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Changes in haematological and biochemical diagnostic parameters of Red Sokoto goats fed tannin-rich *Pterocarpus erinaceus* forage diets

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ABSTRACT

A study was conducted to investigate the effects of feeding with a *Pterocarpus erinaceus* (PE) based diet on the haematological and biochemical diagnostic parameters to assess goat health. Twenty-five Red Sokoto goats of about 5 months old were submitted to one of the five diets containing two sole forage diets, 100% *Andropogon gayanus* (AG) and 100% PE and three mixed forage diets; 25% PE and 75% AG, 50% PE and 50% AG and 75% PE and 25% AG for 84 days in a completely randomized design. Packed cell volume, red blood cell, white blood cell, lymphocyte and monocyte counts were lower (($P<0.05$) in goats fed the sole forage diet of PE than those fed the sole forage diet of AG and mixed forage diets, whereas other haematological parameters were similar among the diets. Serum urea levels varied among the diets; the rank order was: sole forage diet of AG > sole forage diet of PE > mixed forage diets (all $P<0.05$). Glucose levels were higher ($P<0.05$) in the mixed forage diets than the two sole forage diets, which were similar. Goats fed the sole diet of AG had lower ($P<0.05$) total protein and albumin levels than those fed other dietary treatments. Apart from the serum Mg level which was outstandingly affected and lower ($P<0.05$) in the sole diet of AG, other serum minerals were similar among the diets. Since all the studied blood parameters were within the normal range for healthy goats and there were no signs of tannin toxicity, it is concluded that a dietary tannin concentration of 60 g/kg and intake of 1.4 g/kg b.m.. did not pose any threat to the health of the animals under the conditions of the experiment.

Key words: blood metabolic profile, *Andropogon gayanus*, *Pterocarpus erinaceus*, tannins, toxicity, goats

Introduction

In various parts of the world (particularly where animals are raised by natural range grazing in the tropics), it is customary to feed non-conventional feeds such as browse legumes as a supplement to the poor quality and inadequate grasses, especially during the dry season. This is because they are capable of yielding high-protein forage during the critical dry periods of the years.

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Pterocarpus erinaceus (PE) (African rosewood), a legume browse tree belonging to the family Papilionoideae and found mostly in savannah forests of the dried type, is available all-year round and is thus a promising fodder for ruminants in the critical dry season in the tropics. However, like other browse legumes, its utilization is constrained by the presence of antinutritional factors. Feeding animals for extended periods on some rangeland plants containing high levels of antinutritional compounds has been reported to produce detrimental effects on animal health (TABOSA et al., 2000; ADEDAPO et al., 2005). Feeding non-conventional feeds to animals may not only reduce the body mass growth rate but may also affect their health status and ability to withstand diseases (MAHGOUB et al., 2008). Normal physiological processes are affected long before the death of an organism, hence the need to check physiological and biochemical indicators of health and sub-lethal toxicant effects on livestock consuming feeds that contain toxicants. One of the fastest means of ascertaining toxicity of ingested feed in animals is by the assessment of their blood because blood serves as an indicator of the health status of animals and it is normal to assess the cause of an abnormality or malfunctioning of an animal by examining its blood. Blood contains diagnostically relevant parameters which act as a pathological reflector of the status of animals exposed to toxicants (JOSHI et al., 2002). Examining blood for their constituents can provide important information for the diagnosis and prognosis of diseases in animals. This study aimed to investigate the effects of feeding tannin-rich fodder, PE, on the blood metabolic profiles, as a health indicator in goat.

Materials and methods

Experimental site. This study was undertaken at the goat unit of the Teaching and Research Farm of the Federal College of Wildlife Management, New Bussa, Niger State. It is located between latitudes 7º80' and 10º 00' N, longitudes 4º30' and 40º33' E. It has a tropical humid climate with a mean annual temperature of about 34 ºC and relative humidity of about 60%.

Experimental animals and their management. Twenty-five clinically healthy young Red Sokoto goats were used of about 5 months of age, with an initial weight of 7.46 ± 2.4 kg. They were given prophylactic treatments consisting of administration of antibiotics (Oxytetracycline) and were dewormed with albendazole. Animals were also treated against ectoparasites. The animals were balanced for their weight, placed on the experimental diets consisting of sole forage diet of 100% AG, forage mixtures; 75% AG + 25% PE, 50% AG + 50% PE, 25% AG + 75% PE and a sole forage diet of 100% PE, and allowed a two-week adjustment period to the diets in a completely randomized design. They were provided with two feeding troughs and a drinker and were fed twice daily at 0.800 h and 16.00 h. The feeding trial lasted for 84 days, after which blood samples were collected for haematological and biochemical indices study.

Experimental diets and feeding. *Pterocarpus erinaceus* (PE) was harvested fresh before flowering from several plants in the rangeland of the college estate and its environment. The leaves including petioles were plucked and served to the animals fresh. *Andropogon gayanus* (AG) (Gamba grass) was obtained at six weeks old from re-growth of unfertilized pasture. The grass and the browse were chopped into 10 cm pieces and fed *ad libitum* to allow for maximum intake. The animals were randomly allocated to the aforementioned five experimental diets.

Blood sample collection. On the last day of the experiment, two sets of blood samples were taken from the goats via jugular venipuncture using a 5 mL syringe. A 5 mL blood sample was collected into labelled sterile bottles containing EDTA as anticoagulant for the determination of haematological parameters. Blood samples for serum analysis were collected into anticoagulant free bottles, allowed to coagulate at room temperature and centrifuged at 1500× g for 10 minutes. The supernatant sera were then harvested and stored in a freezer for subsequent biochemical analysis.

Chemical analysis. The chemical composition of the AG and PE was determined according to the procedures of ANONYM. (1990). Fibre components of the diets were analysed according to the methods of VAN SOEST et al. (1991). Condensed tannin (CT) was determined by the methods of MAKKAR (2003). Packed cell volume (PCV) and haemoglobin (Hb) concentration determination followed the procedures outlined by DACIE and LEWIS (2001). 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. Mean corpuscular haemoglobin concentration (MCHC), mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) were calculated from RBC, Hb and PCV values as described by DACIE and LEWIS (2001). Serum total protein and its components were obtained by the biuret method (REINHOLD, 1953), serum urea N and creatinine by modifying the method of VALLEY et al. (1980). Mineral elements were estimated with an atomic absorption spectrophotometer, Model 490 (Gallenkamp & Co. Ltd., London). The activity of the enzymes alanine transaminase (ALT) and aspartate transaminase (AST) were measured using the method of REITMAN and FRANKEL (1957) and alkaline phosphate (ALP) by the methods of ROY (1970).

Data analysis. Data were analysed using analysis of variance procedure (SPSS Base 7.5 for Windows (1997). SPSS, 444 N. Michigan Avenue, Chicago, IL, USA.) and treatment means showing significant differences at a probability of ($P<0.05$) were compared using Duncan's procedure of the same software.

Results

The chemical composition of the foliages from PE and AG offered to the experimental animals is presented in Tables 1 and 2. The crude protein content for PE was quite high

compared to that of AG. Both the neutral detergent fibre (NDF) and acid detergent fibre (ADF) were higher in AG than PE. While no tannin was detected in AG, PE had a relatively high CT content.

Table 1. Chemical composition of the experimental forages (% DM)

Composition	*A. gayanus*	*P. erinaceus*
Dry matter	28.60	24.80
Crude protein	9.2	16.00
Ether extract	7.00	2.52
Ash	10.58	7.38
Nitrogen free extract	36.42	49.60
Neutral detergent fibre	69.23	52.41
Acid detergent fibre	39.10	37.6
Organic matter	83.95	88.73
Tannins (g/kg)	ND	60

Table 2. Composition of the experimental diets

Composition	100% AG	75% AG + 25% PE	50% AG + 50% PE	25% AG +75% PE	100% PE
Dry matter	28.60	27.65	26.7	25.75	24.80
Crude protein	9.2	11.0	12.9	14.4	16.00
Ether extract	7.00	5.88	4.76	3.64	2.52
Ash	10.58	9.77	9.0	4.51	7.38
Nitrogen free extract	36.42	39.72	43.0	46.31	49.60
NDF	69.23	65.06	60.85	56.65	52.41
ADF	39.10	38.75	38.37	38.0	37.6
Organic matter	83.95	85.15	86.34	87.54	88.73
Tannin g/kg	ND	15.6	30.8	46	60

AG, *Andropogon gayanus*; PE, *Pterocarpus erinac*eus

Apart from PCV, RBC, WBC, lymphocyte and monocyte counts, which differed ($P<0.05$) among the dietary treatments, other haematological indices did not ($P>0.05$) (Table 3). Packed cell volume and RBC showed the same trend; they were similar among the mixed forage diets, but higher ($P<0.05$) in these diets than in the two sole forage diets. However, they were lower ($P<0.05$) in the sole forage diet of PE than in the sole diet of AG. White blood cell and monocyte counts were higher ($P<0.05$) in the mixed forage diets and sole forage diet of AG than in the sole forage diet of PE. Lymphocyte counts of goats fed the sole forage diet of AG, 75% AG + 25% PE and 50% AG + 50% PE were higher ($P<0.05$) than those fed 25% + 75% PE, which also had higher ($P<0.05$) counts

than those fed the sole diet of PE. Tannins intake increased with increasing levels of PE and were ranked in the following order: 100% PE < 75% PE < 50% PE < 25% PE (all $P<0.05$).

Except for urea, glucose, total protein and globulin, the other serum metabolites of the experimental goats were not significantly influenced by the dietary treatments (Table 4). Urea N was higher ($P<0.05$) in the sole diet of AG than the sole diet of PE, which in turn was higher ($P<0.05$) than that of the mixed forage diets. Glucose was similar in the mixed forage diets but was higher ($P<0.05$) in these diets than the two sole diets, which compared favourably. Total protein and albumin were higher ($P<0.05$) in the mixed forage diets and the sole diet of PE than in the sole diet of AG. With the exception of Mg, other studied serum major minerals were similar among the diets. Serum Mg level of the sole forage diet of AG was lower ($P<0.05$) than that of the mixed forage diets and sole forage diet of PE.

Table 3. Haematological indices and tannin intake of goats fed *Pterocarpus erinaceus* forage

	Proportions of *Pterocapus erinaceus* in the diets					
Parameter	0	25	50	75	100	± SEM
PCV (%)	24.47^{b}	27.73^{a}	28.27^{a}	26.79^{a}	22.04^{c}	1.24
Hb (g/L)	80.05	80.90	80.98	80.16	70.52	8.8
RBC ($\times 10^{12}$/L)	10.36^{b}	11.63^{a}	11.95^{a}	11.40^{a}	9.36^{c}	0.37
MCV (fL)	23.62	24.84	23.66	23.50	23.55	2.11
MCHC (%)	32.90	32.10	31.77	30.46	34.12	2.47
MCH (fmol)	7.77	7.65	7.51	7.16	8.00	0.51
WBC ($\times 10^{9}$/L)	11.06^{a}	10.93^{a}	9.94^{a}	9.50^{a}	7.31^{b}	1.01
Lymphocyte (%)	58.44^{a}	59.82^{a}	60.12^{a}	55.09^{b}	52.05^{c}	2.47
Monocyte (%)	3.41^{a}	3.70^{a}	3.87^{a}	3.23^{a}	2.94^{b}	0.78
Neutrophils (%)	43.06	44.52	45.98	43.16	41.77	3.38
Basophils (%)	0.14	0.13	0.16	0.15	0.13	0.15
Eosinophils (%)	4.45	4.51	4.52	4.46	4.43	0.29
Tannin intake (g/kg b.m.)	-	0.20^{d}	0.43^{c}	0.66^{b}	1.40^{a}	0.10

Means with the different superscripts along the row are significantly ($P<0.05$) different; SEM, standard error of the mean

Table 4. Biochemical components of goats fed tannin-rich *Pterocarpus erinaceus* forage

	Proportions of *Pterocapus erinaceus* in the diets					
Parameters	0	25	50	75	100	± SEM
Urea N (mmol/L)	7.69[a]	6.22[c]	6.23[c]	6.16[c]	7.27[b]	0.15
Creatinine (μmol/L)	101.98	104.76	106.57	117.32	118.15	10.4
Glucose (mmol/L)	3.00[b]	3.74[a]	3.77[a]	3.81[a]	3.17[b]	0.10
Total protein (g/L)	65.15[b]	69.67[a]	70.37[a]	72.54[a]	74.42[a]	1.76
Albumin (g/L)	28.03[b]	31.95[a]	31.77[a]	33.12[a]	34.80[a]	1.25
Globulin (g/L)	37.12	37.72	38.60	39.42	39.62	1.63
Cholesterol (mmol/L)	1.73	1.70	1.72	1.82	1.74	0.20
ALP (IU/L)	10.24	9.92	10.68	11.06	10.39	0.85
ALT (IU/L)	10.50	11.08	9.58	11.11	9.32	0.90
AST (IU/L)	50.75	56.91	57.63	59.48	56.40	5.08
Calcium (mg/dL)	8.33	8.44	8.50	8.55	8.45	0.45
Magnesium (mg/dL)	2.42[b]	2.69[a]	2.73[a]	2.84[a]	2.74[a]	0.08
Phosphorus (mg/dL)	5.45	5.56	5.41	5.50	5.31	0.27
Potassium (mEq/L)	4.10	4.02	4.09	4.07	3.98	0.22
Sodium (mEq/L)	149.19	146.58	150.77	147.78	148.12	12.43

Means with the different superscripts along the row are significantly ($P<0.05$) different; SEM, standard error of the mean

Discussion

The CP, NDF and ADF contents of the AG used in this study were comparable to that reported by other authors (PHENGVICHITH and LEDIN, 2007; OUÉDRAOGO-KONÉ et al., 2008). The nutrient contents of the foliage of PE used were close to the values reported for the same fodder foliage (OUÉDRAOGO-KONÉ et al., 2008). However, CP content for PE was high compared to the average of 12.5% reported for some tropical native browse plants (le HOUÉROU, 1980). The higher detergent fibres of AG than PE confirmed the previous report that states that, in general, grasses have low NDF content compared to tree fodders (KONÉ, 1987). The condensed tannin content of PE was higher than the low to moderate concentrations of <55 g/kg, which have beneficial effects in ruminants (PAWELEK et al., 2008).

The experimental animals, particularly those consuming PE based diets which contained CT, did not show clinical signs of ill health or signs of tannin toxicity such as brisket oedema, diarrhoea, constipation, anorexia, hard pelleted faeces coated with blood and mucous (GARG et al., 1992). The absence of signs of ill health and mortality in the animals consuming sole PE forage diet, in which tannins were more concentrated,

confirms the non-toxic level of tannins in PE. The lower PCV and RBC for goats fed a sole forage diet of tannin-rich PE than those fed sole tannin-free AG forage diet could be attributed to the presence of antinutritional factors in PE, particularly phenols and condensed tannins, that have been reported to have an antinutritional action (ROBINS and BROOKER, 2005; RUBANZA et al., 2005). However, these values were within the ranges of 20-28% and 8-17 $\times 10^{12}$ L for PCV and RBC, respectively, reported for clinically healthy goats (SIROIS, 1995). Parallel results were obtained by MAHGOUB et al. (2008), who observed low PCV for sheep fed non-conventional feeds containing condensed tannins and phenols. The normal RBC values elucidated the absence of haemolytic anaemia and depression of erythrogenesis. The insignificantly different haemoglobin concentrations were within the reported range (80-140 g/L) for goats (SIROIS, 1995) suggesting the absence of microcytic hypochromic anaemia occasioned by iron deficiency and improper utilization for the formation of Hb. The significantly different RBC numbers and the non-significantly varied Hb concentrations among the treatments contradict a previous report, in which a *Sericea lespedeza* diet containing 22.2 g CT/kg DM and intake of 1.03 g/kg b.m. was studied in Kiko crossbred male kids (SOLAIMAN et al., 2010). The fact that the blood indices (MCV, MCH and MCHC), which are important for diagnosis of anaemia in most animals (COLES, 1986), of goats fed the tannin-rich PE did not differ from goats fed sole forage of tannin-free AG and were within the normal ranges (16-25 fL, 5-8 fmol and 28-34%), respectively, (SIROIS, 1995) show explicitly that the goats were not anaemic. The lack of treatment effect on MCV, MCH and MCHC values agree with earlier reports (SOLAIMAN et al., 2010). Oak (*Quercus incana*) poisoning resulting in reduced Hb, MCH, increased bilirubin above the normal ranges and 70% mortality observed in cattle consuming tannin-rich immature tender oak leaves (GARG et al., 1992). The lower WBC, lymphocyte and monocyte counts for the goats fed sole PE forage diet may be connected with the tannins concentration of this diet. Obviously the tannin content of this diet would be higher than in the mixed forage diets, which implies that the animals must have ingested a considerable amount of tannins. Though the animals had lower WBC, lymphocyte and monocyte counts, the values were within the ranges (4-13 $\times$ 10^9 L, 50-70% and 1-4%), respectively, reported for healthy goats (SIROIS, 1995); this could be an important indication of the health status of the experimental animals and confirms the earlier conjecture that the concentration of CT in this diet was lower than the level that could have induced toxicity or ill health in the animals. Monocytes are essential for the immune system as they are precursors of macrophages and lymphocytes essential for humoral and cell-mediated immunity responses (MAHGOUB et al., 2008). Generally, toxic substances in feed tend to suppress haemopoietic tissues with consequent production of a low WBC count. The results agree with that of MAHGOUB et al. (2008) who also indicated low lymphocyte and monocyte counts in sheep fed tannin-rich non-conventional feeds. SOLAIMAN et al. (2010), however, indicated decreased WBC but increased lymphocyte

counts with increasing dietary tannin concentrations of 7.20, 14.6 and 22.2 g/kg and intakes of 0.27, 0.55 and 1.03 g/kg.

Since the serum urea N levels were within the established range of 3.5-10.7 mmol/L for goats (SIROIS, 1995), the significantly elevated urea N concentration of tannin-free AG sole forage diet displays the lower biological value of AG compared to the mixed forage and sole PE diets. The increased catabolism of amino acids, when proteins of lower biological value are used as feed, has been implicated for high plasma urea N levels (ADEROLU et al., 2007). The creatinine values in the current study were within the normal range of 100-200 μmol/L reported for healthy goats by SIROIS (1995). Increased serum urea N and creatinine has been associated with tannic toxicosis in cattle consuming tannin-rich oak fodder (GARG et al., 1992). The depressed serum glucose levels of the two sole forage diets compared to the mixed forage diets possibly reflected the inferior energy quality of the two diets relative to the mixed forage diets. Since the levels were within the variation range (1.1-3.0 mmol/L) indicated for healthy goats (ŽUBČIĆ, 2001), it thus appears plausible to infer that the observed depressed serum glucose is not due to tannic acid intoxication, but that the dietary energy was sufficiently utilized for growth and the animals were not surviving at the expense of body tissues (OLOGHOBO et al., 1992). ZHU et al. (1992) and ZHU and FILIPPISH (1995) reported a lower serum glucose level than the normal in sheep given oral administration of 8 g/kg b.m., intragastric administration of 1 g/kg b.m.. and intraperitoneal administration of 0.1g/kg b.m.. of tannin. It is pertinent to mention that the intake of tannins in the present study (0.2-1.4 g/kg b.m..) was lower than the tolerable intake of 1.1-2.7 g/kg b.m.. by goats without any ill effects (SILANIKOVE et al., 1996). The significantly lower total protein and albumin of goats fed the sole forage diet of AG is an indication of the relatively poor protein quality of the grass and, of course, the level and availability of the dietary protein. But since these dietary protein quality indices were within the ranges of 56-96 g/L and 18.9-44.5 g/L for total protein and albulmin, respectively, for healthy goats (ŽUBČIĆ, 2001), the results indicate the absence of proteinuria and hypoproteinaemia reportedly observed in cattle consuming tannin-rich oak foliage and manifesting tannic acid toxicosis (GARG et al., 1992). The superior values obtained for the sole forage diet of PE and mixed forage diets show that the tannins level of the PE forage is safe and beneficial, and not detrimental, because tannins at low levels are beneficial as they impact some qualities of rumen undegradable protein, thus improving protein availability and utilization. Serum levels of AST, gamma glutamyl transpeptidase (GGT), ALP and cholesterol are those conventionally used for diagnosing human and domestic animal hepatic damage (SILANIKOVE and TIOMKIN, 1992). Specifically, ALP and cholesterol are used to detect bile obstruction, i.e. mild and progressive damage to the liver (SILANIKOVE and TIOMKIN, 1992), whereas liver enzymes such as ALT, which is a liver specific hepatocellular enzyme released by hepatocellular

damage, more than GGT, is used to assess liver damage (MAHGOUB et al., 2008). The normal ranges for ALT, AST and ALP are 7-24 IU/L, 43-132 IU/L and 7-30 IU/L (SIROIS, 1995; DARAMOLA et al., 2005). The fact that none of these blood metabolic profiles in the present study differed from those measured on tannin-free grass (AG), and all of them fell within the normal ranges for goats suggest that no damage to the liver occurred. The result, which is in agreement with that of SILANIKOVE et al. (1996), contradicts the report that the antinutritional factors in *Prosopis julifloral* pod diets caused tissue damage in goats (TABOSA et al., 2000). Damage to the kidneys has been implicated for renal failure and changes in serum urea N, creatinine, uric acid and mineral concentrations (GARG et al., 1992; ZHU et al., 1992). A lack of increase in these metabolites above the normal values suggests that necrotic damage to the kidney did not occur. The results are similar to previous observations (SILANIKOVE et al., 1996). Both hepatic and renal pathology have been attributed to tannic acid toxicosis in sheep given tannic acid at the dose rate of 1 g/kg b.m.. (MURDIATI et al., 1990), whereas only renal damage occurred in cattle dosed with 50 g/day of tannic acid (CEDERVALL et al., 1973). It has been reported that the amount of tannins which can be consumed by goats without signs of toxic effect may be toxic for cattle and sheep (MURDIATI et al., 1990; GARG et al., 1992) because the secretion of proline-rich proteins, which are proteins that have a very high affinity for tannins (MEHANSHO et al., 1987), is higher during eating in goats than in sheep (DOMINIGUE et al., 1991). Moreover, GILBOA (1995) found that the parotid saliva of goats is relatively rich in proline (6.5%), glutamine (16.5%) and glycine (6.1%), which is known to have high tannin-binding capacity, by enhancing the affinity of proteins to tannins (MEHANSHO et al., 1987). This perhaps explains the reason for the lack of tannin toxicosis or systemic toxicity in the present study. Also, the tannin content of PE was within the range of 50-205 g/kg DM at which ill effects from tannins are not usually observed in goats, and the ability of goats to consume large amounts of tannin-rich fodder without exhibiting toxic effects has been related to their ability to avoid consuming browse in amounts exceeding their capacity to detoxify and their enhanced capacity, in comparison with other ruminant species, to detoxify tannins (SILANIKOVE et al., 1996). The established values for Ca, Mg, P, K and Na are 8.8-9.8 mg/dL, 1.80-3.95 mg/dL, 4.2-7.6 mg/dL, 3.6-4.8 mEq/L and 143-157 mEq/L, respectively (MITRUKA and RAWNSLEY, 1977). Lack of decrease in serum mineral concentration below the normal values, particularly those of Ca, P and Mg, which reflect changes in absorption from the gut, implies that: (i) the absorption of these minerals from the gastrointestinal tract was not hampered, and (ii) at least in the short run, feeding tannin-rich fodder (PE) did not cause any sign of mineral depletion. In agreement with this present study, there are no reports on tannin-related toxicity in goats raised on tannin-rich fodders (GILBOA et al., 1995; SILANIKOVE et al., 1996; SOLAIMAN et al., 2010). The generally high serum Mg of animals fed the PE based diets was likely to have been

influenced by the intake of the browse legume, PE. RUSELL and DUNKAN (1980) stated that changes in the diet from grass to legume, especially young legume, cause an increase in plasma Mg levels.

Conclusions

The absence of clinical signs of ill health, tannin toxicity symptoms and the findings of all the haematological and serum metabolites within the established ranges for healthy goats suggest that tannin concentration of 60 g/kg and intake of 1.40 g/kg b.m.. were well tolerated by the goats. It was thus concluded that the supplementation of AG with tannin-rich PE or sole feeding of PE did not cause any major health disorders.

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O. A. OLAFADEHAN: Promjene hematoloških i biokemijskih dijagnostičkih pokazatelja u crvenih sokoto koza hranjenih taninom bogatom krmom od biljke *Pterocarpus erinaceus*. Vet. arhiv 81, 471-483, 2011.

SAŽETAK

Istraživanje je provedeno s ciljem da se utvrdi utjecaj hranidbe krmivom od *Pterocarpus erinaceus* (PE) na hematološke i biokemijske pokazatelje za procjenu zdravlja koza. Dvadesetpet crvenih sokoto koza, u dobi od oko 5 mjeseci, hranjeno je 84 dana jednim od pet krmiva: dva sastavljena od jednog krmiva - 100% *Andropogon gayanus* (AG) i 100% PE i tri sastavljena od mješavina - 25% PE i 75% AG, zatim 50% PE i 50% AG te 75% PE i 25% AG. Životinje su bile podijeljene slučajnim odabirom. Hematokrit, broj crvenih i bijelih krvnih stanica te broj limfocita odnosno monocita bio je niži ($P<0,05$) u koza hranjenih hranom koja je bila temeljena samo na krmivu PE za razliku od onih hranjenih samo s AG ili trima mješavinama. Ostali hematološki pokazatelji bili su slični u promatranih skupina koza. Razina ureje u serumu varirala je između skupina kako slijedi: u koza hranjenih samo krmivom od AG bila je veća nego u koza hranjenih krmivom od PE, a najveća je bila u koza hranjenih mješavinom obaju krmiva ($P<0,05$). Razina glukoze bila je viša ($P<0,05$) u skupina hranjenih mješavinama u odnosu na skupine hranjene samo jednim krmivom, koje su bile međusobno slične. Koze čiji je obrok sadržavao samo AG imale su nižu ($P<0,05$) razinu ukupnih proteina i albumina u odnosu na sve ostale skupine. Osim razine Mg u serumu, koja je bila naglašeno snižena ($P<0,05$) u skupini hranjenoj isključivo s AG, preostali minerali u serumu bili su na sličnoj razini u svih skupina. Budući da su svi promatrani pokazatelji u krvi bili unutar raspona vrijednosti za zdrave koze, a nije bilo znakova trovanja taninom, zaključeno je da koncentracija tanina od 60 g/kg u hrani i unos od 1,4 g/kg tjelesne mase nije izazvala nikakve poremećaje zdravlja u pokusnih životinja.

Ključne riječi: koze, metabolički profil krvi, *Andropogon gayanus*, *Pterocarpus erinaceus*, tanini, toksičnost