European Journal of Applied Sciences – Vol. 13, No. 06
Publication Date: December 21, 2025
DOI:10.14738/aivp.1306.19707.
Aljameel, K. M., Mika'ilu, M. M., & Musa, B. M. (2025). Stress Indicators of Uda Rams Fed Graded Levels of Ensiled and Dried Cassava Peels in Semi-Arid Region of Nigeria. *European Journal of Applied Sciences, Vol - 13(06).* 236-242.

Stress Indicators of Uda Rams Fed Graded Levels of Ensiled and Dried Cassava Peels in Semi-Arid Region of Nigeria

Aljameel, K. M.
Department of Animal Science,
Usamanu Danfodiyo University Sokoto

Mika'ilu, M. M.
Department of Animal Science,
Usamanu Danfodiyo University Sokoto

Musa, B. M.
Department of Animal Science,
Usamanu Danfodiyo University Sokoto

ABSTRACT

The study was conducted at Kebbi State University of Science and Technology Aliero to access the effect of dried and ensiled cassava peels on stress indicators of Uda rams. A completely randomized experimental design (CRD) in a factorial layout (2 by 4) was used in this experiment with two processing methods (Dried and Ensiled) and graded levels (0, 10, 20 and 30) of formulated feeds representing treatments combinations, while each animal serves as replication. Rams fed ensiled cassava peels result shows treatment 3 have lower (P<0.05) rectal temperature readings compared to treatment 1 and 2. The result shows higher readings of pulse rate in treatment 2 compared to the other treatments. The result shows no significant variation (P<0.05) between the two forms of processing in all the parameters measured. The result shows interaction between level of inclusion and form of processing in terms of rectal temperature and respiratory rate. The study concludes that feeding ensiled or dried cassava peels does yield to any form as nutritional stress as indicated by the biomarkers (stress indicators) of the animals

Keywords: Stress indicators, Uda rams, Cassava peels, Ensiled, Dried.

INTRODUCTION

Ruminants, feed mainly on forages and crop residues and are affected by seasonality and experience seasonal weight fluctuation between the wet and dry periods of the year (Dayo *et al*., 2009). Seasonal availability of production inputs such as feed, water and quality pasture constitutes constraint to livestock production (PCOL, 2003). According to Adegbola (1982), the scarcity of energy and protein feedstuffs during dry season is a major setback to ruminant livestock production in the tropics. During this period, the available forages are dry, protein content of which is very low and there is marked decrease in voluntary intake and digestibility by the animal (Oyenuga, 1968; Steinbach, 1997). Therefore, alternative sources of feed resources are being exploited. Cassava is among the feed resources exploited for its high fiber contents. Cassava has played a minor role as an ingredient in livestock feed in sub-Saharan Africa as cassava was often more expensive than imported maize (Tewe, 2004). The high cost

of maize on the continent due to weather induced fluctuations, huge foreign debts and currency devaluation has forced a number of countries in Africa to search for alternatives to maize particularly for its livestock sub-sector (Nweke *et al*., 2002).

A total production of 87 million tons of cassava produced annually in Africa, only 6 percent is used in livestock production mainly in traditional systems. By contrast, in Latin America, 32.4 percent of its cassava is used for livestock feeding while in Asia, over 40 percent of its products is exported in the form of chips and pellets for the European Union livestock industry with another 2.9 percent used for domestic livestock production (International Fund for Agricultural Development - IFAD and Food and Agriculture Organization of United Nations - FAO 2000). The share of African cassava production used as livestock feed is probably underestimated because cassava wastes such as peels, and leaves are fed to goats, sheep and pigs on small-scale farms in traditional systems, in fresh or cut-and-dried forms. In West Africa, waste from cassava production is between 5 - 52 percent thus, is a potential feed resource for the regions (Tewe, 2004). Goat and sheep rearing are highly complementary because cassava processing is carried out around homes, and goats, sheep and chicken are fed by-products of cassava processing. As a complementary energy source, it can undergo stratification within the rumen, so it can be regurgitated with forages and chewed during rumination (Smith, 1992; Tewe *et al*., 2002). Nigeria is currently the world's largest producer of cassava crop (IITA, 2005). Peasant farmers mostly grow cassava as a primary staple food but cassava is also being used as a cash crop to produce industrial ethanol, starches, tapioca, and livestock feeds. Ruminants can be fed not only on cassava tuber, but also the stem, leaves, peel and various by-products of tuber processing such as residues from starch, "garri" and "fufu". However, one of the limiting factors in using cassava as feeds for ruminant animals is its level of cyanide. The cyanide content can be reduced to acceptable level by either sun drying, ensiling and other forms of processing.

A readily available and fast means of assessing clinical and nutritional status of an animal may be the use of blood picture and the stress biomarkers (Robertshaw, 1981). Stress biomarkers are important and reliable medium used to monitor and evaluate health and nutritional status of animals (Oni *et al.,* 2010). It is therefore of uttermost importance to evaluate the stress indicators of an animal particularly, when unconventional feeds are fed so as to scientifically establish its biological influence on health, experimentally in a suitable animal model.

MATERIALS AND METHODS

Experimental Site

The study was conducted at Kebbi State University of Science and Technology Aliero. It is located in the Sudano-Sahelian zone in extreme North-Western part of Nigeria. Aliero is located at the southeast of Kebbi State. It lies between longitude $4^{0}2$N and latitudes $12^{0}12$'N and at altitude of 350m above sea level. The average temperature of 28.3^{o}c (82.9^{o} F), however the maximum daytime temperature are most of the year below 40^{o}C (104.0^{o}F), the dryness makes the heat bearable. The warmest months are February to April, where daytime temperature exceed 42^{o}c (107.6^{o}F).The rainy season is from late May to October; during which showers are a daily occurrence. Rainfall starts late and ends early with mean annual rainfall ranging between 550mm to 650mm. There are two major seasons in the State namely: wet and dry seasons. The dry season starts from October and last up to April, in some part and may extend

to May or June in other part. The wet season on the other hand begins in most part of the state in May and last up to September or October. The hamattan, a dry, cold and fairly dusty wind is experienced in the state between November and February. Heat is more severe in the state in March and April. But the weather in the state is always cold in the mornings and hot in the afternoons except during the hamattan period.

Sources and Processing of Experimental Feeds

The ingredients used in the experiments include: cassava peels, whole cassava root and cassava leaves which were sourced from kebbi State while the remaining feed materials including maize, rice offal, cowpea husk, cowpea haulms, cotton seed cake and salt were purchased from Sokoto Kara market.

Experimental Design and Diet Formulation

A completely randomized experimental design (CRD) in a factorial layout (2 by 4) was used in this experiment with two processing methods (Dried and Ensiled) and graded levels (0, 10, 20 and 30) of formulated feeds representing treatments combinations, while each animal serves as replication. Four animals were allocated to each treatment in which an animal serves as replicate. The animals were balanced for weight according to treatment. Each animal were housed in a pen measuring 2m× 1m, which was disinfected. Each group was assigned to one of the experimental diets and fed *ad libitum* in the morning for12 weeks. Water was offered *ad libitum* to the animals. Four complete experimental diets (isocaloric and isonitrogenous) were formulated with graded levels of the best diet at 0, 10, 20, and 30 % inclusion levels. The experimental diets were used to feed the animals according to the treatments. The diets were designated as treatment 1, 2, 3, and 4 in the experiments. Gross compositions of the experimental diets are shown in Table 1. Maize and cowpea hay was crushed to reduce their particle size, cotton seed cake, cowpea husk, rice milling waste, premix, bone meal and salt were obtained directly from market, records of feed offered and left over were taken daily throughout the trial. The trial lasted for 84 days.

Experimental Animals and Management

Sixteen (32) Uda rams yearlings aged by dentition (Dyce *et al*., 2002) were purchased from village market (Aliero), the animals were quarantine at the Livestock Teaching and Research farm at Kebbi State University of Science and Technology so as to be adapted to their new environment, the animals were dewormed using albendazole super 10% (5 mg of their body weight) and was given an antibiotic as prophylactic treatment. The feeding pens were cleaned and disinfected a week before the experiment commence. Faeces and urine were removed every day from the feeding pens to ensure adequate hygiene, minimal ammonia accumulation, feed and water troughs were also cleaned every morning before feeding.

Table 1: Gross Composition of the Experimental Diets Containing Dried Cassava peels

Ingredients	Control	Dried Cassava peels			Ensiled Cassava peels		
	T1	T2	T3	T4	T2	T3	T4
Cassava peels	0	10	20	30	10	20	30
Maize	10.00	3.00	0.00	0.00	3.00	0.00	0.00
Cowpea husk	25.00	23.00	25.00	21.00	23.00	25.00	21.00
Wheat offal	24.00	18.00	9.00	6.00	18.00	9.00	6.00

Rice offal	14.00	15.50	14.50	11.50	15.50	14.50	11.50
Soya bean meal	0.00	5.00	8.00	10.00	5.00	8.00	10.00
Cotton seed cake	25.00	24.00	22.00	20.00	24.00	22.00	20.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Premix	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Calculated Chemical Analysis							
Energy (Kcal/Kg)	2261			2261	2266		2300
Crude Protein (%)	15.0			15.4	15.0		15.0
Crude Fiber	20.8			23.3	22.5		24.0

Determination of Stress Indicators

Rectal Temperature (RT):

This was obtained through the introduction of a 413 Adtemp digital thermometer (American Diagnostic cooperation ADC), directly into the animal's rectum, at a depth of 3.5 cm, the readings were taking after the thermometer beeps.

Respiratory Rate (move min-1):

This was obtained by observing the abdominal movement, counting the number of movements for one minutes.

Pulse Rate (move min-1):

This was obtained through a 3M Littman classic 27" monitoring stethoscope placed around the mid-co-coccygeal artery, counting the number of beats for one minutes.

Energy Expenditure (EE):

This was calculated from the pulse rate using the formula derived by Shinde *et al.* (1999).

$$EE = 0.13 + 0.50PR$$

Where PR is the pulse rate. The data was collected twice daily at 8h and 15h throughout the experimental period.

Data Analysis

The data collected on stress indicators was subjected to analysis of variance using completely randomized design with processing methods and graded levels as the independent variables (Steel and Torrie, 1980), the interaction of processing methods vs. graded levels was obtained. Duncan's multiple range test (DMRT) was used to express the difference between treatment means each. The level of significance will be set at $P<0.05$.

RESULT

Stress Indicators of Uda Rams Fed Graded Levels of Dried and Ensiled Cassava Peels

The results for stress indicators is presented in Table 2 for rams fed graded levels of dried and ensiled cassava peels. The result shows that there is significant difference ($P<0.05$) between treatment 1 (control) and treatment 2 in terms of rectal temperature recordings while similar difference exist between treatment 3 and 4 in terms of respiratory rate for rams fed dried

cassava peels, there is no difference between treatments 1, 3 and 4 with regards to rectal temperature so also between treatments 1, 2 and 3 in respect to respiratory rate. Rams fed ensiled cassava peels result shows treatment 3 have lower (P<0.05) rectal temperature readings compared to treatment 1 and 2. The result shows higher readings of pulse rate in treatment 2 compared to the other treatments. Main and Interactive effect of level of inclusion and processing method on stress indicators of rams fed graded levels of dried and ensiled cassava peels

The main and interactive (Table 3) effect of stress indicators shows significant difference (P<0.05) in terms of inclusion levels in all the parameters measured. Rams in T1 have high rectal temperature compared to T3, there is no difference between T1, T2 and T4 in terms of rectal temperature. Respiration rate is higher in control treatments (T1) compared to the other treatments. Pulse rate and energy expenditure are higher for rams fed T2 compared to those fed T1, there is no significant difference between T2 and T3 in terms pulse rate and energy expenditure, so also between T3 and T1. The result shows no significant variation (P<0.05) between the two forms of processing in all the parameters measured. The result shows interaction between level of inclusion and form of processing in terms of rectal temperature and respiratory rate (Table 3).

Table 2: Performance of Uda Rams Fed diets containing Ensiled Cassava Peels

Parameters	T1	T2	T3	T4	SEM
Dried					
Rectal temperature (°C)	30.60^{a}	39.09^{ab}	38.95^{b}	39.06^{ab}	0.19
Pulse rate (breaths/min)	66.00	78.80	72.17	70.23	3.49
Respiration rate (breaths/min)	42.70^{a}	35.53^{ab}	40.33^{a}	29.93^{b}	3.45
Energy Expenditure (KJ/kg $W^{0.75}$)	33.13	39.53	36.21	39.38	1.75
Ensiled					
Rectal temperature (°C)	39.60^{a}	39.17^{a}	38.51^{b}	39.01^{ab}	0.21
Pulse rate (breaths/min)	66.00^{b}	77.17^{a}	70.73^{b}	68.47^{b}	1.61
Respiration rate (breaths/min)	42.70^{a}	26.00^{c}	28.67^{bc}	30.87^{b}	1.13
Energy Expenditure (KJ/kg $W^{0.75}$)	33.13	38.71	35.50	34.36	0.81

a,b,c means in the same row with different superscript are significant (P<0.05) different.

Table 3: Main and Interaction of Uda Rams fed graded levels of dried and ensiled Cassava Peels

Parameters	T1	T2	T3	T4	SEM
Rectal temperature (°C)	39.60^{a}	39.09^{ab}	38.95^{b}	39.06^{ab}	0.20
Pulse rate (breaths/min)	66.00^{b}	77.99^{a}	71.45^{ab}	69.35^{b}	2.55
Respiration rate (breaths/min)	42.70^{a}	30.77^{b}	34.50^{b}	30.40^{b}	2.29
Energy Expenditure (KJ/kg $W^{0.75}$)	33.13^{b}	39.12^{a}	35.86^{ab}	36.87^{ab}	1.28
Processing Method					**Interaction**
	Dried	**Ensiled**	**SEM**		
Rectal temperature (°C)	39.28	39.07	0.14		*
Pulse rate (breaths/min)	73.87	71.05	2.00		NS
Respiration rate (breaths/min)	37.17	32.23	2.27		*
Energy Expenditure (KJ/kg $W^{0.75}$)	37.06	35.65	1.00		NS

a,b means in the same row with different superscript are significant (P<0.05) different.

DISCUSSION

The pulse rate reflects primarily the homeostasis of circulation along with the general metabolic status. It is well documented that cardio respiratory system is influenced basal metabolic rate (Blaxter and Boyne, 1982) Several investigators have reported that there is a correlation between heart rate and metabolic heat production (Barkai *et al*., 2002; Yamamoto and Ogura, 1985).

The stress indicators measured in this study rectal temperature, respiratory rate, pulse rate, and energy expenditure provide important insights into the physiological responses of Uda rams to graded levels of dried and ensiled cassava peels. Variations observed among treatments suggest that both the level of inclusion and, to a lesser extent, the form of processing influenced the animals' stress responses.

The higher rectal temperature and respiratory rate observed in the control treatment indicate increased physiological activity, which may be associated with higher metabolic heat production from conventional diets. The reduced rectal temperature recorded in rams fed Treatment 3, particularly with ensiled cassava peels, suggests improved thermal comfort and reduced heat stress. Ensiling is known to reduce anti-nutritional factors such as cyanogenic glycosides in cassava peels, potentially enhancing nutrient utilization and reducing metabolic strain on the animals (Barkai *et al*., 2002). Rectal temperature and respiration rate of the rams are all within the normal reference range. Rectal temperature is strongly associated with many physiological attributes which contribute to heat stress (McManus *et al*., 2009). The findings of the study suggest that cassava intake be it dry or ensiled may not alter the physiological status of the animals or leads to stress as a result of any toxic consumption.

The elevated pulse rate and energy expenditure observed in Treatment 2 may indicate an adaptive physiological response to moderate inclusion levels of cassava peels. This response could be attributed to increased circulatory activity aimed at supporting digestion and nutrient absorption. However, the lack of significant differences between some treatment combinations suggests that rams were able to physiologically adapt to the diets without severe stress, particularly at higher inclusion levels. Heart rate decreased because the general effort of the animal to decrease heat production. This reduction could be achieved by the animal either by intake reduction or by activity reduction or both. The findings of this study found the pulse rate to be within the normal range of sheep (70-90) for all the rams fed dried cassava peels while those fed control and 30% ensiled cassava peels records slightly lower than normal. This may be attributed to high energy intake which may leads to fat accumulation which will in turn reduce the pulse rate. The absence of significant differences between dried and ensiled cassava peels in most parameters implies that both processing methods are suitable for inclusion in ram diets without adversely affecting stress indicators. Nonetheless, the significant interaction between inclusion level and processing method for rectal temperature and respiratory rate highlights that the combined effects of diet formulation and processing can influence thermoregulatory responses.

CONCLUSSION

The study concludes that feeding ensiled or dried cassava peels does yield to any form as nutritional stress as indicated by the biomarkers (stress indicators) of the animals.

References

Adegbola, T. A. (1982). Forage resources and beef production in Nigeria. In: *Beef Production in Nigeria*.

Barkai, D., Landau, S., Brosh, A., Baram, H., and Molle, G. (2002). Estimation of energy intake from heart rate and energy expenditure in sheep under confinement or grazing condition. *Livestock Production and Science*, 73, 237–246.

Blaxter, K. L., and Boyne, A. W. (1982). Fasting and maintanance metabolism in sheep. *Journal of Agricultural Scienece Cambridge*, 99(3), 611–620.

Dayo, P., Ephraim, N., John, P. and Omobowale, A.O. (2009). Constraints to increasing Agricultural Productivity in Nigeria. Nigeria Strategy Support Programme (NSSP) Background Paper No. NSSP 06, International Food Policy Research Institute, Washington D.C., USA.

Dyce, K. M., Sack, W. O., and Wensing, C. J. C. (2002) *Textbook of Veterinary anatomy*. 3rd edn. Philadelhia: Saunders Company .

FAO (2011). World Livestock- livestock in food security. Rome, Italy: Food and Agricultural organizations of the United Nations.

IITA, 2005. Cassava in the Tropics. A Reference Manual, Ibadan, Nigeria pp. 81–92.

McManus, C., Louvandini, H., Paim, T. P., Martins, R. F. S., Barcellos, A. O., Cardoso, C. C. and Santana, O. A. (2011). The challenge of sheep farming in the tropics: aspects related to heat Tolerance. *Japanese Journal of Zootechnic and Science*, 40, 107–120.

Oni, A. O., Onwuka, C. F. I., Arigbede, O. M., Oni, O. O., Anele, U. Y., Yusuf, K. O., … Onifade, O. S. (2010). Chemical composition and in sacco degradability of four varieties of cassava leaves grown in south western Nigeria in the rumen of sheep. *Tropical Animal Health and Production*, *42*, 1385–1393.

Oyenuga, V.A. (1968). *Nigeria's Food and Feeding stuffs: Their Chemistry and Nutritive value.* Ibadan University Press, Ibadan, Nigeria.

PCOL (2003). *Report of the Presidential Committee on Livestock,* vol.1, consolidated report. Abuja, Nigeria.

Robertshaw, D. (1981). The environmental physiology of animal produc-tion: In Environmental Aspects of Housing for Animal Production (Edited by J.A. Clark), pp: 3-18. Butterworths, London.

Shinde, A. K., Karim, S. A., Singh, V. P., and Sankhyan, S. K. (1999). Use of heart rate to predict energy expenditure of sheep on rangeland. *Indian Journal of Animal Science*, 69, 339–341.

Steinbach, J. (1997). Alternative to crop residues as feed resources in mixed farming system. *Crop Residues in Sustainable Mixed Crop/Livestock Farming* (Renard C. Eds), AB International, Netherlands.

Tewe, O. O. (2004). Cassava for livestock feed in sub-Saharan Africa. In NeBambi Lutaladio (Ed.), *The Global Development Cassava Strategy* 75. FAO Paper, Plant Production and Protection Division Food and Agriculture Organization of the United Nations.

Yamamoto, S., and Ogura, Y. (1985). Variations in heart rate and relationship between heart rate and heat production of breeding Japanese Black Cattle. *Japanese Journal of Livestock Management*, 3, 109–118.