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Haematology and Serum Biochemistry of Rams Fed Developed Total Mixed Rations Formulated Agricultural Waste Using Value Addition Science Technology (VAST).

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Abstract

The study is aimed to evaluate the effect developed total mixed rations formulated agricultural waste using value addition science technology (VAST) on for a period of 84 days. A total of twenty-five (25) fattening rams were used for this study. The Rams randomly assigned to five treatments of five rams each. The fed developed total mixed rations formulated as T1, T2, T3, T4 and T5. for a period of 84 days The amount of feed that was offered minus the amount that was refused was used to calculate feed intake. Ad libitum water was provided. At the end of the experiment, three (3) animals from each treatment were selected and fasted. There were no significant (P>0.05) differences among the treatments for Packed Cell Volume (PCV), Haemoglobin (Hb), Red Blood Cell value (RBC), White Blood Cell count (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and White Blood Cell differential (all the parameters measured were within the reference values). The Direct Bilirubin, Conjugated Bilirubin, Albumin, Globulin, Cholesterol, blood urea, Aspartate Aminotransferase (AST), Alanine Aminotransferase, Alkaline phosphatase were significantly (P<0.05) different among the treatment groups. However, Total protein, Glucose, and Creatinine were not statistically (P>0.05) different among the treatment groups. Therefore, the study suggests that using agricultural waste-based total mixed rations formulated using value addition science technology is a viable option for feeding ruminants, as it does not have any adverse effects on the hematological and serum biochemical parameters of the animals.

Keywords: Haematology, Serum Biochemistry, Rams and Total mixed rations

Description of problem

This large population needs properly balanced diet to avoid malnutrition. Malnutrition has been the bane of healthy livelihood mainly as a result of shortage in Agricultural products. Animal protein is essential in human nutrition in order to solve the problem (1; 2). The livestock sector is a critical component of the agricultural economy in Nigeria, particularly in the semi-arid regions of Borno State in North East Nigeria. However, the productivity of these animals is often constrained by the availability and quality of feed resources, especially during the dry season when natural pastures are depleted.

Traditional feeding practices in the region primarily rely on crop residues, browses, and agro-byproducts, which are abundant but typically low in nutritional quality. According to (3), utilisation of these feed resources leads to severe emaciation and mortality of herds and flocks during the long dry season. To promote productivity of animals dependent on fibrous feed of low digestibility, degradability and nitrogen content as found in North East Nigeria (4), there is need to do nutritional evaluation of locally available feed ingredients as to develop appropriate feed techniques and rations which can be followed by farmers so as to find the best use of available feed stuff in Borno state north east Nigeria. (5) reported that crop residues browse plants and agro-industries by product can fill the gap of supply and demand for conventional feed resources in north east region of Nigeria.

Blood which is a important special circulatory tissue is composed of cells in a fluid intercellular substance (plasma) with the major function of maintaining homeostasis (6).. Blood composition of animal might be influenced by certain factors such as nutrition, management, and great of animals, sex, age, diseases and stress factors that might affect blood values (7). Blood is an important indicator of physiological and pathological changes in an organism (8). Therefore, this study aims to investigate and evaluate the effect of developed total mixed rations formulated agricultural waste using value addition science technology (VAST) on haematology and serum biochemistry of Rams.

MATERIALAND METHOD

Experimental Site:

The studies were carried out at the field laboratory and Livestock Teaching and Research Farm, Department of Animal Science, University of Maiduguri, Borno State. The state is geo-located in North-eastern Nigeria, the area lies within latitude 110 50'N and longitude 130 09'E and has an elevation of 320 m above mean sea level (9). The mean ambient temperature could be as low as 23 °C during the harmattan season and gets as high as 40°C or more during the hot dry season. Relative humidity is about 45% in August which usually drops to about 5% in the months of December and January and has precipitation of 203 mm/year. Day length varies from 11-12 hours (9). The State falls within the Sahel savannah vegetation zone. The State is one of the largest livestock producing area in Nigeria. Among the livestock produced in the area are cattle, sheep, goats, donkey, poultry and camels.

Experimental Animal and their Management

A total of twenty-five (25) fattening rams were used for this study. The animals were allowed to rest for three (3) weeks before the commencement of the trial for quarantine and adaptation period with experimental diets. The animals received prophylactic treatment against internal and external parasites. Experimental Diets. The gross composition of experimental diets was formulated. The experimental animals were fed total mixed ration at the rate of 4% body weight.

Experimental design and Feeding

The animals were allotted to five (5) treatments; five (5) animals were randomly allocated to each treatment. The animals were housed in individual pens with adequate ventilation. The animals were

Table 1: Formulations for Ram Fattening

Feed ingredients	T1	T2	T3	T4	T5
Cowpea husk	20	20	20	20	20
Groundnut haulms	20	20	0	20	0
Sorghum stover	0	0	20	0	20
Wheat offal	30	0	0	0	0
Maize bran	0	30	30	30	30
Cottonseed cake	25	25	25	0	0
Ziziphus Mauritania leaves	0	0	0	0	25
Faiherbia albida leaves	0	0	0	25	0
Bone meal	4	4	4	4	4
Salt	1	1	1	1	1

balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. The experimental diet was offered at 4% of body weight for a period of 84 days (12 weeks). Feed intake was determined as the difference of the amounts of feed offered and the refusals. Water was given *ad libitum*.

Blood Sample Collection for Haematological parameters and Serum Biochemistry Determination

At the end of the experiment, three (3) animals from each treatment were selected and fasted overnight (12 hours) and bled in the morning (7:00 – 8:00 am) to avoid excessive bleeding (10). Blood samples were collected from each animal's jugular vein using sterilized disposable (5 ml) syringe. Two separate samples bottle, in which one contains ethylene diamine tetra – acetic acid (EDTA) and the other one blank were used. The sample bloods collected in EDTA were used for haematological studies while the samples in plain bottles were used for serum biochemistry analyses. The samples in the test tubes were centrifuged for five minutes at 1400/rpm so as to separate the serum from the blood for serum biochemical analysis.

Haematological Parameters

Packed cell volume (PCV), red blood cells (RBC) count, white blood cells (WBC) counts, Leucocytes differential counts and haemoglobin concentration (HB) were determined in accordance with the methods outlined by (11).

Erythrocyte indices which include the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were computed in accordance with the standard formulae of (7) and (12) as shown below:

$$\text{MCV} = \frac{\text{PCV}}{\text{RBC Count in } 10^6 \text{ /mm3}} \times \frac{10}{1}$$

$$\text{MCH} = \frac{\text{Hb(g/dL)}}{\text{RBC in } 10^6\text{/mm3}} \times \frac{10}{1}$$

$$\text{MCHC} = \frac{\text{Hb}\left(\frac{\text{g}}{\text{dL}}\right)}{\text{PCV (\%)}} \times \frac{10}{1}$$

Serum Biochemical Analysis

The blood urea concentrations were estimated by Nessler's reaction. Serum total proteins were estimated by the biuret method

as described by Kohen and Allen (13). Albumins were determined by Bromo Cresol Green (BCG) method (14), while globulin concentrations were determined by difference between total protein and albumin. Albumin/globulin ratio were calculated by dividing albumin value by the calculated globulin value. Aspirate amino transferase (AST or SGOT), Alanine Amino transferase ALT or SGPT), alkaline phosphate (ALP) activities were determined using spectrophotometric method, as described by (15). Total bilirubin was determined using orbital techniques as described by (16).

Statistical Analysis

Data obtained from the all experiments were subjected to analysis of variance using completely randomized design (CRD) and significant difference between treatments means were separated using the least significance difference (LSD) at 5% level. Data

$Y_{ij} = \mu + T_i + ?_{ij}$

Where;

Y_{ij}= observation on the i^{th} treatment of the j^{th} random error,

μ = overall mean,

T_i = fixed effect of dietary treatment,

$?_{ij}$ = random error

Results and Discussion

The heamatological parameters of animals fed with different diets are shown in Table 2. There were no significant ($P>0.05$) differences among the treatments for packed cell volume (PCV), haemoglobin (Hb), red blood cell value (RBC), white blood cell count (WBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and white blood cell differential (all the parameters measured were within the reference values).

The pack cell volume, hemoglobin level, white blood cell count, red blood cell count, neutrophils, eosinophils, lymphocyte, and monocytes were all within a similar range for all diets, with no significant differences between the means. PCV value of sheep ranged from 28.43 to 30.67 %. The PCV values obtained in this study were lower than the finding of (17); (18) whose reported value 43.86% and 38-45% respectively, and (12) reported that PCV value the range value of 27 – 45%. The result generally showed growing and fattening sheep to have comparable the same PCV values which is in conformity with the finding of (19) stated the adults sheep to have higher values in PCV than in lambs, In the sheep, age exhibited remarkable influence on the PCV values. These findings suggest that all the diets tested in this study were nutritionally adequate and provided the necessary nutrients for the animals. The haemoglobin values were within the normal range (8 – 16g/d*l*) of haemoglobin for healthy sheep (20). Normally, increase in the Hb concentration is connected with better ability to stand firm with disease infection and low level is an indication of easily infection with disease and poor nutrition (21). The values obtained for PCV and Hb in all the treatment groups; this indicates nutritional adequacy of all diets since values did not indicate mal-or-under nutrition (22)The white blood cells (WBC) were within the normal range values of sheep 5.2 to 27.70 x 10^9/L and 6.93 – 12.66 x 10^9/L) as reported by (19) and (23) respectively. This trial showed that the animals were healthy because decrease in number of WBC below the normal range is an indication of allergic conditions, while elevated values

Table 2: Haematological Parameters of fattened rams on total mixed ratio formulated metabolite

Parameters	T0	T1	T2	T3	T4	SEM
Pack Cell Volume (%)	Parameters	T0	T1	T2	T3	T4	SEM
Pack Cell Volume (%)	29.67	28.67	29.33	30.67	28.43	4.30^{NS}
Hemoglobin (g/dl)	9.87	9.53	9.77	10.20	9.20	0.47^{NS}
White Blood Cell ($\times10^3$/L)	9.43	6.73	8.00	7.67	8.87	0.72^{NS}
Red Blood Cell ($\times10^6$/L)	9.57	10.13	11.00	10.07	10.87	0.58^{NS}
Neutrophils (%)	36.67	30.33	34.67	33.67	40.00	5.11^{NS}
Eosinophils (%)	1.33	2.00	0.67	1.67	1.00	0.93^{NS}
Lymphocyte (%)	62.00	67.67	64.00	64.67	58.67	5.04^{NS}
Monocytes (%)	0.3333	0.00	0.67	0.6667	0.00	0.21^{NS}

9.67aSEM = Standard error of means; a, b = Means in the same row bearing same superscripts no differ significantly (P<0.05) NS=Not significant (p>0.05);

(leucocytosis) indicate the existence of a recent infection, usually with bacteria (24). While the results of this study are useful in providing information on the blood metabolite levels of animals fed with different diets, it is important to note that there may be other factors that could impact the blood metabolite levels, such as stress, disease, or other environmental factors. Therefore, further research is needed to investigate the underlying mechanisms of these effects and to explore potential applications in animal production. These results suggest that the different diets did not have a significant impact on the animals' blood metabolite levels. The blood metabolite levels for all diets were within a normal range, indicating that the diets provided adequate nutrition for the animals.

Table 3: Serum biochemical analysis of fattened rams on total mixed ratio formulated

Parameters	T1	T2	T3	T4	T5	SEM
Direct Bilirubin (mmol/L)	2.8bc	2.4c	3.2ab	3.00ab	3.6a	0.2408*
Conjugated Bilirubin (mmol/L)	3.2b	4.2a	4.0a	4.1a	4.5a	0.2066*
Total Protein (g/L)	62a	58a	60a	64a	68a	5.6862^{NS}
Albumin (g/L)	28b	30ab	22c	27b	33a	1.2111*
Globulin (g/L)	34ab	28b	38a	37a	35a	1.9149*
Glucose (mmol/L)	4.8a	4.8a	4.6a	4.6a	4.6a	0.3742^{NS}
Cholesterol (mmol/L)	1.8bc	1.4c	2ab	2.4a	2.2ab	0.1357*
Urea/N (mmol/L)	5.2a	4c	4.2c	4.8b	5ab	0.0966*
Creatinine (µmol/L)	82a	81a	88a	86a	79a	3.1833^{NS}
Aspartate Aminotransferase (iu/L)	51b	76a	57sb	50b	59ab	6.4859*
Alanine Aminotransferase (iu/L)	30a	19b	32a	31a	33a	0.9661*
Alkaline phosphatase (iu/L)	48c	58bc	63b	60b	87a	3.2455*

SEM = Standard error of means; a, b = Means in the same row bearing same superscripts no differ significantly (P<0.05) NS=Not significant (p>0.05); *= Significant (P<0.05)

The serum biochemical indices of Rams fed experimental diets are presented in Table 3. The Direct Bilirubin, Conjugated Bilirubin, Albumin, Globulin Cholesterol blood urea, Aspartate Aminotransferase (AST), Alanine Aminotransferase, Alkaline phosphatase with diet different plant diets were significantly (P<0.05) different among the treatment groups. However, Total protein, Glucose, and Creatinine were not statistically (P>0.05) different among the treatment groups.

The results show that there were some differences in the serum biochemistry parameters between the different diets. The total bilirubin level was higher (P<0.05) in T5 and lowest in T2. The conjugated bilirubin level was highest in T5 and lowest

in T1. The result showed that value slightly but fell within normal range as reported by (25) total and conjugated normal range 1.71-8.55 and 0 - 4.61, respectively. Bilirubin tests measure the amount of the bilirubin in the blood sample and it is considered the true test for the liver function as it reflects the ability of the liver to take up, process and secrete bilirubin into the bile. The results indicate that the experimental diets did not have any debilitating effect on the liver function as seen from the bilirubin.

The total protein level was highest in T5 and lowest in T2. Total protein values 58.1 g/L are reported by (27) and (28) which are compared well to this study. However report (19) results were slightly lower than the physiological range of total protein (60–93 g/L and 6.0–83 g/dL) values for sheep, respectively. (10) reported that serum total proteins of animals are indirect indices for measuring nutritional protein adequacy in farm animals. The albumin level was highest in T5 and lowest in T3. The globulin level was highest in T4 and lowest in T2. Albumin values 29.6 g/L are reported by (27) and (28) which are compared well to this study. The albumin is an important blood clot factor due to its ability to prevent haemorrhage. Therefore the higher the value the better it is to the animals. This could be the reason why the sheep have comparable total protein content among the different groups. The observation is agreement with Allison (1955) and Anon (29) who found changes in protein reserve in animal as indicated by serum total protein to be associated with alteration in the albumin fraction.

The cholesterol level was highest in T4 and lowest in T2. However, the values of fell within normal ranges of 1.9–3.5 mmol/L (30). The urea/N level was highest in T1 and lowest in T2. The urea values obtained in this study were within the range (6.1–7.5 mmol/L) reported by (19) for growing lamb, The urea values obtained in this study is good indication of efficiency of utilization of nitrogen and urea recycling and has brough about adequate levels the amino acid balance. The blood urea values in the experiment were within the recommended limits and suggested that the kidneys and liver in the body of the sheep were functioning normal.

The aspartate aminotransferase level was highest in T2 and lowest in T4. The alanine aminotransferase level was highest in T4 and lowest in T2. The alkaline phosphatase level was highest in T5 and lowest in T1. The values on serum aspartate amino transferase (AST) and serum alanine amino transferase (ALT) activity observed in this study were within the normal range (40.0-123 IU/L) and (25.0–70 IU/L) respectively reported for healthy sheep 8). The serum alanine amino transferase (ALT) and serum alkaline phosphatase (ALP) activity show significant differences among treatments, and values were not within the normal range (IU/l) as reported for clinically healthy ewes (8). Both ALP and ALT are present in many tissue cells, especially liver and heart cells therefore increased values could indicate necrosis of cells (31). Alanine aminotransferase (ALT) is a liver-specific hepatocellular enzyme in some animals measuring hepatic necrosis (32). A decrease in serum ALP and ALT below the normal range has been reported to signify necrosis and mycocardial infarction or response to the presence of a number of toxin factors (33).

These findings suggest that the different diets had varying impacts on the animals' serum biochemistry parameters, which may have

implications for animal health and nutrition. For example, the higher levels of direct and conjugated bilirubin in T4 suggest that this diet may be more taxing on the liver than other diets. The higher total protein, albumin, and globulin levels in T4 suggest that this diet provided the animals with more protein than other diets. The higher alkaline phosphatase level in T4 suggests that this diet may have had a higher calcium content than

The results of this study suggest that the different diets had varying impacts on the serum biochemistry parameters of animals, which may have implications for animal health and nutrition. The findings highlight the importance of selecting the appropriate diet for different types of animals or for different stages of growth, based on their nutritional needs and health goals.

Conclusion

Therefore, the study suggests that using agricultural waste-based total mixed rations formulated using value addition science technology is a viable option for feeding ruminants, as it does not have any adverse effects on the hematological parameters of the animals. Further research is needed to determine the optimal formulation and feeding strategies to maximize the benefits of these diets.

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