valuable information about the role of dietary therapy in promoting goat health and welfare, with implications for broader animal nutrition and welfare research. Since all WAD goats used in this experiment recorded hematological values that were similar to those of Daramola et al. (2005) and Tambuwal et al. (2002). This shows that WAD goats can do well in all management systems accepted by Imasuen (2014).

V. CONCLUSION

Assessment of liver function and damage is critical in the "diagnosis and treatment of liver disease". Aspartate aminotransferase (AST), alkaline phosphatase (ALP), and alanine aminotransferase (ALT) are important biomarkers commonly used to assess liver function. According to Yildirim et al (2011), these enzymes and#039; blood activity may indicate liver damage. An increase in their levels above normal can also be related to muscle damage. These enzymes and#039; normal values suggest that the processed diets did not damage the integrity of the liver and the animal as stated in the study by Aikpitanyi and Egweh (2020). In this study, serum protein was found in the range of 30-65 g/dL, which corresponds to serum protein values reported by Merck (2011) in clinically healthy dwarf goats. The serum albumin values observed in this study were similar to those of WAD goats by Yusuf et al. (2012) but higher than Okoruwani et al. reported intervals. (2014) and Opara et al. (2010) respectively. This finding suggests that the dietary protein content was sufficient to support the growth of the animal, as Olafadehan et al. (2020). Based on the AST and ALP values reported by Merck (2011), this study recorded reduced values in different management systems, indicating that WAD goats can perform well in all management systems used. Imasuen (2014) agreed with this. Based on the results, hairy leaf (Vernonia amygdalina) supplementation is recommended for intensively treated WAD goats because their hematological and biochemical serum showed a more stable maximum production. Therefore, further research should be conducted and directed to determine the standard threshold of blood parameters (hematological and

serum biochemical indices) and the level of added sorghum plant supplementation for goats reared under different systemic exposures.

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