



**PHYSIOLOGICAL, HAEMATOLOGICAL AND SEROLOGICAL RESPONSES IN
WAD GOATS FED BROWSES WITH GLIRICIDIA HAY BASED DIETS IN
DRY SEASON**

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ABSTRACT

This experiment was conducted to determine the effects of *Leucaena leucocephala* (Lam) (Fli), *Gliricidia sepium* Jacq (FGs), *Gmelina arborea* Roxb (FGa), and *Pennisetum purpureum* (Schumacher) (FPp), 1) and *Gliricidia sepium* (HG) hay basal diet and Concentrate (Cc.) on the physiological, hematology and serum biochemistry values of WAD goats. Sixteen goats comprising 8 bucks and 8 does aged 4-6 months and averaging 4.43 kg in weight were divided into 4 treatment groups of 4 animals per group and each group randomly assigned to one of the 4 treatments (T1=FP-HG, T2=FG-HG, T3=FL-HG, and T4=FGa-HG) (for 12 Twelve weeks) in a Completely Randomized Design. At the end of the trial the physiological parameters monitored are Pulse rates (bpm), Body temperature (°C), Rectal temperature (°C), Respiratory rate (bpm), and Heat stress index with ranges within the normal reference values of 60-150, 37-40, 37-42, 20-40 and less than threshold of 65-72 respectively. Furthermore, haematology parameters measured viz were, Leucogram and its differential count, Erythrogram and its derivatives and some Serum biochemical parameters. All indices of the aforementioned were all within the normal range values though a limit is from different authors which is scientifically tenable. This development presupposes that Grass- legume-concentrate (T1) and Browsers Legume -legume concentrate (T2 and T3) as well as non-legume browse-legume browse-concentrate (T4) mixture can be sustainably subsisted and survived upon by goats depending upon their availability especially in the dry season.

Keywords: Blood, Forages, Temperature, Respiratory, Bucks

INTRODUCTION

The problem of seasonal fluctuation in both quality and quantity of animal feed in the tropics calls for exploration of some variety of multipurpose tree and shrubs abundant all the year round in the region in order to determine their suitability for livestock feeding. Due to the non availability of pastures in the dry season, more attention is now being given to tree leaves and shrubs for feeding sheep and goats in most areas of the World (Ayuk, *et al.*, 2007). In Nigeria, heavy weight loss and high mortality in goat due to lack of forage during the dry season are common in livestock farms. Multipurpose trees and shrubs fodders are important feed resources for bridging the seasonal deficit in feed quantity and quality (Okagbare, *et al.*, 2005). Francis (1988) reported that some flocks were controlled by tethering to avoid crop damage during the cropping season in Southeast Nigeria. (Okagbare, *et al.*, 2004) showed that *Gmelina arborea* leaves are rich source of protein with high content of protein (22.29%) and high ash (6.28%). This high nitrogen content of these tree species contributes to improving the nutritional quality of the diet of grazing ruminants (Adoeye, 2004). Osakwe and Smith, (2004) reported that there have been few grazing trials in the country to determine productivity of pasture and small ruminant performance, they suggested the planting of browse species such as *Leucaena leucocephala*, *Gliricidia sepium* and *Gmelina arborea* as hedgerows of alleys in native or productive permanent grass species which may overcome the constraint to animal production caused by lack of fodder in the dry season. (Sansacy and Emery, 2002) suggested that in order to reduce competition between man and livestock for feeding stuffs, non-conventional feed ingredients should be exploited and used for livestock feeding.



Browse from trees and shrubs plays an important role in feeding ruminants in many parts of the world and there has been considerable research into the nutritional properties of many tropical fodder species. However, while there is growing interest in exploiting tree fodder as an extra resource from trees planted for other purposes, comparatively little is known about the potential of tropical browse species, the preference for browsing particular tree species or the impact of browsing on the trees. The composition of tree fodder varies depending on a range of factors including tree species and cultivars, season, age of growth, climate, and plant part utilized. .

Evaluation of the blood profile of animals may give some potentials of a dietary treatment to meet the metabolic needs of the animal since according to (Church *et al.*, 1984), dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inference on the nutritive value of feeds offered to the animals. The assertion of Okoruwa, *et al.*, (2016) that most of the available information on haematological parameters of goats in the humid tropics is based on disease prognosis. The various functions of blood are made possible by the individual and collective actions of its constituents the biochemical and haematological components. Hence the objective of this study is to investigate the Physiological Haematological and Serum biochemical indices in WAD goat fed browse with *Gliricidia* hay basal diets

MATERIALS AND METHOD

Experimental Site

The experiment was carried out at the experimental site of Pasture and Range unit of Department of Animal Production of the College of Agricultural Sciences, Olabisi Onabanjo University, Isa- Ope Campus, Ayetoro, Ogun state. It is located within longitude 2° 45' E and 3° 5' E, latitude 6°, 55,' N and 7°, 15,' N at altitude, 90-120 meters above sea level .Climate/Vegetation:- sub-humid forest mosaic savanna type with an annual rainfall of 1,945.3mm. Rainy season is between early May and November. Maximum temperature varies 29°C during the peak of the wet season and 34°C at the onset of the wet season and the mean relative humidity is 72.81% while evaporation is 1806.9mm,, soil type:- oxic paleustalf . (soil texture: sandy loam) (Ogungbesan, *et al.* , 2024)

Table 1: Soil Chemical and Physical Parameters

PARAMETER UNIT	VALUE
CHEMICAL	
NaCmo ¹ kg ⁻¹	50
KCmo ¹ kg ⁻¹	22
CaCmo ¹ kg ⁻¹	95
MgCmo ¹ kg ⁻¹	86
PMgKg ¹	6.86
Zn MgKg ¹	6.75
N%	0.79
Organic Carbon%	0.79
Organic Manure%	1.19
H ⁺	0.13
C.E.C	2.7
pHH ₂ O	5.5
PHYSICAL	
Sand%	75.16
Clay%	15.57
Silt%	9.25

The entire area is made up of undulating surface, which is drained mainly by River Rori and River Ayinbo (Ogungbesan, *et al.* , 2024)

Experimental Feed Materials:

From the Pasture and Range section of the farm ,forages (*Leucaena leucocephala*, *Gliricidia sepium*, *Gmelina arborea* and *Pennisetum purpureum*) were harvested and browses sorted into leaves (leaves plus fine stem up to 6mm in diameter,(Ogungbesan, *et al.* ,2016) while the



Pennisetum purpureum the plants cut at 30 cm above ground to achieve good quick regrowth (Teutsch,2009). Leaves were allowed to wilt over night before feeding. Another set of *Gliricidia* were harvested sorted as above were air dried into hay.(Ogungbesan, *et al* .,2016)

Pen Management:

The pens (3.5mx3.5m) and metabolism cages were swept and dusted. They were later fumigated with Dettol Chloroxylonol®, a strong antiseptic disinfectant manufactured by Reckitt Benckiser ogun state, Nigeria at the rate of 27ml to 1 liter of water and also with Diazintol (Diazinon Dimpylate® a strong and broad-spectrum insecticide manufactured by Alfasan International B.V. Holland, acaricides and larvicides at the rate of 2ml to 1litre of water). Wood shaven were later spread on the floor of pens. (Ogungbesan *et al* .,2016)

Experimental Animals and their Management

Sixteen (8 bucks and 8 does) West African Dwarf goats breed and aged between 4 and 7 months with an average initial live weight of 5.79 ± 0.60 kg were used in this experiment. The goats which were sourced from home stead and local markets within and outside the station's environs were on arrival, lairaged in the adaptation pen where they were, prior to the commencement of the experiment, dewormed with Levaject (Levamisole®) intramuscularly at 1ml/20kg, Ivomec (Ivermectin®) subcutaneously at 1ml/40kg around the shoulder blade. (Ogungbesan, *et al* .,2016) Terroxy L.A. (Oxytetracyclin® long Acting at 1ml/10kg was applied intramuscularly; they were also dipped in Diazintol (Diazinon®)solution and Tanvit (Multivitamin ®and anti-stress) was administered intramuscularly at 3ml/animal. During the last 2weeks of the 12 (twelve) weeks of the experiment, the animals were transferred to modified metabolism cages (0.9m x 0.75m x 0.9m) (Ogungbesan, *et al* .,2014);

Table 2: Feed Component and Dietary Treatments Allocation

Materials	T1	T2	T3	T4
<i>Pennisetum purpureum</i> (Pp)	40	-	-	-
<i>Gliricidia Sepium</i> (FGs)	-	40	-	-
<i>Leucaena Leucacephala</i> (FLI)	-	-	40	-
<i>Gmelina arborea</i> (FGa)	-	-	-	40
<i>Gliricidia Sepium</i> (HGs)	40	40	40	40
Forage (LI + Gs) 4% body weight (80)	80	80	80	80
Concentrate 1% body weight (20)	20	20	20	20
Total	100	100	100	100

T1=FP-HG,T2=FG-HG,T3=FL-HG,and T4=FGa-HG

The animals were divided into 4 treatments groups of animal each based on their sex, age and were also balanced for their weight. Each group was randomly assigned to one of the four (4) treatments and the experiment was in a Completely Randomized Design (Ogungbesan, *et al* .,2015) Each animal was fed twice daily at 0800hours (GMT) and 1400 hours (GMT) with forage allowance (browse and hay) at 4% of their body weight and concentrate allowance at 1% of their body weight. The feed allowance (forage and concentrate) was adjusted as the animals changed weight. Fresh drinking was available ad libitum. Each component was served in separate containers from the Month of January to Month March (Ogungbesan, *et al* .,2016)



Table 3: Ingredient Composition of Concentrate Diets

Ingredients	Percentage
SBW	20
CO	20
GC	20
PKC	15
BDG	15
SBM	5
FM	0.5
OS	2.5
BM	1
TS	1

SBW= Sorghum brewer's waste , CO= Corn offal ,GC= Groundnut cake,PKC = Palm kernel cake ,BDG=Brewer's dry grain, SBM= Soya bean meal, FM= Fish meal, OS= Oyster shell, BM=Bone meal ,TS =Table salt .

Collection of Blood

The animals were left to adjust to the feed in the 1st 2 weeks of feeding in metabolism cage, then blood samples were collected . The blood samples were taken by venipuncture of the jugular vein into two different containers at a time from each animal. Blood for haematological indices was collected into bijou bottles containing Disodium salt of Ethylene diamine tetraacetic acid (EDTA) as anticoagulant, while blood for serum biochemical was collected into universal bottles, and allowed to clot at room temperature and the serum separated by centrifugation at 2, 300 rpm for 10minutes. All samples were kept in the refrigerator and aliquot were taken for analysis.(Ogungbesan, *et al.*, 2016, 2020)

Hematological Parameters Analysis

Five milliliters of blood were collected into bijou bottle. Electronic particle counter was used to obtain the total erythrocyte (R.B.C) and leukocyte (W.B.C) counts and its components, Red blood cell (RBC) and white blood cell (WBC) were measured using the improved Neubauer haemocytometer after appropriate dilution . Ogungbesan *et al.*, 2009 2016, 2020 Haemoglobin concentration (Hb) was determined through Drabkins Solution. (Ogungbesan, *et al.*,(2009) , Ogungbesan, *et al.*, (2016), Ogungbesan, *et al.*, (2020)) .

Packed cell volume (P.C.V) was determined by microhaematocrit technique; this involved spinning of 75 mm long by 1-1.2mm diameter capillary tubes filled the $\frac{3}{4}$ mark with jugular blood using microhaematocrit centrifuge at 10,000 rpm for 5minutes. Blood smears for differential was made, leucocytes count was prepared for each sample and leucocytes were counted from each smear. Mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) were calculated from PCV, Hb and RBC values (Ogungbesan, *et al.*, 2009 , Ogungbesan, *et al.*, 2016, Ogungbesan, *et al.*, 2020) .

Serum Biochemistry Analysis.

Albumin, Bilirubin, Serum Glutamate Pyruvate Transaminase (SGPT), Serum Glutamate Oxaloacetate Transaminase (SGPT) and Alkaline Phosphatase (ALP) were analysed spectrophotometrically by using commercially available diagnostic kits (RANDOX® Test Kits). (Ogungbesan, *et al.*, 2009 , Ogungbesan, *et al.*, 2016, Ogungbesan, *et al.*, 2020) .

Physiological Indices

Digital thermometer was used to measure the body temperature value via the fore limb armpit of the goats. Rectal temperature was measured with the digital thermometer placed about 2 cm in the rectum, while pulse rate was measured in beats per minute using a stethoscope placed on the 4th half intercostal space. Respiratory rate was measured in breaths per minute by counting the number of flank movements per minute using a stop watch and stethoscope. The relationship between pulse rate and respiratory rate together with their normal average values was used to derive log transformed heat stress index (HSI) according to (Olademeji, *et al.*,1996) as follows:



$H = (AR/AP) \times (NP/NR)$
Where H = Heat stress index.
AR = Average respiration.
AP = Average pulse rate value.
NP = Normal pulse rate value.
NR = Normal respiratory rate.

Statistical Analysis :

All data generated were analyzed using completely randomized design or one –way ANOVA according to the general linear model in Statistical Analytical System (2002). Significantly difference means were compared using least significant difference method at 0.05 level of significant. The linear model is:-

$$X_{ij} = \mu + \alpha_i + e_{ij}$$

μ = Grand population mean

X_{ij} = individual data generated from the fixed treatments effects

α_j = the fixed treatments (forages combinations 1 to 4) effects

e_{ij} = the error (replicate) term within each treatment (SAS ,2002).

RESULTS AND DISCUSSION

Proximate Composition of Elephant Grass, Browsers and Concentrate Fed during the Experiment

As shown in table 4 below the dry matter (%FM) ranged from 28.94 in FGA to 91.08 in Conc. the DM is the fresh matter fed less the water content which is a function of all other components like CP, CF, CA ,NFE ,Cf,(crude fat). The difference could be attributed to proper stage of harvesting, differences in the type, quantity, chemical composition and DM content which maximizes the nutritive value of feed [Zagi and Mahmud 2022] .Other factors affecting the DM include .The variability among the species well established in that it is one the factor influencing the chemical composition of herbages. (Ogungbesan *et al.*, 2014 Other indices of variability include vegetation, climate, plant parts, age, season, edaphic factors like soil moisture. fertility, fertilization liming and pH, post-harvest treatments, growing conditions (water stress, drought stress, photo periodic (Ogungbesan *et al.*, 2014) ,as well as laboratory analytical dissimilarities with forage yield and leaf to stem ratio (Ogungbesan *et al.*, 2014. Furthermore Accumulation of mineral elements as part of dry matter in plants depends on soil properties, total and plant-available amounts of elements, cultivation and fertilization system, climate, as well as plant properties . Moreover, various plant species have a different ability to accumulate mineral elements, even if they are grown under the same conditions (Ogungbesan *et al.*, 2014).The CP (%DM) or crude protein that is by far the most vital nutrient of the diets ranged from 7.23 in Pp to 22.56 in FGS is conveniently more than the critical 7 % CP recommended for ruminant animals by Ogunjemite and Ibhaze (2020) for optimum ruminal performance.The CF (%DM) which is the portion that houses the detergent component that increases the the fibre component utilization in term of Hemicellulose and Holocellulose (Cellulose) is directly inverse to crude protein that determineS the quality of feed. The crude fibre recorded minimum value of 10.33 in Coc. to maximum value of 25.73 in FLI, the fibre can acted upon by the microbes in the rumen through secretion of enzymes that will degrade the cell wall constituent to release the soluble carbohydrates for both energy of host animal and the microbes that are in turn ueds as microbial protein for the host animal (Ogungbesan, *et al.*, 2014). The crude ash (inorganic constituents) values forwarded included the silica added ash iin the silica free ash also impart a lot of usefulness and effeciency of utilization as silica though common in tropical feed are of less nutritional importance as compared with other elements either major macro,minor macro, major micro or minor micro. (Ogungbesan, *et al.*, 2013, Ogungbesan, *et al.*, 2014), the inorganic part ranged from 1.97 in Pp to 12.64 in FGa .The last indices of the chemical composition is the most concentrated carbohydrate or energy part called the NFE (%DM) was highest in FEG (61.93) , and lowest in the FLL (39.04).The value in FEG is pre supposes the more reason the grass is being used



essentially in the establishment of forage dry season preservation “Energy Bank”, while that lower quantity in FLL would definitely be compensated for through the degradation of the Cell wall of the legume of the Holo-cellulose or cellulose and the lignin components which comprised of the “non-core lignin” that is degradable to generating more energy for both the rumen microbes and the host animals. (Ogunbesan *et al.*, 2014).

Table 4 Proximate Composition of Elephant Grass, Browse and Concentrate Fed during the Experiment

Components	Elephant grass	FGS	FLL	FGA	GS H	Conc.
Dry Matter (%FM)	33.76	31.32	30.67	28.94	87.00	91.08
Crude Protein(%DM)	7.23	22.56	20.48	20.86	19.57	21.20
Crude Fiber (%DM)	22.49	21.03	25.73	13.57	23.68	10.33
Crude fat (%DM)	1.97	5.35	6.82	12.64	3.43	8.45
Crude ash(%DM)	6.38	9.25	7.93	5.83	11.76	12.36
NFE(%DM)	61.93	41.81	39.04	47.55	41.56	47.66

FEG= Fresh Elephant grass FGS= Fresh *Gliridia sepium*, FLL= *Leucaena leucocephala*, FGA= *Gmelina arborea*, GSH= *Gliridia sepium* Hay. Conc.=Concentrate

Effects of Treatments on the Mean Physiological variables of WAD Goats Fed Browse and *Gliridia sepium* Hay Basal Diets.

As shown in Table 5 below, the pulse/heart rate (beat per minute bpm) ranged significantly ($P < 0.05$) from T3(120.93) to T4 (132.45) that is with the normal range of 60-150. implies that of the combination there was none with tachycardiac abnormally increase in the heart rate (Tachycardia) or abnormally decrease in the rate (Bradycardia) but rather Eucardia which is normal rate that compares favourably to the records of authors like that of Akinsola, *et al.*, (2013) and Iyeghe – Erakpotobor, *et al.*, (2013) ie increase heart of pulse rate property, active ingredient or bioactive ingredients (Abdullahi, *et al.*, 2014). The next parameters is body temperature ($^{\circ}\text{C}$) where lowest ($P > 0.05$) and highest ($P > 0.05$) was recorded in T3 (37.34) and T4 (38.10) respectively which also fall within the normal range of 37-40 that from the rectum ($^{\circ}\text{C}$) also ranged insignificantly from T2 (38.150c) to T3 (38.83 $^{\circ}\text{C}$). Since the values are not different from that of the control, it implies that the test diets and or its interaction do not have or potentiate any bioactive substances or plant secondary metabolites or phytochemicals, etc (Abdullahi *et al.*, 2014) that can neither cause abnormal diet induced low temperature (Hypothermia) nor abnormal high temperature (Hyperthermia). Moreso, that range of the recorded temperature values are comparably within the prescribed normal value. (Akinsola, *et al.*, (2013) and Iyeghe – Erakpotobor, *et al.*, (2013) On that Table 5 also is respiratory rate (beat per minute (bpm)) which was significantly lowest ($P > 0.05$) in T4 (33.61) and highest significantly in T1 (39.75) and these values are comfortably within the normal range of 20-40 which scientifically presupposes that test diets or their combinations do not have ingredient of allelochemicals that cause or potentiate abnormally pathological increase respiratory rate (hyperpnea) or decrease rate Hypopnea). Lastly, on the table is Heat stress index which is the value of relationship among normal and average respiratory and pulse rate respectively that must not be up to or more the than range of .65-72 or else it will potentiate a disorder.

Table 5: Effects of Treatments on the Mean Physiological variables of WAD Goat Fed Browse and *Gliricidia sepium* Hay Basal Diets.

Parameters	TREATMENTS				SEM	Normal Range
	T1	T2	T3	T4		
Pulse Rate(bpm)	130.50 ^a	130.00 ^a	120.93 ^b	132.45 ^a	4.69	60-150
RTC	100	99.61	92.66	101.49		
Body O°	37.70	37.85	37.34	38.01	0.63	37-40
RTC	100	100.40	99.05	100.82		
Rectal O°	38.18	38.15	38.83	38.68	0.42	37-42
RTC	100	99.92	101.70	101.31		
Resp.Rate(bpm)	39.75 ^a	37.49 ^a	38.95 ^a	33.61 ^b	2.76	20-40
RTC	100	94.31	97.99	84.55		
HIS	16.81 ^b	17.48 ^b	15.06 ^c	19.21 ^a	0.85	65-72
RTC	100	103.99	89.58	114.27		

abc:Means in the same row with different superscripts differ significantly ($P < 0.05$) Rtc=Relative to control

Haematological Parameters of West Africa Dwarf Goats Fed Browse with *Gliricidia* Hay Basal Diets.

Table 6 below shows the haematocrit or Packed cell volume (%) that is a metric representation of the quantity of volume the red blood cells occupy in relation to the overall volume of blood in a sample of capillary, venous, or arterial blood. Low PCV can lead to haemodilution and also potentiate anaemia while high PCV can also be used as an indicator of dehydration in non-anaemic patient. Haematocrit was significantly highest ($P < 0.05$) in T3 (26.75) and lowest ($P < 0.05$) in T1 (26.75) and are within the normal range 21-35. The Erythrocyte ($\times 10^6/\mu\text{l}$) ranged ($P < 0.05$) from T1 (12.80) to T3 (13.58) which is still within the reference values 7.38 to 13.62 (Daramola, *et al.*, 2005, Ogungbesan, *et al.*, 2009, 2016, 2020). Red blood cells, also called erythrocytes, are responsible for delivering oxygen throughout the body. Rbc indices are metrics that are crucial to diagnosing the underlying cause of anemia of either nutritional or parasitic origin (Ogungbesan, *et al.*, 2009). MCV, MCH and MCHC are considered RBC indices give details about average cell size, cell size hemoglobin content, and hemoglobin concentration, respectively (Ogungbesan, *et al.*, 2009). Furthermore, the lowest levels of red blood cells may be a sign of anemia, internal bleeding, inadequate iron / nutrients consumption, vitamin deficiency, or other health problems. But increase in RBC may be ascribed to high concentration of metabolite in the diet but erythrocyte count is greater than one high and indicative of high oxygen carrying capacity of the blood allaying the fear of occurrence of anemia (Ogungbesan, *et al.*, 2009).

Haemoglobin (g/dl) was ($P > 0.05$) lowest in T1 (6.75) and highest non significantly in T3 (7.65) while also falling with reference value of 5.2 to 8.00. There were no significant differences ($P < 0.05$) in the values of the haemoglobin concentration (Hb) of the goats. T3 had the highest Hb concentration, which indicate that the dietary treatments is capable of supporting high oxygen carrying capacity blood in goats. The values recorded in this study fell within the range of 6.75 -7.65 and they compare favourably with the range of 7-15g/dl reported for WAD goats by (Daramola, *et al.*, 2005). Ogungbesan, *et al.*, 2009, 2016, 2020)

The leucocyte or white blood cell count ($\times 10^3/\mu\text{l}$) depicted that there was no significant difference ($P > 0.05$) between the lowest T₂ (10.50) and the highest T₄ (10.93) despite being within the normal value of 6.80 to 20.10. From a functional perspective, circulating leukocytes, or white blood cells (WBC), belong to two systems: the phagocytic system and the immunocytic system. Studies have revealed, an elevated WBC (leucocytosis) suggests an immunological reaction against contamination or toxic chemicals from feed or other means in the body, whereas a smaller count (leucopenia) implies the presence of infectious infections or antigens in the body. (Ogungbesan, *et al.*, 2009, 2016, 2020). Next is the Lymphocytes (%) differential count in leucogram, is an integral part of the immunocytic system in the specific immune system. Its effector cells (ie, T and B lymphocytes) are responsible for both the production of humoral immunity in the form of antibodies directed against



specific antigens as well as cell-mediated immunity in the form of specific cytokine production. The immunocytic or specific immune system is comprised of the circulating lymphocytes. (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.* 2016, Ogunbesan, *et al.*, 2020) Cells of the immunocytic system respond specifically to antigens by undergoing clonal expansion and differentiation into highly specialized effector cells and memory cells where significant ($P < 0.05$) lowest and highest were observed in T2 (57.80) and T1 (62.50) respectively which is comfortably within the normal range of 47.000 to 82.00. (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan, *et al.*, 2020). Monocytes (%) or the phagocytes (ie, granulocytes, monocyte/macrophage continuum) are the first line of defense against invading microorganisms; they are attracted to sites of infection and, by the process of phagocytosis, ingest and destroy bacteria and other agents on contact. Therefore, the phagocytes can be thought of as the non-specific immune system (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan, *et al.*, 2020). Furthermore, Monocytosis are phagocytic in nature and will increase the tolerance and resistance level of animals to infectious diseases. Its content was lowest significantly in treatments 1, 2 and 4 having 1.75 and T3 having highest value of 2.25 in which all the values are also in the referenced range 0 to 5 (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan, *et al.*, 2020). Last differential count of leucocyte measured was Neutrophils, these are primarily function as phagocytes, it is noteworthy that these cells also function as secretory cells. Both when fusion of granules with phagocytic vacuoles occurs and when effective neutrophils breakdown, biologically active molecules are released. but must not be usually low such that the system will not be able to fight against any inclement or unhealthy condition. (Ogunbesan *et al.* 2016, 2020). The neutrophilia (abnormal high level of neutrophil in the blood) is almost always associated with defence against infectious. (Ogunbesan, *et al.* 2009) and there were significant difference in neutrophils ($P < 0.05$) between T4 the lowest (32.50) and T₃, (38.30), the range is also favourably compared to the reference range of 17.00 to 52.00. (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan, *et al.*, 2020)

Other derivatives of Erythrogram measured are MCV (fl) AND MCHC (%) were significantly ($P < 0.05$) lowest and highest in T1 (17.00) and T1 (25.38) as well as T3 (20.31) and T1 (31.50) respectively., falling between the reference values of 15.50 and 30.00 as well as 22.72 and 36.00 (the lowest and highest limit of value of MCHC are from the two different authors viz Ajala, *et al.*, (2000) and Daramola *et al.*, (2005). MCV determines the red blood cell's size, The haemato-physiological implication of this is that there could not have been once again any form of anaemia be it macrocytic, normocytic, microcytic, normochromic or hypochromic (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan *et al.*, 2020). while the MCHC (g/dl) really gives the actual amount of haemoglobin in RBC while the abnormally high hemoglobin in plasma leads to high viscosity and low oxygen uptake, abnormal conjugation of hemoglobin and haptoglobin can lead to hyper haemoglobinuria (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2016, Ogunbesan, *et al.*, 2020).

The last Erythrocyte derivatives measured was MCH (pg) with similar ($P > 0.05$) least value and highest values in T1 (4.50) and T3 (5.75) respectively that are also conforming with the reference range of 2.02 to 8.00. MCH is mostly associated with hemoglobin concentration. Decreased MCH causes hypochromic anemia because of a deficiency of iron in the diet. Increased MCH may be caused during hemolysis where extracellular hemoglobin level increases (Ogunbesan, *et al.*, 2009, Ogunbesan *et al.*, 2016, Ogunbesan, *et al.*, 2020)

Table 6: shows the Haematological Characteristics of West Africa Dwarf Goats Fed Browse with Gliricidia Hay Basal Diets

Parameters	TREATMENTS				SEM	Normal Range
	T1	T2	T3	T4		
PCV(%)	21.5 ^c	24.5 ^b	26.75 ^a	24.25 ^b	0.06	21-35
RTC	100	113.95	124.42	112.79		
RBCx10 ⁶ µl.	12.8 ^{ab}	12.98 ^{ab}	13.58 ^a	13.43 ^a	0.59	7.38-13.62
RTC	100	101.41	106.09	104.92		
Hb(g/dl)	6.75	7.53	7.65	6.88	0.29	7-15[5.2–8.0]1
RTC	100	111.56	113.33	101.93		
WBCx10 ³ µl.	10.82	10.50	10.72	10.93	0.12	6.8-20.1
RTC	100	97.04	99.08	101.02		
Lymphocytes(%)	62.5 ^a	57.8 ^c	60.3 ^b	61.0 ^b	0.3	47-82
RTC	100	92.48	96.48	97.6		
Monocytes(%)	1.75	1.75	2.25	1.75	0.5	0-5
RTC	100	100	128.57	1.75		
Neutrophils(%)	33.5 ^c	36.5 ^b	38.3 ^a	32.5 ^d	0.09	17-52
RTC	100	108.96	114.33	97.01		
MCV (fl)	17.0 ^d	19.5 ^b	20.31 ^a	18.15 ^c	0.2	15.5-30
RTC	100	114.71	119.47	106.76		
MCHC(%)	31.5 ^a	30.88 ^a	25.38 ^c	28.38 ^b	0.06	30-36 [22.73-25.07]2
RTC	100	98.03	80.57	90.10		
MCH(pg)	4.5	5.0	5.75	5.13	0.2	5.2-8.0 [2.20-8.0]3
RTC	100	111.11	127.78	114.00		

abc:Means in the same row with different superscripts differ significantly (P<0.05) Rtc=Relative to control abc:Means in the same row with different superscripts differ significantly (P<0.05)

Where

WBCs = White blood cells, RBCs = Red blood cells, PCV = Packed cell volume, Hb = Haemoglobin, MCHC = Mean corpuscular haemoglobin concentration, MCV= Mean corpuscular volume, MCH= Mean corpuscular haemoglobin

Source: (Daramola, *et al.*, 2005, 1=Adebayo, *et al.*., 2021,2=Ajala, *et al.*, 2000, 3= Shahab, *et al.* (2017))

Serum Biochemistry Parameters of West African Dwarf Goat Fed Browse with Gliricidia Hay Basal Diets.

First to be considered on the list of the Serum biochemical parameters measured is the Protein (g/dl) as usual the “ The Proto amine ie the first amine “ happens to have the highest similar (P>0.05) value for in T4(6.88) and lowest in T3 (7.7) falling within the normal value of 6.3 to 8.5 The high serum total protein in animals could reflected to the nutritional adequacy and safety of the test diets which agrees with the report of Okoruwa, *et al.*, (2016) who found that total protein syntheses in animals are related to the amount of protein present in the diets. The protein differential count analysed for is Globulin(g/dl) having also non-significantly (P>0.05) highest value in T1(3.60) and lowest in T3 (4.3) ranging also within the reference limits of 2.7 to 3.9 Globulins, term for proteins in the blood other than albumin calculated as Total Protein minus Albumin, globulins are the other major protein fraction. If abnormally high depicts Infections, multiple myeloma but if unusually low signifies Leukemias, immunosuppression. (Reed, 2017). Much as it is involved in immunology, if its ratio, that is Albumin/Globulin is abnormally high then it mean hepatopathies and nutritional disorders are occurring perniciously while the commonly determined second differential that is the Albumin(g/dl) was also non-significantly ranging from 3.20 in treatments 2 and 4 and to 3.55 in Treatment 1 and also compares favourably with the normal range of 2.8 to 4.3. (Kaneko, *et al.*., 2008 , Reed, 2017). Albumin is one of the major types of protein made by the liver and its level in the blood reflects both dietary intake of protein and the liver's ability to make proteins.. Albumin level is a general indicator of health and nutritional status (Kaneko, *et al.*., 2008 , Reed, 2017) . If



high, it shows dehydration, infection, malignancy and if low indicating sickness starvation, burns, kidney disease, liver disease. (Kaneko, *et al.*, 2008, Reed, 2017) The AST or GOT /Glutamate oxalo-acetate transaminases / SGOT/ SERUM Glutamate oxalo-acetate transaminases significantly ($P < 0.05$) ranged from 316 in T1 to 377 in T4 and they fall within the reference range of 167 to 513. which is suggesting that none of the combinations has no damaging effects on vital organs, specifically heart, and generally kidney, liver etc, because the enzyme is liberated prominently in cardiotoxicity or heart injury and to an extent in moderate or low injury to kidney and liver (Kaneko, *et al.*, 2008, Ogungbesan, *et al.*, 2009, Reed, 2017, Ogungbesan, *et al.*, 2020) Hence it is a specific heart function test.

ALT OR Gamma Glutamyl Transferase (GGT) or Serum Gamma Glutamyl Transferase (GGT) was lowest ($P < 0.05$) in T1 with 22.00 and highest ($P < 0.05$) in T4 with a value of 24.75 comparable to 22 to 49 normal range. S Gamma Glutamyl Transferase (GGT), the highest activity of GGT is in bile ducts epithelium and in kidney. (Kaneko, *et al.*, 2008, Ogungbesan *et al.*, 2009 and Reed, 2017, Ogungbesan, *et al.*, 2020,) The enzyme is located in membrane structures of the cells. (Kaneko, *et al.*, 2008, Ogungbesan, *et al.*, 2009, Reed, 2017, Ogungbesan *et al.*, 2020) The increased serum activity of GGT is usually associated with cholestasis and bile ducts damage. Very high activity of GGT is also in colostrum of cattle, sheep and goat (Klinkon and Ježek 2012) Hence it is a specific liver function test.

ALP otherwise known as SALP (Serum alkaline phosphate), ranged significantly from 79.25 in T2 to 105.00 in T1 conforming to the reference values of 93 to 387. Serum alkaline phosphate (IU/L) it is used in diagnosis of liver injury or damage. In adult animals activity of SALP can increase at increased activity of osteoblasts. (Kaneko, *et al.*, 2008, Ogungbesan *et al.*, 2009 Reed, 2017 and Ogungbesan, *et al.*, 2020). Activity of ALP is increased at acute and chronic liver diseases (especially cholestatic hepatopathias) and in diseases of bones (rachitis, periostitis). (Klinkon and Ježek 2012) All the same, it indicates that all feed combination allowance had little or no osteolytic tendencies (Anbarasu, *et al.*, 2002) and hepatotoxic or hepatocytolytic properties because it is used in diagnosis of liver injury or damage (Kaneko, *et al.*, 2008, Ogungbesan, *et al.*, 2009, Reed, 2017 and Ogungbesan *et al.*, 2020) Other serum biochemical Parameters verified are Blood urea nitrogen (mg/dl) which was significantly ($P < 0.05$) lowest in T4 (13.6) and highest ($P < 0.05$) in T1 (18.55) but also comparable to the two limits of 10 and 20 , A waste product from protein breakdown formed by the liver and excreted by the kidney often considered with creatinine to evaluate kidney function (Kaneko, *et al.*, 2008, Ogungbesan, *et al.*, 2009 , Reed, 2017 and Ogungbesan, *et al.*, 2020) and the concentration of urea in blood depends from nutrition, diagnostically is important also at diseases of kidneys .Diagnostically, if higher than normal it implies Kidney dysfunction, stress and high protein diets and if lower than normal it denotes low protein diets and liver disease (Kaneko, *et al.*, 2008 , Ogungbesan, *et al.*, 2009 Reed, 2017 and Ogungbesan, *et al.*, 2020) Creatinine (mg/dl) values monitored was similar among the treatment in that the lowest ($P > 0.05$) was T4 (1.18) and highest ($P > 0.05$) in T2 (1.25) falling conveniently between accepted limit of 0.7 and 1.5. Creatinine is a waste product from the muscles (voluntary and involuntary) breakdown of a compound called creatine, which is excreted into urine by the kidneys (Kaneko, *et al.*, 2008, Ogungbesan *et al.*, 2009 Reed, 2017 and Ogungbesan *et al.*, 2020) .To evaluate kidney function and monitor therapy for kidney disease; creatinine may be measured in blood, urine or both to evaluate kidney function and Kidney dysfunction which may be due to a variety of different causes such as drug/feed toxicity, poorly controlled diabetes or inadequate blood flow through the kidneys as seen with shock or congestive heart failure. (Kaneko, *et al.*, 2008, Ogungbesan *et al.*, 2009 Reed, 2017 and Ogungbesan *et al.*, 2020)

The total bilirubin (mg/dl) measured ,ranged non significantly ($P > 0.05$) from 0.13 in both treatments 1 and 3 to 0.35 in T2 incidentally conforming to the reference limits of 0-1.17 Total serum bilirubin is formatted by enzymatic decay of haeme at disintegration of mature erythrocytes (Kaneko, *et al.*, 2008) These processes are taking course in spleen, liver and bone marrow.(Kaneko, *et al.* , 2008 and Reed, 2017) Hyperbilirubinemia could be due to liver diseases (e.g., hepatitis, fatty liver) and haemolysis due to infections or feed toxins. Obstructive jaundice (bile duct blockage) (Kaneko,



et al., 2008, Reed, 2017) while Hypobilirubinemia which rarely occurs in field condition could suggests reduced red blood cell turnover, severe iron deficiency anemia and malnutrition or overhydration as well as excessive antioxidant supplementation (Kaneko, *et al.*, 2008, Reed, 2017) The last but not the least metabolites on the table is the differential /direct bilirubin (μmol) was similarly lowest 2.8 in T4 and highest 3.50 in T2 though ranging comfortably in the normal range of 0-5. Direct bilirubin (Conjugated bilirubin) The conjugated form is water-soluble, made in the liver and excreted in the blood; it reacts directly with diazo dyes, so it is called direct reacting To test the liver's ability to conjugate bilirubin and excrete it (Kaneko, *et al.*, 2008, Reed, 2017).The similar trend in the last three variables in terms of their non significance and the general picture painted in terms of the response from respective combinations and hence treatments allude to the fact that the treatments components or combinations can successfully be adopted for the sustainability of small ruminants especially goats. In essence, Grass/legume concentrates combinations (Ogunbesan, *et al.*, 2009, Ogunbesan, *et al.*, 2012 Ogunbesan *et al.*, 2013) Browse legume-Browse legume combinations (Ogunbesan, *et al.*, 2012, Ogunbesan *et al.*, 2013) and Non browse legume-Browse legume combinations i.e. the present study . This development is a forerunner of Hay combinations of the above, Silage combinations of the above and even value-added technology of the above combinations into Total mix ration, Total mix pellet etc. Lastly, the exploration of Grass-Grass combinations with or without concentrate especially in the rainy season at the pre-bloom stage of the grasses.

Table 7: Shows the Serum Biochemistry Parameters of West African Dwarf Goat Fed Browse with Gliricidia Hay Basal Diets.

Parameters	TREATMENTS				SEM	Normal Range
	T1	T2	T3	T4		
Total Protein(g/dl)	7.1	7.3	7.7	6.88	0.4	6.3-8.5
RTC	100	102.82	108.45	96.90		
Globulin(g/dl)	3.6	4.1	4.3	3.9	0.3	[2.7-3.9]
RTC	100	113.89	119.44	108.33		
Albumin(g/dl)	3.53	3.20	3.40	3.20	0.4	2.8-4.3
RTC	100	91.43	97.14	91.43		
AST	316 ^d	349 ^b	336 ^c	377 ^a	0.1	167-513
RTC	100	110.44	106.33	119.30		
ALT	22.0 ^c	23.3 ^b	24.25 ^a	24.75 ^a	0.5	22-49
RTC	100	103.99	89.58	114.27		
ALP	105.5 ^a	79.25 ^d	88.5 ^c	96.75 ^b	0.3	93-387
RTC	100	75.12	83.89	91.71		
BUN(mg/dl)	18.55 ^a	14.56 ^c	16.15 ^b	13.6 ^d	0.2	10-20 REF1
RTC	100	78.49	87.06	73.32		
Creatinine(mg/dl)	1.2	1.25	1.18	1.10	0.3	0.7-1.5 RTEFS1
RTC	100	104.17	98.33	91.67		
T.Bil(mg/dl)	0.13	0.35	0.13	0.33	0.07	0-1.71 REF
RTC	100	269.23	100	253.85		
D.Bil($\mu\text{mol/L}$)	3.5	3.5	3.3	2.8	0.5	0-5.134
RTC	100	100	94.29	80.00		

abc: Means in the same row with different superscripts differ significantly ($P < 0.05$) Rtc=Relative to control
 AST= Aspartate transaminase, ALT= Alanine transaminase, ALP= Alanine phosphatase, BUN= blood urea nitrogen. Sources: 1=Kaneko, *et al.*, 2008 .

CONCLUSION AND RECOMMENDATION

From the result, it can be concluded that feeding WAD goats with some browses both in fresh and preserved form .combinations involving conventional Grass legume concentrate and legume legume concentrate as well as non-legume browse -legume browse concentrate mixture can be utilized by WAD GOATS .The legume-legume can be fed in different form either fresh or preserved



without any disorder that can potentiate sub clinical or overt clinical symptoms which will exacerbate production and or reproduction.

It is hereby recommended that practice managements, environmental and social factors that will increase the production of Grasses, Legume, Browse and agronomical practices that will engender the production of crops and its by-products for concentrate production. The design of browse system production for generation products and byproducts, for diverse usefulness and services should be encouraged.

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