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Blood Profile of West African Dwarf Goats Fed *Panicum maximum* Supplemented with *Afzelia africana* and *Newbouldia laevis*

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Abstract: The haematological and biochemical status of twenty West African dwarf goats fed *Panicum maximum* supplemented with foliage from *Afzelia africana* and *Newbouldia laevis* was investigated. Values for PCV, Hb concentration and RBC count differed significantly ($P < 0.05$) between the diets. Average PCV value was highest in 25Nwb:75Pm diet and least in 25Afz:75Pm diet. Hb concentration was significantly higher in diet 25Nwb:75Pm than in diet 25Afz:75Pm but not different from all the other dietary treatments. RBC counts observed differed between the dietary treatments. Apart from the values obtained for sodium, potassium, bicarbonate, total protein and aspartate transaminase, differences between the measured biochemical parameters were not significant ($P > 0.05$) between the diets. Sodium was highest in 25Afz:75Pm diet and varied significantly ($P < 0.05$) compared to 50Nwb:50Pm diet. Potassium in the serum of the studied animals was significantly higher ($P < 0.05$) in 25Afz:75Pm diet than in 25Nwb:75Pm and 100Pm (control) diets but did not differ from diets 50Afz:50Pm and 50Nwb:50Pm. In terms of total protein level, only the 100Pm (control) diet differed significantly from the supplemented diets. Activities of the enzymes alanine transaminase, aspartate transaminase and alkaline phosphatase in the sampled sera did not vary between the diets except for aspartate transaminase where, only the 50Nwb:50Pm diet differed from the other diets. These results to a large extent suggest the positive potential of the studied plant leaves in the feeding of goats without adverse effects.

Key words: Goats, haematological indices, serum biochemistry, *Afzelia africana*, *Newbouldia laevis*

Introduction

The West African dwarf (WAD) goat is the dominant breed of small ruminants and make up 38 percent of the 38 million goats found in the West African humid zone (Gall, 1996). It is well adapted to this environment and trypanotolerant (Steele, 1996). Generally, the feeding pattern of these dwarf goats is characteristic of the native husbandry practice whereby they scavenge for food to meet their daily nutrient requirements (Daramola *et al.*, 2005). However, due to scarcity of enough green fodder for these natural browsers, particularly in the dry season, attempts have focused on the utilization of the abundant but unconventional foliages by goats in this eco-zone which tend to be green all-year-round. With a large proportion of plants being used for the nourishment of various domestic animals (Rehm and Epsig, 1991), naturally occurring browse species thus appear a vital component in the diet of sheep and goats, with goats particularly dependent on them to meet their nutrient requirements.

Afzelia africana (Sm.) is a legume common to the savannah of tropical humid Africa (Nielson, 1965) and quick growing (Prinsen, 1986). It's foliage can be lopped and fed to ruminants (Aye and Adeyeye, 2002) and have a high nutritive value for goats (Anugwa *et al.*, 2000). *Newbouldia laevis* (P. Beauv.) is a fast growing non-leguminous shrub or small tree common in the forest area of West Africa (Akobundu, 1984) and planted around the homestead (Okigbo, 1980) with a widespread distribution. Haematological and biochemical determinations in animals have been well documented by Oduye and Adadevoh (1976) and Taiwo and Anosa (1995). According to Karesh and Cook (1995) examining blood for their constituents is used to monitor and evaluate disease prognosis of animals. Much of the available information on the haematology and biochemistry for goats in the humid tropics has mostly been on disease prognosis. Thus, information on blood parameters of goats offered foliages from these unconventional plants as feed have mostly been scanty. The objective of this study therefore is to provide information on some haematological and biochemical parameters of the West African dwarf goat fed a basal diet of *Panicum maximum* (Pm) supplemented with *Afzelia africana* (Afz) and *Newbouldia laevis* (Nwb).

Materials and Methods

Animal management and feeding: This experiment was carried out in the Teaching and Research Farm of Ambrose Alli University, Ekpoma, Nigeria. It involved 20 WAD female goats purchased from the open market and weighing between 5.5 and 9.5Kg. The goats were vaccinated against Peste de Petit Ruminant (PPR), dipped and dewormed. They were housed individually and randomly allotted to one of five dietary treatment groups and in replicates of four animals per treatment.

The dietary treatments comprised animals solely on *Panicum maximum* (100Pm), 25%Afz:75%Pm, 50%Afz:50%Pm, 25%Nwb:75%Pm, 50%Nwb:50%Pm. Quantity of the diet offered the animals was calculated on the basis of 50g DM Kg^{-1} d^{-1} and had free access to water.

Blood collection: On the last day of an 84-day experimental feeding trial period, two sets of blood samples were taken from all the animals via jugular venipuncture using a 10ml 20guage syringe. One set of the blood samples (5ml) was collected into plastic tubes containing the anti-coagulant ethylene diamine tetraacetic acid (EDTA) for the determination of haematological parameters. The other set of blood samples (10ml) was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 10mins at 3000 rmp. The supernatant sera were then stored in a freezer for subsequent biochemical analysis.

Analysis: The proximate chemical composition of the basal and supplemental foliages offered the animals were determined according to the procedures of AOAC (1990).

Haematological values of the blood samples were estimated for packed cell volume (PCV), haemoglobin (Hb) concentration following the procedures outlined by Schalm *et al.* (1975). Red blood cell (RBC) and total white blood cell (WBC) as well as the differential WBC counts were determined using the Neubauer haemocytometer after appropriate dilution. Values for the constants: mean corpuscular haemoglobin (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were calculated from RBC, Hb and PCV values as described by Jain (1986).

Biochemical constituents of the serum samples estimated include calcium (Lorenz, 1982), sodium and potassium (Berman, 1975), inorganic phosphorus, chloride and bicarbonate (Toro and Ackermann, 1975), urea (Tietz, 1970), creatinine (Bonsnes and Taussky, 1945) and cholesterol (Allain *et al.*, 1974). Total protein and albumin were by the method of Peters *et al.* (1982) and globulin according to Coles (1986).

The activity of the enzymes alanine transaminase (ALT) and aspartate transaminase (AST) was measured using the method of Reitman and Frankel (1957) and alkaline phosphatase (ALP) was by the method of Roy (1970).

Resulting haematological and biochemical data obtained from the samples were then compared statistically on the basis of the different dietary treatments using analysis of variance procedure for completely randomized design and differences between means separated using the Duncan's multiple range test (SAS, 1994).

Results and Discussion

The chemical composition of the leaves from *Afzelia africana* and *Newbouldia laevis* offered the animals as well as that of *Panicum maximum* are presented in Table 1. The crude protein content for *A. africana* and *N. laevis* were quite high compared to that of *P. maximum* and comparable to the average of 12.50% reported for some tropical native browse plants (Le Houérou, 1980). Relative to the suggested requirement range of 0.19-0.77% for calcium (McDowell, 1997), 0.01-1.0% for potassium (McDowell, 1992), 0.01-0.25% for sodium (Fettman *et al.*, 1984) and 1.20-2.70% for phosphorus (Akinsoyinu, 1986) the inorganic mineral contents of the plant leaves appeared adequate for ruminants.

Table 2 shows the haematological values of the goats solely on *Panicum* (100Pm) and those on 25 and 50 percent supplementation with *Afzelia* (25Afz:75Pm and 50Afz:50Pm) and *Newbouldia* (25Nwb:75Pm and 50Nwb:50Pm).

The observed haematological values showed that except for PCV, Hb concentration and RBC count, where the mean values between the five diets significantly ($P < 0.05$) differed; all the other haematological parameters measured did not. Mean PCV was highest in 25Nwb:75Pm diet and least in 25Afz:75Pm diet. However, these values were within the range of 21-35% reported for WAD goats by Daramola *et al.* (2005). In contrast, Taiwo and Ogunsanmi (2003) reported higher values of 36.9% and 35.5% for clinically healthy WAD goats and sheep respectively. The implication of this observed PCV values, going by the reports of Dargie and Allonby (1975), is that only the goats on 25Nwb:75Pm diet could probably have the high tendency for a return of PCV to normal level following an infection through compensatory accelerated production. This is in view of the fact that only the goats on this diet had values above the 32% PCV documented to be normal for circulatory system in sheep (Frandson, 1974). A comparison of the PCV values in this study to that from other investigators for Zarabi and Baladi goats (El-Barody and Luikart, 2000), Red Sokoto goats (Tambuwal *et al.*, 2002), WAD sheep (Taiwo and Ogunsanmi, 2003) and WAD goats (Daramola *et al.*, 2005) however, support the observation of Azab and Abdel-Maksoud (1999) that PCV values for ruminants varies from breed to breed.

The haemoglobin concentration in the blood of the studied goats showed a similar pattern of variation as with PCV. Mean Hb concentration was significantly higher ($P < 0.05$) in diet 25Nwb:75Pm than in diet 25Afz:75Pm but did not differ from the other dietary treatments. Nevertheless, the Hb range in this study was similar to the mean value for goats fed *Prosopis juliflora* by Misri *et al.* (2000) and fell within the range of 7-15g/dl reported by Daramola *et al.* (2005). It however was lower than the value of 11.40g/dl reported for Red Sokoto goats (Tambuwal *et al.*, 2002) and in cattle fed different

Table 1: Chemical composition (g/100gDM) of the leaves offered the experimental goats

Nutrient	Leaves		
	Afzelia africana	*Newbouldia laevis*	*Panicum maximum*
Dry matter	30.50	42.24	34.72
Crude protein	29.85	15.57	8.44
Ash	6.66	2.49	12.86
Crude fibre	24.24	12.38	21.34
Ether extract	7.95	13.59	6.46
Nitrogen free extract	31.31	55.98	50.90
Gross energy (Kcal/g)	3.25	4.09	3.68
Calcium	0.31	0.51	0.30
Phosphorus	0.32	0.26	0.34
Potassium	1.14	1.02	5.34
Sodium	0.14	0.17	1.86

levels of extracted rice bran (Singh *et al.*, 2002). With the relatively higher Hb concentration observed in this study, the dietary treatments generally seemed to be capable of supporting high oxygen carrying capacity blood in goats.

Although the RBC counts observed in this experiment differed significantly ($P < 0.05$) between the dietary treatments they however, were much lower than the 9.2-13.5g/l range reported for Red Sokoto goats (Tambuwal *et al.*, 2002) and 9.9 and 18.7g/l (Taiwo and Ogunsanmi, 2003) for goats and sheep respectively. Red blood cell indices aid in the characterization of anemia (Merck's Veterinary Manual, 1979). Thus, the low RBC counts recorded for the goats in the different diets present a likely high susceptibility to anemia-related disease conditions by these goats. This is corroborated by the fact that the goats in this study recorded MCV values that were relatively high compared to the normal range of 18-34fl for goats, which could have resulted from the release of immature red blood cells into the blood system (Merck Veterinary Manual, 1979).

WBC counts in all the diets was higher than reported values by Tambuwal *et al.* (2002) for Red Sokoto goats, Taiwo and Ogunsanmi (2003) for WAD sheep and Daramola *et al.* (2005) for WAD goats.

According to Otesile *et al.* (1991) serum biochemistry is a generalized medium of assessing the health status of animals. Variations in the biochemical indices of the WAD goats placed on the different dietary treatments are shown in Table 3. Aside from the values for sodium, potassium, bicarbonate, total protein and arspartate transaminase, differences between the measured biochemical parameters were not significantly ($P > 0.05$) different between the diets.

The concentration of sodium was highest in the 25Afz:75Pm diet and varied significantly ($P < 0.05$) compared to 50Nwb:50Pm diet. The observation was comparable to that reported for Red Sokoto goats (Tambuwal *et al.*, 2002). However, this study reported serum sodium means that were lower than levels observed with mange infested and non-infested WAD goats by Adejinmi *et al.* (2000) and the value of 149.9mmol/l for temperate sheep (English *et al.*, 1969). Oduye and Fasanmi (1971) had earlier attributed low sodium levels to be the case in tropical environment. The range of 129.3-138.1mmol/l reported for WAD goats by Daramola *et al.* (2005) were lower than observed in this study. It is thought that the marked variation in sodium levels in the serum of the goats on diets 25Afz:75Pm and 50Nwb:50Pm may have resulted from variable intake of sodium in these diets based on the sodium content of the plant leaves as earlier shown in Table 1. However, the generally higher sodium level in the *Afzelia* than the *Newbouldia* supplemented diets may be attributed to cellular dehydration characterized by haemo-dilution as observed by Zilva and Pannall (1984).

Mean potassium levels in the serum of the studied animals was significantly higher ($P < 0.05$) in 25Afz:75Pm diet than in 25Nwb:75Pm and 100Pm (control) diets but did not differ from that of diets 50Afz:50Pm and 50Nwb:50Pm. Whether the presence of *Panicum maximum* at high levels, that is 75% and above in this case resulted in the readsorption of potassium (Tanwar *et al.*, 2000) is not too clear in this study. The potassium level reported by Tanwar *et al.* (2000) for non-ketotic healthy goats was comparable to diets with high *P. maximum* content in this study.

Bicarbonates which are chiefly chemical buffers are responsible for maintaining acid/base balance in the animal body. According to Jain (1986) this is usually regulated by the kidney and the digestive tract. In this study, the control group and 50Nwb:50Pm diet had significantly ($P < 0.05$) higher values than 50Afz:50Pm diet but did not differ from that of diets 25Afz::75Pm and 25Nwb:75Pm respectively.

Serum proteins are important in osmotic regulation, immunity and transport of several substances in the animal body (Jain, 1986). However, in this experiment, apart from the control diet (100Pm) the supplement diets did not differ significantly in terms of their total protein levels in the serum of the goats. Besides, the statistically non-significant ($P > 0.05$) difference between the control and 25Afz::75Pm diet may be related to the findings of Tewe and Maner (1980) that serum protein is not related to the amount of calories contained in diets but to the availability of protein. The diets in this study did not significantly affect the globulin levels in the serum of the goats thus indicating the safety of these leaves as supplements for goats. The higher values for total protein, albumin and globulin in this study compared to reports by Esugbohungbe and Oduyemi (2002) suggest that the studied plants could contain low levels of tannin known to diminish nutrient permeability in gut walls as well as increase excretion of endogenous protein which is subsequently passed out in the faeces and so may not alter protein metabolism (Mitjavila *et al.*, 1977).

Table 2: Effect of supplementing *Panicum maximum* with *Afzelia africana* and *Newbouldia laevis* on the hematological parameters of WAD goats

Parameters	Dietary treatments					
	100Pm	25Afz:75Pm	50Afz:50Pm	25Nwb:75Pm	50Nwb:50Pm	Mean±SE
PCV (%)	30.25[ab]	25.75[b]	30.50[ab]	34.00[a]	29.50[ab]	30±2.97
Hb (g/l)	9.80[ab]	8.45[b]	10.13[ab]	11.00[a]	9.75[ab]	9.83±0.92
RBC (x10^{6}il)	3.13[ab]	2.70[b]	3.25[ab]	3.65[a]	3.18[ab]	3.18±0.34
MCHC (g/dl)	32.80	32.83	33.48	32.70	33.05	32.97±0.31
MCH (i/g)	30.80	31.35	31.40	30.28	31.38	31.04±0.49
MCV (fl)	94.25	95.50	93.75	93.00	93.00	93.90±1.04
WBC (x10^{3}il)	27.98	29.70	20.95	26.30	29.98	26.98±3.68
Lymphocytes (%)	67.50	65.50	58.00	66.50	56.25	62.75±5.22
Neutrophils (%)	32.25	32.75	39.50	31.25	41.00	35.35±4.54
Eosinophils (%)	0.25	0.25	0.00	0.00	0.25	0.15±0.14
Monocytes (%)	0.50	1.25	2.50	2.25	2.25	1.75±0.85
Basophils (%)	0.00	0.25	0.00	0.00	0.00	0.05±0.11

100Pm= 100% Panicum maximum; 25Afz:75Pm= 25% *Afzelia Africana* + 75% *Panicum maximum*; 50Afz:50Pm= 50% *Afzelia Africana* + 50% *Panicum maximum*; 25Nwb:75Pm= 25% *Newbouldia laevis* + 75% *Panicum maximum*; 50Nwb:50Pm= 50% *Newbouldia laevis* + 75% *Panicum maximum*. SE = standard error of the means.

Table 3: Effect of supplementing *Panicum maximum* with *Afzelia africana* and *Newbouldia laevis* on serum biochemical values of WAD goats

Parameters	Dietary treatments					
	100Pm	25Afz:75Pm	50Afz:50Pm	25Nwb:75Pm	50Nwb:50Pm	Mean±SE
Sodium (mmol/l)	138.00[ab]	142.00[a]	138.50[ab]	136.50[ab]	135.25[ab]	138.05 ±2.55
Potassium (mmol/l)	4.80[b]	5.58[a]	5.05[ab]	4.85[b]	5.07[ab]	5.07±0.31
Chloride (mmol/l)	94.83	92.03	96.00	97.70	92.58	94.63±2.36
Bicarbonate (mmol/l)	16.50[a]	15.00[ab]	13.00[b]	15.25[ab]	16.75[a]	15.30±1.49
Calcium (mmol/l)	2.20	2.33	2.43	2.28	2.30	2.31±0.08
Phosphorus (mmol/l)	1.70	2.15	2.15	1.68	2.03	1.94±0.24
Urea (mg/dl)	37.30	37.20	34.35	32.25	32.85	34.79±2.37
Creatinine (mg/dl)	0.25	0.30	0.25	0.25	0.25	0.26±0.02
Cholesterol (mg/dl)	103.55	102.58	117.05	106.48	126.93	111.32±10.45
Total protein (g/dl)	7.53[b]	8.48[ab]	9.20[a]	9.55[a]	9.25[a]	8.80±0.81
Albumin (g/dl)	3.13	3.05	3.28	3.20	3.30	3.19±0.10
Globulin (g/dl)	5.88	5.38	6.00	6.48	5.95	5.94±0.39
ALT (IU/l)	10.63	10.50	12.03	10.73	8.00	10.38±1.47
AST (IU/l)	46.40[ab]	49.33[ab]	59.00[a]	43.45[ab]	41.05[b]	47.85±6.97
ALP (IU/l)	60.93	56.25	79.18	65.55	30.73	58.53 ±17.74

100Pm= 100% *Panicum maximum*; 25Afz:75Pm= 25% *Afzelia Africana* + 75% *Panicum maximum*; 50Afz:50Pm= 50% *Afzelia Africana* + 50% *Panicum maximum*; 25Nwb:75Pm= 25% *Newbouldia laevis* + 75% *Panicum maximum*; 50Nwb:50Pm= 50% *Newbouldia laevis* + 75% *Panicum maximum*.SE = standard error of the means.

Urea and creatinine levels did not differ between the diets in this study. However, compared to values reported for apparently healthy Marwari goats (Tanwar *et al*., 2000), this study reported high serum urea values. This may probably have been due to persistent hypoglycemia since according to Radostits *et al*. (1994) catabolic activity is increased for gluconeogenesis thus resulting in higher serum urea levels.

The monitored activities of the enzymes alanine transaminase (ALT), aspartate transaminase (AST) and alkaline phosphatase (ALP) in the sera of the goats studied did not vary widely between the diets except for AST where only the mean from the 50Nwb:50Pm treatment differed significantly from the other diets. Enzymes are protein catalysts present mostly in living cells and are constantly and rapidly degraded although, renewed by new synthesis (Coles, 1986). According to Zilva and Pannall (1984), normal enzyme level in serum is a reflection of a balance between synthesis and their release, as a result of the different physiological processes in the body. Transaminase enzymes are those mostly responsible for the synthesis of non-essential amino acids through the process known as transamination according to Carola *et al*. (1990). In this study, the relatively close and but low mean levels observed for the transaminases could be an indication that the test diets did not differ in their effects on enzyme secretion mechanism. According to Keele and Neil (1971), serum levels of AST are significantly high under disease and morbid conditions involving injuries to large numbers of metabolically active cells. However, the result of this study suggests a contrary situation in this regard thus indicating the potential of the studied plant leaves in the feeding of goats. Guyton (1991) observed that ALP level in the blood is usually a good indicator of bone formation since osteoblasts secrete large quantities of this enzyme. Thus, since the diets in this study did not differ from especially the 100Pm diet, it may be deduced that the leaves under study did not adversely disrupt the activity of these osteoblasts. Although the level of ALP can be influenced by disease, pregnancy as well as blood pH (Kelly, 1974), since apparently healthy and non-pregnant goats were used for this study, this parameter cannot be said to have been affected by these factors.

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