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Comparative evaluation of the performance, blood profile, methane emission and CO_2 yield of goats' faeces fed *Gliricidia*, *Leucaena* and *Mimosa* diets.

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Abstract
An experiment was conducted to compare the performance, blood profile, methane (CH_4) emission and carbon dioxide (CO_2) yield of goats' faeces fed Gliricidia sepium, Leucaena leucocephala and Mimosa pudica diets. Sixteen West African Dwarf (WAD) bucks aged 8 - 10 months and weighing 7.22 – 7.67kg were bought, quarantined, vaccinated and used for this study. They were randomly allotted to four treatments with four animals per treatment in a Completely Randomized Design. They were weighed at the beginning of the experiment and subsequently weekly. They were housed individually in separate pens with feeding and watering troughs, fed for 10 weeks; 8 weeks in pens and 2 weeks in metabolism cages. The experimental diets contained different ingredients as shown on Table 1. T1 contained 0% forage while T2, T3 and T4 contained 20% Leucaena, 20% Gliricidia and 20% Mimosa forages, respectively. Daily feed intake was recorded as the difference between feed served and refusals. In the metabolism cages, faeces voided were collected and bulked for biogas digestion using an outdoor anaerobic digester. A gas analyser was used to measure the percentage of CH_4 in CO_2 equivalent and hydrogen sulphide (H_2S) in the gas produced from each faecal sample (treatment). Blood was collected at the last day of the experiment, taken to the laboratory for haematological and biochemical indices of goats and compared with the normal ranges of these indices for goats. Results showed that there were no significant ($P>0.05$) differences in the initial body weights, final body weights, feed intake, body weight gain and feed conversion ratio (FCR) of the goats. Significant ($P<0.05$) differences existed in the Packed cell volume (PCV), haemoglobin (Hb), Red blood cell (RBC), White blood cell (WBC), neutrophil, lymphocyte, eosinophil and monocyte values of the goats. PCV was highest for goats on T4 (34.67%), Hb was highest for goats on T4 (10.43g/dl) and T2 (10.47g/dl), RBC was highest for goats on T2 ($4.83x10^6$ml), WBC was highest for goats on T2 ($9.00x10^3$ml), neutrophil was highest for goats on T2 (42.33%), lymphocyte was highest for goats on T1 (59.33%), eosinophil was highest for goats on T3 (7.67%) and monocyte was highest for goats on T4 (7.32%). Significant ($P<0.05$) differences existed in Aspartate aminotransferase (ALT), Alanine aminotransferase (ALT), Alkaline phosphatase (ALP), total protein, Albumin, potassium and chloride values of the goats. Significant ($P<0.05$) differences existed in CH_4 and CO_2 yield of goats' faeces. CH_4 was lowest in faeces of goats on T4 ($58\pm1.15\%$) and CO_2 was lowest in the faeces of goats on T2 ($25.00\pm1.73\%$). T4 (Mimosa pudica diet) proved superior in terms of methane reducing effect and also had the best PCV and Hb, it is therefore recommended to goat farmers for a greener and environment friendly goat production.

Keywords: *Carbon dioxide, Gliricidia, Leucaena, methane emission, Mimosa and goats.*

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I. Introduction

One of the answers to the reduced animal protein intake in Nigeria is increasing ruminant production at a sustainable level (Ukanwoko *et al*., 2020a). Meat is a major component of the animal protein (International Technology Association, 2004). Goat meat ranks next after beef and constitutes about 24% of the total meat consumed by Nigerians (Ukanwoko *et al.*, 2020b). Goats adapt to a changing climatic environment more readily than their ruminant counterparts. As a result they are used for food and sources of income (Pragna *et al*., 2018), no wonder they are called village banks by peasant farmers (Oluwatayo and Oluwatayo, 2012).

Globally sheep and goats account for 56% of the world ruminant population, there are 1.2 billion sheep and 1 billion goats (FAO, 2016). The global livestock sector is responsible for 37% of human induced methane emissions and 80% (Gill *et al.,* 2010) – 89% (Jiao *et al*., 2014) come from enteric fermentation. Enteric methane from ruminants is the largest contributor to greenhouse gas (Montes *et al*., 2013). Methane is a greenhouse gas that is known to have 28 – 34 folds global warming potential than carbon dioxide. It is also taken as a dietary energy loss in ruminants in the range of 2 – 12% of the gross energy ingested by the animal (Moss *et al*., 2000).

Reduction of methane emissions emanating from livestock is of global environmental concern and should be a major factor guiding ruminant animal production (Machmuller, 2006). It is therefore a priority to both Animal Scientists and Environmentalists (Martin *et al*., 2010). This can be done by modifying the ruminal ecosystem, breed selection and nutritional strategies (Marino *et al*., 2016). Forages (*Gliricidia sepium, Leucaena leucocephala, Mimosa pudica* etc) containing tannins have direct and indirect effects on methanogenesis when fed to goats. Tannins inhibit the activities of methanogenic bacteria and decrease hydrogen production used for methane production (Patra and Saxena, 2010). Tannins also have beneficial effects on the weight gain of ruminants (Min *et al.,* 2006).

Blood profile of goats has been reported to be affected by nutrition and other factors like sex, breed, disease, genetics etc (Ukanwoko, 2016). It is a pointer to the productive and health status of an animal (Isaac *et al*., 2013).

This study is therefore aimed at comparing the blood profile, performance, methane and carbon dioxide reducing effect of some tannin - containing forages used in goat production.

II. Materials And Methods

Experimental location

This experiment was carried out at the Goat unit of the University of Port Harcourt Research and Demonstration Farm, Abuja campus, Obio – Akpor Local Government Area of Rivers State in the South – South zone of Nigeria. It is in the humid tropics with rainfall from March – November. It has an average rainfall of 367mm in 182 days, a temperature of 25 – 28^0C and a relative humidity of 80% (Ijeomah *et al*., 2013).

Experimental animals and management

Sixteen (16) West African Dwarf (WAD) bucks aged 8 - 10 months were purchased from the nearby village. The bucks were quarantined for 14 days during which they were vaccinated against PPR, treated against endoparasites and ectoparasites using ivermectin. They were randomly allotted to four treatments with four animals per treatment in a Completely Randomized Design. They were weighed at the beginning of the experiment and weekly subsequently. They were housed individually in separate pens with feeding and watering troughs and fed for 10 weeks, 8 weeks in the pens and 2 weeks inside the metabolism cages.

Experimental diets

The cassava peels used were collected from cassava processing unit in Igwuruta, Port Harcourt. The fresh cassava peels were sun – dried on a concrete floor for 3-5 days. The sun – dried cassava peels were milled and bagged in sacks for feed formulation. The forages (*Leucaena leucocephala*, *Mimosa pudica* and *Gliricidia sepium leaves)* were harvested from Choba environs, air - dried on a concrete floor, crushed and bagged for feed formulation. The other ingredients – wheat offal, palm kernel cake, soyabean meal, bone meal and common salt were purchased from the market and used for feed formulation as shown in Table 1.

Table 1.The composition of the experimental diets

	Diets			
Ingredients (%)	**T1**	**T2**	**T3**	**T4**
Cassava peels	34	30	30	30
Leucaena leucocephala	0	20	0	0
Gliricidia sepium	0	0	20	0
Mimosa pudica	0	0	0	20
Wheat offal	30	24	24	24
Palm kernel cake	28	18	18	18
Soyabean meal	5	5	5	5
Bone meal	2	2	2	2
Common salt	1	1	1	1
	100	100	100	100
Calculated CP (%)	17.04	18.91	17.68	17.00
Calculated CF (%)	13.73	13.91	14.18	12.21

Feeding trial

The animals were fed the experimental diets morning and evening for 10 weeks. Water was given to the animals *ad libitum*. Daily feed intake was recorded as the difference between feed served and refusals. During the last 2 weeks, the animals were transferred to previously disinfected metabolism cages where faeces and urine voided by the animals were collected. The faeces were dried and bulked for each animal. The bulk of the faecal samples were used to determine the gas output of the goats via biogas production.

Blood collection and analysis

On the last day of the experiment, blood was collected from the jugular vein of each animal using a sterilized needle and disposable syringe and taken to the laboratory for analysis. 10ml of blood was collected. Blood of about 3 ml was emptied into sterile sample bottles containing the anti-coagulant ethylene diamine tetra-acetic acid (EDTA) for laboratory analysis to determine haematological parameters like PCV, Hb, WBC, RBC, neutrophils, monocytes, eosinophils and lymphocytes according to Joshi *et al*. (2002). The remaining 7 ml of blood were emptied into sample bottles without EDTA for serum biochemical analysis which includes AST, ALP, ALT, Total protein, Potassium, Chloride, and Urea using the method described by Ogunsami *et al*. (2002).

Bio-digestion of the faecal output:
Feedstock, inoculum and experimental digester

The bulk of the goats' faeces from the four treatments were digested. The initial inoculum was collected from anaerobic sludge of daily manure obtained from an anaerobic digester situated at the University Farm. The bio-digestion was conducted by using an outdoor anaerobic digester fabricated from local 25 Litres plastic gallons with internally installed thermometer, air valve and a gas flow meter. The goats' faeces were ground into powder with a grinding machine to reduce the particle size. The working ratio was 2:1 w/v of dry dung and sterile water while 2 L of inoculum was used to feed the digester. All reactors were gently mixed manually and poured into the digester and allowed for 21 days for biogas production. The produced biogas was collected in a 25 m^3 biogas bag made of a strong material (ethylene propylene diene monomer), which has a flexible structure and pressure resistance

A gas analyser was used to analyse the biogas produced to measure the percentage of CH_4 in CO_2 equivalent and hydrogen sulphide in each faecal sample (treatment).

Chemical analysis: The forages *(Gliricidia sepium, Leucaena leucocephala* and *Mimosa pudica),* the experimental diets and faecal samples were analysed for dry matter, crude protein, crude fibre, ether extract, ash and nitrogen – free – extract according to A.O.A.C (2005).

Statistical analysis: The data obtained were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980). Differences between means were determined using Duncan's Multiple Range test (Duncan, 1955).

III. Results

Proximate composition of the experimental diets, Leucaena, Gliricidia and Mimosa forages.

The proximate composition of the experimental diets, *Leucaena, Gliricidia* and *Mimosa* forages is presented on Table 2. The dry matter contents of the experimental diets ranged from 87.35 – 89.98% while those of the forages ranged from 88.87 – 91.91%. The crude protein content was highest in T2 (21.41%) and lowest in T1 (17.28%), for the forages, crude protein content ranged from 18.01% in *Mimosa* to 22.83% in *Leucaena*. The crude fibre content ranged from 14.70% in T2 to 19.08% in T4 whereas in the forages, crude fibre was highest in *Mimosa* (19.70%) and lowest in *Leucaena* (13.83%). Ether extract ranged from 3.13% in T4 to 4.31% in T2 while in the forages ether extract was highest in *Gliricidia* (3.78%) and lowest in *Mimosa* (2.07%). Ash was highest in T3 (9.76%) and lowest in T2 (6.09%) whereas in the forages, ash was highest in *Gliricidia* (10.40%) and lowest in *Mimosa* (5.90%). Nitrogen free extract ranged from 50.13% in T3 to 51.49% in T2 whereas in the forages, it ranged from 49.89% in *Gliricidia* to 54.02% in *Mimosa.*

Growth performance of WAD goats fed Gliricidia, Leucaena and Mimosa diets.

The growth performance of WAD goats fed *Gliricidia, Leucaena* and *Mimosa* diets is presented on Table 3. There were no significant differences (P<0.05) in the initial body weight, final body weight, feed intake, body weight gain and feed conversion ratio of goats on the experimental diets.

Table 2. Proximate composition of the experimental diets, *Gliricidia, Leucaena* and *Mimosa* forages.

	Treatments				Forages		
Parameters (%)	**T1**	**T2**	**T3**	**T4**	**LL**	**GS**	**MP**
Dry Matter	89.98	88.04	88.94	87.35	88.87	91.91	89.71
Crude protein	17.28	21.41	19.93	18.78	22.83	20.27	18.01
Crude fibre	16.69	14.70	16.06	19.08	13.83	15.89	19.70
Ether extract	3.85	4.31	3.68	3.13	3.39	3.78	2.07
Ash	9.68	6.09	9.76	6.60	6.93	10.40	5.90
Nitrogen free extract	51.05	51.49	50.13	50.37	52.22	49.89	54.02

Where T1 = 0% forage, T2 = 20% LL, T3 = 20% GS and T4 = 20% MP.
LL = *Leucaena leucocephala*, GS = *Gliricidia sepium* and MP = *Mimosa pudica*

Table 3. Growth performance of West African Dwarf goats fed *Gliricidia, Leucaena* and *Mimosa* diets.

	Treatments				
Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**
Initial body weight (kg)	7.62	7.62	7.25	7.22	0.56
Final body weight (kg)	8.25	8.25	7.87	7.79	0.47
Feed intake (g/day)	414.62	460.33	460.67	444.09	8.81
Body weight gain (kg)	0.63	0.63	0.62	0.57	0.32
Feed conversion ratio	0.66	0.73	0.77	0.78	0.53

Haematological indices of WAD goats fed Gliricidia, Leucaena and Mimosa diets.

The haematological indices of WAD goats fed *Gliricidia*, *Leucaena* and *Mimosa* diets are presented on Table 4. There were significant (P<0.05) differences in the PCV, Hb, RBC, WBC, neutrophil, lymphocyte, eosinophil and monocyte values and non significant (P>0.05) differences in the platelet values of WAD goats fed the experimental diets. PCV was within the range of 27.67% in T1 to 34.67% in T4. Hb fell within the range of 9.20g/dl in T1 to 10.43g/dl and 10.47g/dl in T4 and T2 respectively. RBC was within the range of $4.40x10^6$ml in T1 to $4.83x10^6$ml in T2. WBC fell within the range of $5.40x10^3$ml in T4 to $9.00x10^3$ml in T2. Neutrophil was within the range of 30.67% in T1 to 42.33% in T2. Lymphocyte was within the range of 46.67% in T3 to 59.33% in T1. Eosinophil fell within the range of 3.67% in T1 to 7.67% in T3. Monocyte fell within the range of 6.33% in T1 to 7.32% in T4.

Serum biochemical profile of WAD goats fed Gliricidia, Leucaena and Mimosa diets.

The serum biochemical profile of WAD goats fed *Gliricidia, Leucaena* and *Mimosa* diets is presented on Table 5. There were significant (P<0.05) differences in the AST, ALT, ALP, total protein, albumin, potassium and chloride values of goats fed the experimental diets. AST fell within the range of 66.00IU/L in T4 to 78.33IU/L in T1. ALT fell within the range of 14.27IU/L in T3 to 16.67IU/L in T1. ALP fell within the range of 27.86IU/L in T4 to 32.67IU/L in T1. Total protein was in the range of 56.33g/dl in T3 to 58.00g/l in T2 and T4. Albumin was in the range of 28.33g/dl in T4 to 33.33g/dl in T1. Potassium fell within the range of 2.50mmol/l in T3 to 3.43mmol/l in T1. Chloride fell within the range of 59.00mmol/l in T4 to 67.67mmol/l in T3.

Table 4. Haematological indices of West African Dwarf goats fed *Gliricidia, Leucaena* and *Mimosa* diets

^{abcd}Means within each row with different superscripts are significantly different (P<0.05).

	Treatments					
Parameters	**T1**	**T2**	**T3**	**T4**	**SEM**	**Normal Range**
PCV (%)	27.67^{d}	31.33^{b}	29.67^{c}	34.67^{a}	3.15	24 – 45
Hb (g/dl)	9.20^{c}	10.47^{a}	9.90^{b}	10.43^{a}	1.05	8 -16
RBC ($x10^6$ml)	4.40^{d}	4.83^{a}	4.45^{c}	4.77^{b}	0.33	2 – 4
WBC ($x10^3$ml)	7.83^{b}	9.00^{a}	6.87^{c}	5.40^{d}	1.15	4 – 12
Platelet ($X10^9$)	230.00	231.00	230.00	231.00	12.59	150 - 280
Neutrophil (%)	30.67^{b}	37.67^{ab}	42.33^{a}	37.33^{ab}	2.44	18 – 43
Lymphocyte (%)	59.33^{a}	52.67^{ab}	46.67^{b}	53.00^{ab}	2.63	40 – 60
Eosinophil (%)	3.67^{d}	6.67^{b}	7.67^{a}	6.00^{c}	0.76	0 – 10
Monocyte (%)	6.33^{c}	6.67^{b}	6.50^{b}	7.32^{a}	0.60	2 – 10

Where PCV = Packed cell volume, Hb = Haemoglobin, RBC = Red blood cells, WBC = White blood cells, Normal Range source – RAR, 2009.

Table 5. Serum biochemical profile of West African Dwarf goats fed *Gliricidia, Leucaena* and *Mimosa* diets.

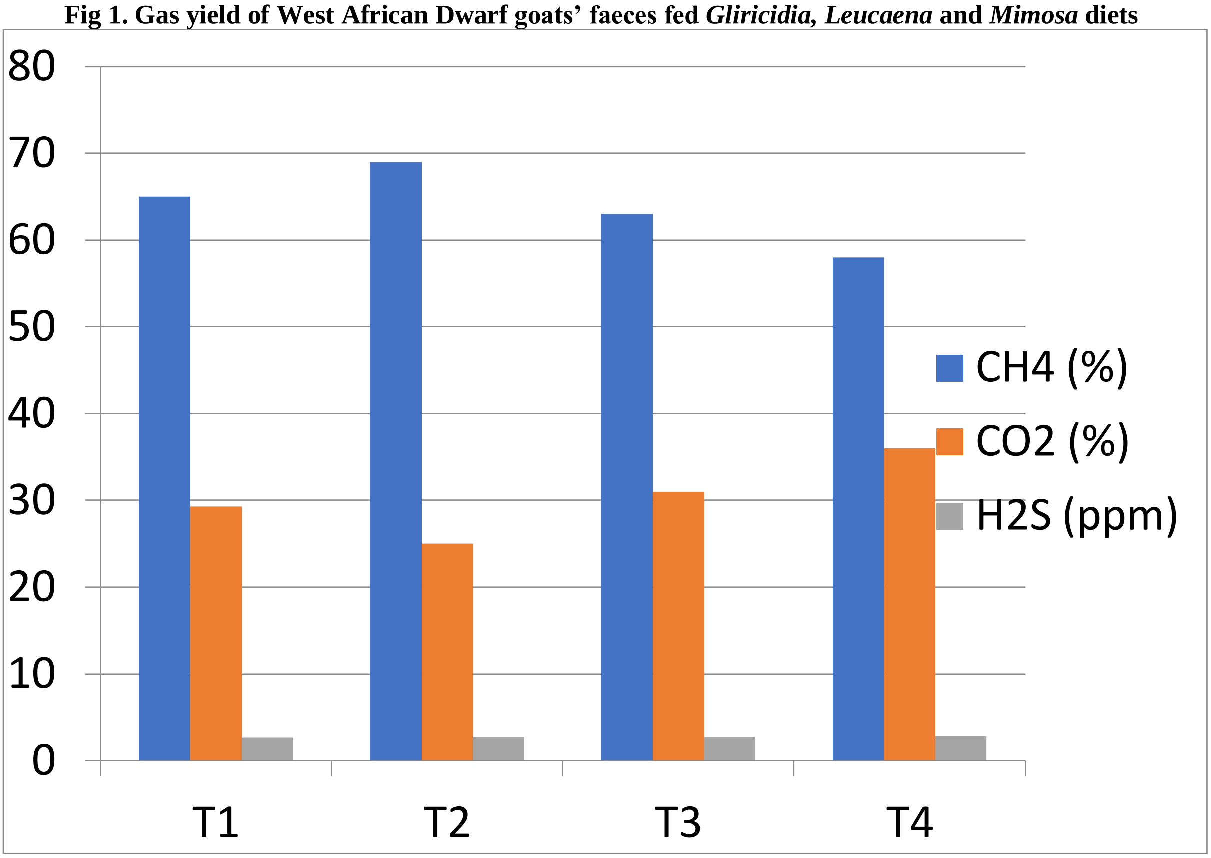
Parameters	Treatments T1	T2	T3	T4	SEM	Normal range
AST (IU/L)	78.33^{a}	71.33^{b}	68.00^{bc}	66.00^{c}	1.18	50 - 90
ALT (IU/L)	16.67^{a}	15.13^{ab}	14.27^{b}	15.23^{ab}	0.88	10 - 30
ALP (IU/L)	32.67^{a}	30.67^{b}	28.12^{c}	27.86^{d}	7.67	12 - 34
Total protein (g/dl)	56.67^{b}	58.00^{a}	56.33^{c}	58.00^{a}	3.87	30 - 69
Albumin (g/dl)	33.33^{a}	30.00^{ab}	30.33^{ab}	28.33^{b}	1.38	20 - 42
Potassium (mmol/l)	3.43^{a}	2.83^{b}	2.50^{c}	3.07^{ab}	0.18	3 - 6
Chloride (mmol/l)	60.33^{b}	57.33^{d}	67.67^{a}	59.00^{c}	5.78	50 - 95
Urea (mmol/l)	4.46	4.47	4.48	4.49	0.67	0.8 – 9.7

^{abcd}Means within each row with different superscripts are significantly different ($P<0.05$).
Where AST – Aspartate aminotransferase, ALT – Alanine aminotransferase, ALP – Alkaline phosphatase.

Gas yield of West African Dwarf goats' faeces fed Gliricidia, Leucaena and Mimosa diets

The gas yield of WAD goats' faeces fed *Gliricidia. Leucaena* and *Mimosa* diets is shown on Figure 1. There were significant ($P<0.05$) differences in the methane (CH_4) and carbon dioxide (CO_2) contents of the goats' faeces. CH_4 is measured in percentages in CO_2 equivalent. It fell within the range of 58$\pm$1.15% in T4 to 69$\pm$0.57% in T2. T1 and T3 had 65$\pm$1.15% and 63$\pm$1.73% CH_4 respectively. CO_2 fell within the range of 25.00$\pm$1.73% in T2 to 36.00$\pm$1.73% in T4 while T1 and T3 had 29.33$\pm$1.45% and 31.00$\pm$0.57% CO_2 respectively. There were no significant ($P>0.05$) differences in the hydrogen sulphide contents of the goats' faeces.

Fig 1. Gas yield of West African Dwarf goats' faeces fed *Gliricidia, Leucaena* and *Mimosa* diets



Treatments

IV. Discussion

The results of the proximate composition of the experimental diets showed CP content in the range of 17.28 – 21.41%. This range is well above the 13.73% CP content reported by Okafor *et al.* (2012) for goat production. The CF content of the experimental diets reported in this study (14.70 – 19.08%) were well above 12% recommended CF requirement for production of goats (Ukanwoko *et al.*, 2020c). The CP contents of *Gliricidia sepium* (20.24%) and *Leucaena leucocephala* (22.83%) reported in this study were lower than the CP contents of 28.4% and 30.2% reported by Yousuf *et al.* (2007) for *Gliricidia sepium* and *Leucaena leucocephala* respectively. Variations might be due to differences in sampling and analytical procedure, differences in geographical locations of the forages and stage of growth at which the forages were harvested (Gizzi and Givens, 2004).

The non – significant effect of the experimental diets on the growth performance of goats reported in this study agrees with Ukanwoko and Ironkwe (2012) who also reported a non – significant effect of *Gliricidia sepium* and *Leucaena leucocephala* diets on the final weights of goats. The low bodyweight gain reported in this study might be due to the composition of tannin containing forages in the experimental diets. Tannins have been reported to reduce palatability of feed, feed intake and protein digestibility (Silanikove *et al*., 2006). With increased tannin content in feed comes decrease in bodyweight gain, low and medium inclusion of tannin (>50g/kg of feed) is the way out (Sebsibe and Mastewal, 2018).

The PCV range reported in this study agrees with the range of 24 – 45% PCV reported by RAR (2009) and that (22 – 35%) reported by Radiostit *et al*. (2002) for WAD goats. PCV is an indication of the protein content of the experimental diets, low PCV shows inadequate protein content of the diets. The range of Hb in this study is higher than that (7.23+0.28g/dl) reported by Obua *et al*. (2012) but compares favourably with the Hb range of 8.08 – 9 50g/dl reported by Ogundu *et al*. (2008). Hb has been reported to be the oxygen carrier (Daramola *et al*., 2005). RBC of goats in this study is higher than the normal range of 2 – $4x10^6$ml reported by RAR (2009) but lower than the range of 6.35 – $11.95x10^6$ml reported by Ocheja *et al*. (2014). The range of WBC in this study falls within the normal range of 4 – $12x10^3$ml and 6.8 – $20.1x10^3$ml reported by RAR (2009) and Daramola *et al*. (2005) respectively. A normal WBC is indicative of a sound immune system not adversely affected by the experimental diets. Neutrophil in the normal range shows the number of immune cells in circulation in the animals' body which reflects a normal physiological state. The range of neutrophil reported in this study falls within the normal range of 18 – 43% neutrophil reported by RAR (2009) but higher than the neutrophil range of 17.52 – 36.40% reported by Daramola *et al*. (2005). Lymphocytes are known to produce antibodies that fight against disease causing viruses and bacteria. The range of lymphocytes reported in this study falls within the normal range of 40 – 60% reported by RAR (2009) for goats. Monocyte percentage in this study fell within the range (2 – 10%) reported by RAR (2009).

AST as an enzyme is responsible for the production of oxaloacetate and glutamate and liver functionality in general. High AST shows abnormal function of the liver. The range of AST in this study fell within the range of 50 -90u/l reported for goats by RAR (2009). ALT range in this study fell within the normal range of 10 – 30u/l reported by RAR (2009) for goats. ALT is important in the metabolism of amino acid and gluconeogenesis. ALP range fell within the normal range of 12 – 34 u/l reported by RAR (2009) for goats. ALP is an enzyme that catalyses the organic phosphate esters hydrolysis. The range of total protein in this study fell within the normal range of 30 – 69g/l reported by RAR (2009) for goats. Total protein is involved in the clotting of blood and immunity, transports lipids, vitamins, hormones and metals. Albumin range in this study fell within the normal range of 20 – 42g/l (RAR, 2009). Albumin is involved in transporting nutrients and lipophilic hormones. Only the potassium levels of T1 and T4 fell within the normal range of 3 – 6mmol/l (RAR, 2009). Potassium is known to transport oxygen and carbon dioxide, it is also involved in acid – base balance maintenance, contraction of muscles, transmission of nerve impulse and maintenance of osmotic pressure. The range of chloride in this study fell within the normal range of 0.8 – 9.7mmol/l (RAR, 2009). Chloride is an anion whose function is to absorb amino acid and minerals, it is also involved in protein digestion and maintains acid – base balance.

CH_4 was lowest in T4 (59$\pm$1.15%), followed by T3 (63$\pm$1.73%), T1 (65$\pm$1.15%) and T2 (69$\pm$1.15%) in CO_2 equivalent. Grossi *et al.* (2019) reported 93% methane emission in CO_2 equivalent from goats. Going by this report, T4 reduced methane emission by 35% (93 – 58%), T3 by 30% (93 – 63%), T2 by 28% (93 – 69%) and T1 by 24% (93 – 65%). This made T4 (*Mimosa* diet) the best methane reducing diet. The 24% reduction of methane by T2 (*Leucaena leucocephala* diet) is lower than 43% reduction reported by Tan *et al*. (2011) using the same forage *in vitro*. The reduction in the methane emission reported in this study could be attributed to the presence of phytometabolites – tannins and saponins which have been reported to have anti – methanogenic effect (Bodas *et al*., 2012). This result is supported by Broucek (2015) who reported that methane yield from faeces of ruminants is strongly related to feed intake. CO_2 was lowest in T2 (25.00$\pm$1.73%), followed by T1 (29.33$\pm$1.45%), T3 (31.00$\pm$0.57%) and T4 (36.00$\pm$1.73%). This result agrees with Diagi *et al.* (2019) who reported methane as the most abundant gas during ruminants' faeces bio – digestion.

V. Conclusion And Recommendation

The growth parameters of goats that fed *Gliricidia, Leucaena* and *Mimosa* diets were not adversely affected by the experimental diets. The PCV, Hb, RBC, WBC and other haematological and serum biochemical parameters were within the normal range for goats. Methane emission was lowest in T4 (the *Mimosa pudica* diet) compared to other diets and this makes T4 the best methane reducing diet. T4 is therefore recommended to goat farmers for a greener and friendlier environment since this diet will on the long run reduce global warming better than the other treatments. Further studies should be carried out to know the best *Mimosa pudica* inclusion level with the least methane emission.

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