FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 11 No. 4, December 2025: Pp.133- 139

https://doi.org/10.33003/jaat.2025.1104.15

PHYSIOLOGICAL CHANGES IN UDA SHEEP FED ENSILED UREA-MOLASSES TREATED SOYBEAN HAULMS IN CONCENTRATE DIETS

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ABSTRACT

The development of new feedstuffs for ruminant nutrition should consider feed resources that will not affect the physiology of the animals. This study was therefore designed to investigate the physiological changes in sheep that were fed varying levels of ensiled urea-molasses treated soybean haulms. The soybean haulms were treated with a solution of urea and molasses (4:1 v/v), ensiled at 70% moisture, thereafter dried and used as test ingredient to formulate experimental diets at 0, 30, 40 and 50% and designated as D1, D2, D3 and D4. A total of 20 rams weighing 12.60 ± 0.20 kg used in the experiment were divided into four groups of five animals each and assigned to one of the experimental diets in a completely randomized design (CRD). The feeding trial lasted for 84 days and data on blood parameters was subjected to one-way analysis of variance using SPSS (version 23). Result indicate that PCV, Hb, MCV and MCH increased significantly ($p<0.05$) in rams fed D2 and D3, while WBC reduced ($p<0.05$) progressively across D1 to D4. Feeding of D4 to sheep resulted in a reduction ($p<0.05$) in ALT and serum chloride while there were irregular difference ($p<0.05$) in triglyceride, iron and glutathione peroxidase with inclusion of processed soybean haulms. In conclusion, feeding D1 to D4 improved haematological parameters and did not adversely affect the physiology of the sheep. Therefore, soybean haulms treated with urea and molasses and ensiled can be included in the diet up to 50%.

Keywords: Soybean haulms, Urea, Molasses, Ensiling, Sheep, Physiology

INTRODUCTION

Small ruminant production is an integral part of livestock production given the numerous advantages associated with raising sheep and goat for meat supply. Some of the advantages include their role in the food chain for rural household, income to household, religious purpose, hubby and security during crop failure (Lebbie, 2004; Ozung *et al*., 2011). These places the production of sheep and goat in a vintage position to address the problems of protein supply especially for rural household. Nevertheless, there have been challenges of improved production and expansion including the problem of feed supply.

The low productivity of sheep and goats is explained by the inability to supplement their feeding with concentrate diets that are specially prepared to meet the nutritional requirements of the animals for optimum production. This is because the supply of forages is characterized by fluctuations in terms of quantity and quality all year round. This calls for concerted efforts to improve feed supply and subsequently, the productivity of the animals. This is where the need for an alternative supply of feedstuff that is readily available and has less competition with man and non-ruminant animals have become necessary. One of those alternatives is soybean haulms which has shown potential to be used as feedstuff in ruminants (Omotosho *et al*., 2020; Ikyume *et al.*, 2023; Afele *et al.,* 2024; Ikyume *et al*., 2024). However, soybean haulms also have limited use in the diets of the animals due to the low quality and structural fibre contained in them. Processing of the haulms will likely improve the quality and efficient utilization by sheep.

Processing could employ one or a combination of physical, biological and chemical methods. Several authors have demonstrated that processing techniques such as grinding, extrusion, heat treatment, and drying (Makker *et al.,* 2016; Krizsan *et al*., 2018; Cai *et al*., 2019; Wang *et al*., 2020; Li *et al*., 2021; Chen *et al*., 2022; Ogu *et al*., 2024) of crop residue has helped improve their shelf life, quality and utilization. There is report that treating with urea and molasses and subsequently ensiling soybean haulms will improve the structural fibre in the haulms and enhance the utilization of nutrients from the haulms (Ogu *et al*., 2024). It important to feed these processed soybean haulms to ascertain the response of the animals to feeding regimes using them, and this has not been adequately addressed in literature. This is why the research was designed to assess the effect of the processing methods adopted and the use of different levels of the processed soybean haulms which were above the levels recommended from previous research on the use of the raw soybean haulms (Ikyume *et al*., 2023; Afele *et al*., 2024; Ikyume *et al*., 2024) on the performance of Uda sheep.

MATERIALS AND METHODS

Experimental Area

The field experiment and processing of soybean haulms was conducted at Animal Science Teaching and Research Farm, Joseph Sarwuan Tarka University Makurdi (JoSTUM), Benue State, Nigeria. Proximate components and fibre fractions analyses were carried out at the Animal Nutrition Laboratory, College of Animal Science, JoSTUM, while mineral analysis was done in the Soil Science laboratory, College of Agronomy, JoSTUM. Makurdi is located in the Guinea savannah vegetation zone and its geographical coordinates are 8° 53' 0" North, and 7° 73' 0" East for longitude and latitude respectively (Google Earth, 2023). Makurdi has a minimum temperature range of

21.71º C ± 3.43° C and a maximum temperature range of 32.98 ± 2.43º C with an average annual precipitation of 134.92 mm (5.31 inches) and a relative humidity between 39.5 ± 2.20 % and 64.0 ± 4.80 % while being placed 84 meters above sea level (TAC, 2011).

Sourcing of soybean haulms, molasses, urea and processing the soybean haulms

Soybean haulms were sourced around the University environs, then dried and milled into coarse form using a hammer mill. Urea was bought from an agro shop in Makurdi while molasses was purchased from the Dangote Sugar Industry in Lagos. The procedure for processing soybean haulms used in this experiment is described in the work of Ogu *et al.* (2024).

Experimental Design and Diets Preparation

The experimental design was a completely randomized design, with four experimental diets formulated containing varying inclusion levels of processed soybean haulms. The four experimental diets were designated as D1, D2, D3 and D4 with soybean haulms inclusion levels of 0, 30, 40 and 50% respectively. The composition of each treatment diet is presented in Table 1.

Table 1: Gross Composition of Experimental Diets

	Treatment Diets			
Ingredients	**D1 (0 %)**	**D2 (30 %)**	**D3 (40 %)**	**D4 (50 %)**
Maize	50	20	10	-
Soybean meal	10	10	10	10
Rice offal	10	10	10	10
Palm kernel cake	25	25	25	25
Processed soybean haulms	-	30	40	50
Bone meal	3	3	3	3
Vitamin Premix	1	1	1	1
Table salt	1	1	1	1
Total	**100**	**100**	**100**	**100**

Experimental Animals, Housing, and Management

Twenty (20) yearling Uda rams were purchased from a livestock market in the Lafia local government area of Nasarawa State. The animals were housed in individual pens during the experimental period. Prior to the commencement of the experiment, the animals were quarantined for six weeks. During the quarantine period, they were given prophylaxis treatment to ensure they remained healthy during the experiment. They were administered with antibiotics (oxytetracycline, LA), given multivitamins to boost their appetite and treated for endo and ecto parasite using ivermectin. Other husbandry practices were carried out throughout the experimental period. The animals were managed on a basal diet (*Panicum maximun*) and experimental throughout the experimental period at 4% of their body weight each. Water was provided *ad libitum* and the experiment was for a period of 84 days.

Data collection

Blood collection and analysis

About 8 ml of blood were collected from all the experimental animals on the morning of the last day of the feeding trial. 3 ml of the collected blood were emptied into individual labelled collection bottles containing ethylene diamine tetra acetic acid (EDTA) in order to avoid blood clotting, and used for the determination of haematological analysis. The remaining 5 ml was emptied into bottles without EDTA, and serum harvested for determination of serum indices including oxidative biomarkers. Haematological parameters including red blood cell (RBC), white blood cell (WBC), relative lymphocyte counts were evaluated using an automated blood analyser (ADVIA 120, Bayer USA). Packed cell volume (PCV) and haemoglobin (Hb) were determined using the micro haematocrit method and cyanmethemoglobin method respectively. The serum indices including oxidative biomarkers were determined as reported in our previous works (Afele *et al*., 2020; Ikyume *et al*., 2021). The determination of trace elements (zinc, copper and manganese) of the blood serum samples was carried out on the Analyst 800 Atomic Absorption Spectrometer (AAS) mode.

Statistical Analysis

Data on physiological changes obtained from the experiment was subjected to one-way analysis of variance using SPSS (version 23). Significant differences among treatment means where applicable were separated using the Duncan Multiple Range Test contained in the statistical software at a probability level of 5 %.

RESULTS

Haematological parameters of Uda rams feed different inclusion levels of ensiled urea-molasses treated soybean haulms

Table 2 is the result of haematological parameters of Uda rams fed varying levels of ensiled urea-molasses treated soybean haulms. Packed cell volume (PCV), white blood cells (WBC), haemoglobin (Hb), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were influenced by the different treatment diets in this experiment. The PCV was higher in D2 and D3 (31.33 %) compared to other diets. The rams in D1 and D4 had PCV values of 26.33 and 26.67%, respectively. The WBC decreased ($p<0.05$) with increasing amount of treated soybean haulms in the diet of the rams. The WBC was higher in D1 (6.93×10^{12}L) and least in D4 (5.47×10^{12}L). As observed for PCV, haemoglobin concentration was higher in D2 and D3 (10.44 g/dl, respectively) but reduced ($p<0.05$) in rams in D1 and D4 (8.78 and 8.89 g/dl, respectively. The mcv and MCH concentration in the blood of the rams on the different concentrate diets followed the pattern of PCV and Hb. These were higher in animals feeding D2 and D3 (47.64 and 48.20 fl for as well as 15.86 and 16.05 of MCV and MCH for D2 and D3, respectively). The animals feeding D1 and D4 had MCV of 41.53 and 42.32 fl, respectively and MCH of 13.87 and 14.07 pg, respectively. Other haematological parameters such as red blood cells, mean corpuscular haemoglobin concentration and erythrocytes were not affected ($p>0.05$) by the different treatment diets.

Table 2: Haematological Indices of Sheep Fed Varying Levels of Ensiled Urea-Molasses Treated Soybean Haulms (PSBH)

Parameters	D 1	D 2	D 3	D 4	SEM
PCV (%)	26.33^{b}	31.33^{a}	31.33^{a}	26.67^{b}	0.92
RBC x 10^{12} (l)	6.33	6.57	6.50	6.30	0.06
WBC x 10^{9} (l)	6.93^{a}	6.40^{ab}	5.67^{bc}	5.47^{c}	0.21
Hb (g/dl)	8.78^{b}	10.44^{a}	10.44^{a}	8.89^{b}	0.31
MCV (fl)	41.53^{b}	47.64^{a}	48.20^{a}	42.32^{b}	1.09
MCH (pg)	13.87^{b}	15.86^{a}	16.05^{a}	14.07^{b}	0.36
MCHC (g/dl)	33.37	33.27	33.27	33.23	0.02
Lymphocytes (%)	64.00	65.67	64.33	67.00	0.63
Neutrophil (%)	27.33	25.67	27.00	26.00	0.52
Eosinophil (%)	3.00	2.67	3.00	2.33	0.28
Basophil (%)	0.33	0.33	0.67	0.00	0.19
Monocytes (%)	5.33	5.67	5.00	4.67	0.30

[abc] Means with different superscripts along the treatment rows are significant ($P<0.05$)
PCV = Packed Cell Volume; RBC = Red Blood Cells; WBC = White Blood Cells; Hb = Haemoglobin; MCV = Mean Corpuscular Volume; MCH = Mean Corpuscular haemoglobin; MCHC = Mean Corpuscular haemoglobin Concentration; SEM = Standard Error of Mean, PSBH = Processed soybean haulms. D1=0% inclusion level of PSBH, D2=30% inclusion level of PSBH, D3=40% inclusion level of PSBH, D4=50% inclusion level of PSBH

Serum proteins, enzymes, glucose and lipids of Uda rams feed different inclusion levels of ensiled urea-molasses treated soybean haulms

The result of serum proteins, enzymes, glucose and lipid of ram fed concentrate diets containing different levels of ensiled urea-molasses treated soybean haulms in presented in Table 3. Alanine aminotransferase (ALT) and Triglycerides were the only serum indices that were significantly ($p<0.05$) affected by the treatment diets. The ALT values were comparable in D1, D2 and D3, (29.07, 25.78 and 25.67 µ/L, respectively), but reduced ($p<0.05$) in Diet 4 (24.15 µ/L) compared to D1 only. Triglyceride levels on the other hand was higher ($p<0.05$) in the sheep fed D3 (107.97 mg/dl) compared to D2 (84.88 mg/dl) only. Triglyceride levels in D1 and D4 (96.91 and 104.06 mg/dl) were comparable to both D2 and D3. Serum proteins, aspartate aminotransferase, glucose, cholesterol, high density lipoprotein and low density lipoprotein were not affected ($p>0.05$) by the different treatments.

Table 3: Blood Serum Parameters of Sheep Fed Varying Levels of Ensiled Urea-Molasses Treated Soybean Haulms (PSBH)

Parameters	D 1	D 2	D 3	D 4	SEM
Total Protein (g/dl)	6.72	7.09	5.50	5.50	0.39
Albumin (g/dl)	4.21	3.76	4.47	4.40	0.13
AST (µ/L)	118.41	129.69	123.79	129.18	4.74
ALT (µ/L)	29.07^{a}	25.78^{ab}	25.67^{ab}	24.15^{b}	0.78
Glucose (mg/dl)	60.43	59.71	66.91	64.03	3.12
Cholesterol (µg/dl)	77.00	77.83	73.53	72.67	2.69
Triglyceride (mg/dl)	96.91^{ab}	84.88^{b}	107.97^{a}	104.06^{ab}	3.81

HDL (mg/dl)	21.33	23.10	22.73	23.43	0.51
LDL (mg/dl)	36.28	37.75	29.21	28.43	2.86

[ab] Means with different superscripts across the treatment rows are significant (P<0.05)
ALT = Alanine aminotransferase; AST = Aspartate aminotransferase; HDL = High-Density Lipoprotein; LDL = Low-Density Lipoprotein, SEM = Standard Error of Mean, PSBH = Processed soybeann haulms, D1=0% inclusion level of PSBH, D2=30% inclusion level of PSBH, D3=40% inclusion level of PSBH, D4=50% inclusion level of PSBH

Serum minerals of Uda rams feed different inclusion levels of ensiled urea-molasses treated soybean haulms

The serum minerals of rams fed concentrate diets containing varying levels of ensiled urea-molasses treated soybean is as seen in Table 4. Only iron and chloride concentration in the blood serum was affected (p<0.05) by the treatment diets. Serum iron was higher (p<0.05) in D3 (1.28 µgl^{-1}) compared only to D1 (1.18 µgl^{-1}). Iron concentration in D2 and D4 (1.23 and 1.25 µgl^{-1}, respectively) was comparable to D1 and D3. Chloride decreased (p<0.05) only in D4 (102.47 mmol/L) compared to the other treatments (111.28, 108.37 ans 110.20 mmol/L for D1, D2, and D3, respectively). The concentration of Zinc (Zn), copper (Cu), manganese (Mn), aluminium (Al), sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) were not affected (p>0.05) by the different treatments.

Table 4: Blood Mineral Concetration in Sheep Fed Varying Levels of Ensiled Urea-Molasses Treated Soybean Haulms (PSBH)

Minerals	D 1	D 2	D 3	D 4	SEM
Zinc (µgl^{-1})	0.07	0.28	0.07	0.07	0.05
Copper (µgl^{-1})	0.67	0.74	0.73	0.74	0.02
Manganese (µgl^{-1})	0.58	0.65	0.67	0.67	0.02
Aluminium (µgl^{-1})	0.30	0.33	0.35	0.34	0.01
Iron (µgl^{-1})	1.18^{b}	1.23^{ab}	1.28^{a}	1.25^{ab}	0.02
Sodium (mmol/L)	160.18	170.10	146.41	120.23	9.14
Potassium (mmol/L)	5.15	5.47	4.71	3.87	0.29
Chloride (mmol/L)	111.28^{a}	108.37^{a}	110.20^{a}	102.47^{b}	1.17
Calcium (mmol/L)	7.62	6.33	6.95	7.23	0.24
Magnesium (mmol/L)	3.46	2.88	3.16	3.29	0.11

[ab] Means with different superscripts across the treatment rows are significant (P<0.05)
SEM = Standard Error of Mean, PSBH = Processed soybean haulms, abc Means with different superscripts across the treatment rows are significant (P<0.05). D1=0% inclusion level of PSBH, D2=30% inclusion level of PSBH, D3=40% inclusion level of PSBH, D4=50% inclusion level of PSBH.

Oxidative stress response of Uda rams feed different inclusion levels of ensiled urea-molasses treated soybean haulms

Table 5 is the result of oxidative stress biomarkers from sheep fed varying levels of ensiled urea-molasses treated soybean haulms. All parameters measured except glutathione peroxidase (GPx) were not affected (p>0.05) by the different treatments. The GPx concentration from sheep fed D1 (0.11 Iµ/L) was higher (p<0.05) compared to 0.03 Iµ/L in sheep fed D3. However, GPx concentration from sheep in D2 (0.06 Iµ/L) and D4 (0.07 Iµ/L) were similar (p>0.05) to both D1 and D3. Other biomarkers such as superoxide dismutase, nitric oxide, uric acid and malondiadehyde ranged between 6.36-19.61 Iµ/L, 4.01-5.46 µm/L, 7.46-7.86 mg/dl, and 0.90-1.06 mmol/L, respectively and did not show significant (p>0.05) differences across the different treatment groups.

Table 5: Oxidative Stress Parameters of Sheep Fed Varying Levels of Ensiled Urea- Molasses Treated Soybean Haulms (PBSH)

Parameters	D 1	D 2	D 3	D 4	SEM
SOD (IU/L)	19.61	13.15	6.36	10.58	3.04
GPx (IU/L)	0.11^{a}	0.06^{ab}	0.03^{b}	0.07^{ab}	0.01
Nitric Oxide (µm/L)	4.01	4.19	4.35	5.46	0.27
Uric Oxide (mg/dl)	7.86	7.84	7.46	7.68	0.13
MDA (mmol/L)	1.06	0.97	0.90	1.04	0.03

[ab] Means with different superscripts along the treatment rows are significant (P<0.05)
SOD = Superoxide Dismutase; GPx = Glutathione Peroxidase; MDA = Malondialdehyde; SEM = Standard Error of Mean, PSBH = Processed soybean haulms, D1=0% inclusion level of PSBH, D2=30% inclusion level of PSBH, D3=40% inclusion level of PSBH, D4=50% inclusion level of PSBH.

DISCUSSION

Blood function to transport oxygen, distribute nutrient enzymes, and remove waste products, thereby maintaining homeostasis of the internal environment. There are reports that processing of feed stuff could affect the haematological parameters of farm animals (Aya *et al*., 2013). Increased packed cell volume, haemoglobin, mean corpuscular volume, and mean corpuscular haemoglobin in the blood of the animals at inclusion of 30 and 40% processed soybean haulms may be explained by the quality of the diets following the processing method adopted to improve the quality of the soybean haulms. This assertion that the quality of soybean haulms improved after processing is supported by the fact that in previous work, packed cells volume and haemoglobin concentration in serum of sheep reduced with inclusion of unprocessed soybean haulms in the diet at 30% (Ikyume *et al.,* 2023). Inclusion of processed soybean haulms may have provided a better quality diets compared to the composition in the control (D1), but the haulms treated may be included up to certain levels with a decline observed at 50%. An increase in PCV of the rams fed diets with processed soybean haulms included up to 40 % may have improved nutritional status of the rams, leading to better red blood cell production. Although PCV decrease beyond 40% inclusion of treated soybean haulms in the diets of the rams, the PCV in all the treatments were within the range provided by Merck manual (2012) for sheep. The inclusion levels adopted in this current study are therefore safe for the animals given that all haematological levels observed were within normal ranges. The values are also consistent with the ranges provided by Njidda *et al.* (2014) and Agbaye *et al.* (2021). The non-significant RBC values across the treatment groups are indications of good oxygen-carrying capacity in all the experimental animals and these all fell within the recommended reference range from the Merck Manual (2012) and the reports of Seixas *et al*. (2021) and this is consistent with report of Ikyume *et al*. (2023). In a similar vein, inclusion of soybean haulms in diets of West African dwarf goats did not influence haematological parameters of the animals (Ikyume *et al.,* 2024). The decrease in white blood cell count in this study could indicate that higher levels of treated soybean haulms may have had an immunosuppressive effect, and this may be because of the use of urea in treating the soybean haulms and not the soybean haulms. This true because previous studies did not indicate changes in white blood cells of sheep or goat when soybean haulms was included in their diets at 30% (Ikyume *et al*., 2023; Ikyume *et al*., 2024). Although white blood cells decreased with increasing amount of the processed soybean haulms, the levels of white blood cells across all the various treatment were within the range for white blood cells reported in the report of Ikyume *et al*. (2023) for sheep fed soybean haulms in diets. The animals in this current research did not show any clinical signs of disease throughout the research, and challenges of ammonia poison may not have ensured with the processing method and quantity of the processed soybean haulms utilized.

Good feeding can be certified by knowing the blood serum constituents of the animals as it measures body functions through nutrition. A reduction in the alanine aminotransferase (ALT) with increasing amount of processed soybean haulms may be explained by either the antioxidant properties of molasses which may help mitigate oxidative stress and liver damage or the effect of urea and molasses to influence ruminal fermentation, potentially reducing the production of toxic compounds that may harm the liver, thereby leading to reduction of ALT in the blood. It is either the use urea to treat the haulms helped in maintaining a stable ruminal pH, thereby reducing the risk of acidosis and associated toxicity, with report of urea increasing ruminal pH (Wahyono *et al*., 2022) or molasses helped to stimulate the growth of certain microbes, potentially enhancing the degradation of toxic compounds, with reports that dietary addition of molasses lcould improve fiber digestibility and enhance ruminal biohydrogenation of fatty acids (Martel *et al*., 2011), thereby improving rumen health. The variations observed in the triglyceride levels across the groups may not be primarily due to the treatments adopted in this current research. This is because triglyceride reduced in animals fed 30% processed soybean haulms compared to only to 40% inclusion. Although serum proteins in this current study were not influenced by the different levels of processed soybean haulms, in another research ensiling rice straw with urea and molasses and feeding to sheep, serum albumin decreased with increasing amount of urea used in the processing method (Kwaido *et al*., 2024). This difference could be due to the different crop residue used in the two research. Non-significant differences in the serum enzymes, glucose and lipid profile of the sheep fed processed soybean haulms at different levels is consistent with Ikyume *et al* (2023; 2024) for sheep and goats, respectively fed soybean haulms and Kwaido *et al.* (2024) for sheep fed ensiled urea and molasses treated rice straw.

Minerals are essential to animal metabolism and function as structural components of tissues (NRC, 2007) and act as electrolytes in body fluids to maintain the acid-base balance, osmotic pressure, and permeability of cell membranes. Mineral deficiencies and excesses can cause severe nutritional changes that impair animal performance (Pereira *et al.*, 2019). Higher iron concentration in D3 (1.28 μg/L) compared to D1 (1.18 μg/L), suggest potential benefits of treated soybean haulms on iron status. This increase in iron in D3 compared to control correspond with a higher haemoglobin in D3 compared to control because iron helps in the production of haemoglobin (Rashidi-Alavijeh *et al.,* 2023). It is important to further explore the interactions between urea, molasses, and other nutrients that may impact iron absorption. A decrease in chloride concentration when processed soybean haulms were included at 50% indicate possible effects on electrolyte balance. Reduced chloride levels can disrupt the balance of other electrolytes like sodium, potassium, and bicarbonate. In a similar vein, report of Ikyume *et al*. (2024) indicates a reduced chloride concentration when soybean haulms were include at the diet of goats at 30%, while on a contrary, another report of Ikyume *et al*. (2023) did not indicate changes in chloride for sheep fed diets containing soybean haulms at 30%. The use of the haulms may be specie specific for animals, while the processing method adopted in this research may have accounted for the differences in the chloride concentration of sheep in this current research and that of Ikyume *et al*. (2023). Even though there was a reduction in chloride when the processed soybean haulms was included at 50%, same was not for sodium and potassium, even though there were numerical reduction in those electrolytes as well. The concentrations of chloride across all treatment groups is within the ranges obtained for sheep in the work of Ikyume *et al*. (2023) and above 85 mmol/L reported as threshold for chloride deficiency (Underwood and Suttle, 1999).

Oxidative biomarkers can be useful Higher glutathione Peroxidase (GPx) in D1 (0.11 Iμ/L) compared to D3 (0.03 Iμ/L), suggest potential antioxidant effects, but same was not the case for animals in D2 and D4. This suggest that individual animal effect may have been responsible for this lower GPx in D3 compared to control. The feeding of soybean haulms to sheep did not affect the concentration of glutathione peroxidase in sheep as well as superoxide dismutase and malondialdehyde (Ikyume *et al*., 2023). The malondialdehyde (MDA) values obtained in this study were lower than the values reported by Aktas *et al.* (2017) but fell within the reference range reported by Nafizi *et al.* (2010) for healthy male adult sheep.

CONCLUSION

The processing method for soybean haulms in this study and inclusion levels adopted improved haematological profile of the animals with potential for a decrease in in white blood cells at higher levels. The treatments did not adversely affect the serum enzymes, lipids and proteins. The use of processed soybean haulms in the diets of sheep up to 50 % did not distort the oxidative balance of the animals. The treatment of soybean haulms with urea and molasses and ensiling to be used as feedstuff can be included in the diets of sheep up to 50 % without having deleterious effects on the animal's physiology.

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