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# Body Thermoregulatory Adaptations And Reproductive Potentials Of Yankassa Rams Fed Diets Containing Urea-Molasses Treated Cassava Peel Ensiled With Caged-Layer Droppings

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## Abstract

This study was conducted to evaluate the physiological responses and reproductive performance of sheep fed diets containing urea-molasses treated cassava peels ensiled with caged layer droppings. The experiment took place at the Federal University of Agriculture Teaching and Research Farm, Adamawa. Twenty-one clinically healthy Yankassa breed of sheep, aged approximately 6 to 7 months, were used for the trial, which lasted for 63 days. Feed offered was measured daily. Statistical differences between mean values of the studied parameters were assessed using one-way repeated measures ANOVA. Thermoregulatory parameters—including heart rate, respiratory rate, earlobe temperature, and rectal temperature—showed no significant differences between treatment groups and the control group throughout the experimental period. Semen pH and abnormalities in sheep fed a diet with 25% replacement of urea-molasses treated cassava peels ensiled with caged layer droppings were not significantly different from the control group but were significantly better than those in the 50% replacement group. Conversely, reproductive parameters such as semen motility, live sperm percentage, semen concentration and volume, scrotal length, scrotal circumference, and libido were significantly improved in sheep fed the 50% replacement diet compared to the 25% replacement group, with no significant difference from the control. It can be concluded that the inclusion of urea-molasses treated cassava peels ensiled with caged layer droppings had no adverse effects on the thermoregulatory parameters of the sheep. Furthermore, the 50% replacement diet appears to be the most beneficial in terms of reproductive performance, falling within recommended nutritional standards for small ruminants.

***Keywords;*** *Sheep nutrition, urea-molasses treated cassava peels, caged layer droppings, physiological responses, reproductive morphometrics,*

## Introduction

The amount of animal protein consumed (4.5g/person/day) in the majority of emerging third-world nations, including Nigeria, is significantly less than the 35g daily recommended amount (FAO, 2001; Anaso et al. 2024c). Finding a new alternative method to stay competitive in the industry, improve performance while lowering production costs as much as possible, and provide consumers with high-quality protein is crucial to meeting the growing global demand for animal protein and preserving profitability (Anaso et al. 2021b; Anaso et al. 2024b; Anaso et al. 2025).

Anaso et al. (2023) assert that better nutrition can enhance livestock's reproductive and productive performance. Studies have been done to examine the effects of various feedstuffs on the reproductive performance and physiological response of cattle, with a small number focusing on goats and sheep. However, the exact mechanism by which feed affects ruminant reproductive performance and physiological response is still not fully scientifically proven (Anaso et al. 2024a; Anaso and Olafadehan 2025).

According to a study by Mohamed (2018), feeding Egyptian Barki ewes halophytic fodder shrubs (Atriplex, Acacia, and Cassava) did not pose any significant physiological risks or affect their ability to reproduce.

Despite having a low crude protein content and containing cyanogenic glycosides that are poisonous to livestock, cassava peels and other agroindustrial byproducts have been used to feed ruminant animals (Anaso et al., 2021a; Anaso et al., 2021b). However, they have undergone processing to maintain their nutritional value and lower the amount of cyanogenic glycosides and phytate (Oboh, 2006). To detoxify the cyanide concentration, a variety of processing techniques have been employed, including sun drying, ensiling, soaking, sun drying, and retting (Olafadehan, 2011). Molasses and poultry droppings have been utilized to increase the nutritional content of fibrous meals. Thus, ensiling the final product and treating it with caged-layer droppings and molasses can increase the nutritional content of cassava peels. This research focused on the thermoregulatory adaptations and reproductive potentials of Yankassa Rams fed complete diets containing caged layer droppings-molasses ensiled cassava peel as a substitute for corn bran.

## Materials and Method

### Study area

The research was conducted in Mubi town, the Northern Senatorial District of Adamawa State, Nigeria, at the Federal University of Agriculture Mubi Teaching and Research Farm's Monogastric Unit, the Morugo Agricultural/Research site was the study's location. Situated at the base of the Mandara Mountains, which divide

Nigeria from the Republic of Cameroun, Mubi is 1906 feet above sea level and falls between latitude 10.27 and longitude 13.28 (10.2801° N, 13.2774° E).

**Source of feed ingredients and experimental animals**

The cassava peels which were used for the experimental diet were obtained from selected farms during peeling of cassava in the post harvesting operation. Caged layer droppings were gotten from poultry farms within the university environment, while molasses and urea were gotten from Mubi Central market. The experimental rams were purchased from a nearby reputable animal farm Adamawa Nigeria.

**Experimental animals, management and diets**

Twenty one clinically healthy rams of Yankassa breed about 6 to 7 months with average initial body weight (BW) of 18.30 ± 0.46 kg were used for the experiment. The animals were ascertained to be healthy by a veterinary consultant, having vital parameters within normal ranges and showing no sign of disease. One week prior to the arrival of the animals, the surroundings and pens were thoroughly cleaned and disinfected with a strong antiseptic (morigad). On arrival, the rams were administered prophylactic treatment which included the intramuscular administration of oxytetracycline L.A. (Long acting) an antibiotic (1ml/10kg BW) against bacterial diseases. Ivomectin (0.5ml/25BW) was subcutaneously administered to the animals to protect them against endo-parasites inside the body cavity and ecto-parasites on the skin. Vitalyte was orally administered as anti-stress for a week in drinking water, before the animals were individually penned. Prior to isolation in their pen, they were allowed to adapt to their environment and the experimental diet for the period of one week before the commencement of experiment. The cages were cleaned thoroughly once a week.

Rams were weighed for their initial weight before starting feeding trials and they were randomized into three groups of similar body weight in completely randomized design (CRD). Experimental diets were fed to the animals and water given *ad libitum* through experimental period of 63 days.

100kg of dried cassava peel was collected, washed and allowed to wilt for 2 hours and mixed with 20kg of cage layers droppings and 10kg of molasses. It was allowed to for 30 days, then sundried for 3 days and grinded before taking to the laboratory for other analysis. The total amount of feeds offered daily and representative samples were on weekly basis and pooled together after the experiment. The quantity of feed provided and residue of each day was weighed to determine the feed intake of individual animal. The initial body weights of the goats were taken at commencement of the experiment and subsequently at 7 days interval in the morning before feeding.

**Experimental diet**

Three experimental diets were formulated with the inclusion of the three different types of supplement on cassava peel which include the cassava peel + molasses + cage layer droppings. T1 indicates 0% treated cassava peel replacement, T2 indicates 25% replacement of maize with treated cassava peel, and, T3 indicates the replacement of maize with 50% of treated cassava peel.

**Table 1: Experimental diet with different inclusion level of treated cassava peel with urea-molasses ensiled with cage layer droppings on West Africa dwarf goat.**

| Ingredients (kg) | Treatment 1 0%replacmet of cassava peel | Treatment 2 25% replacement of cassava peel | Treatment 3 50% replacement of cassava peel |
|---|---|---|---|
| Maize | 28 | 21 | 14 |
| Treated cassava peel | 0 | 7 | 14 |
| GNC | 18 | 18 | 18 |
| Corn bran | 21 | 21 | 21 |
| TSH | 28 | 28 | 28 |
| Limestone | 2 | 2 | 2 |
| Salt | 1 | 1 | 1 |
| Urea | 1 | 1 | 1 |
| Vitamin premix | 1 | 1 | 1 |
| Cp | 15.90 | 15.95 | 15.99 |
| Total | 100 | 100 | 100 |

**Collection of thermoregulatory parameters**

Every goat's heart rate, respiration rate, and rectal temperature were recorded twice a week at 10:00 a.m. A digital thermometer was used to measure the rectal temperature. According to Anaso et al. (2024b) and Anaso and Alagbe (2025), the sensory tip was cleaned with an antiseptic, lubricated with petroleum jelly Vaseline, and then placed into the rectum of a single animal at the temperature display of constant "C L0" on the thermometer's mini digital screen. Following the digital thermometer's beeping alarm signal, the device was taken out of the rectum, and the recorded body temperature was noted. After the alert signal beeped and the temperature was recorded, the digital thermometer was taken out of the earlobe. Using the seconds hand on an analog wristwatch, the number of abdominal movements per minute was counted for one minute, and the counts were recorded in order to determine the respiratory rate. A stethoscope positioned at the left side of the ribs was used to measure the heart rate.

According to Olafadehan et al. (2023, Anaso et al., 2024b; Anaso and Alagbe, 2025), the loop dope sound was the typical heart sound because it signified a full heart beat for one minute using the seconds hand on an analog wristwatch.

**Testicular and semen parameters**

According to Bratte et al. (1999), Akpa et al. (2012), and Anaso et al. (2024b), scrotal length (SL) was measured in centimeters using a flexible measuring tape as the distance along the scrotum's caudal surface, from its site of attachment to the tip of the scrotum. After the testes are pushed firmly into the scrotum, the greatest diameter surrounding the pendulous scrotum is known as the scrotal circumference (SC) (Akpa et al., 2006). A measuring tape was used to convert it to centimeters (cm).

As described by Zemjanis (1970), an automatic electro ejaculator (Autojact, Neovet) with 12 V and 5 A was used to electroejaculate all of the bucks from each session. A series of 1-35 stimuli lasting between 30 and 5 minutes is then shown.

By directly measuring the millimeter graduation of the collection vial, the volume of the semen samples was assessed right away, and the result was expressed in milliliters (mL). By visualizing the consistency of the ejaculates, the semen's appearance was assessed and categorized as watery, thick, milky, creamy marble, and creamy. Every semen sample was smeared, allowed to air dry, labeled, and stored for additional analysis.

10 µL of semen was mixed with 1 mL of Tris dilution buffer (Hydroxymethylaminomethane) (3.0 g), sodium citrate (2.0 g), and fructose (1.0 g) to measure the progressive motility. After that, an optical microscope (100x magnification) was used to examine a 10 µL aliquot of the diluted semen sample that had been placed between a heated slide and coverslip (37ºC). A percentage was used to represent the progressive motility.

A hemocytometer crossed with microscopic grids was used to measure the spermatozoa concentration. Sperm cells were counted in five huge squares, each counting diagonally from top left to bottom right and from top right to bottom left (Rekwot et al., 1997; Anaso et al., 2024b). Formaldehyde was utilized as a dilution reagent before counting. Using an automated pipette, a drop of semen was extracted from each sample and diluted 1:100 with formaldehyde. After mounting the hemocytometer in the microscope, a drop of the solution was pipetted into the hemocytometer chamber using an absorbable tube and an O-no pette. The outcome was noted as the sample's concentration of sperm cells.

As soon as the semen sample was collected, a smear was made using eosin-nigrosin stain to assess the live to dead sperm ratio. Using an automated pipette, a diluted drop of semen was put on a sanitized glass slide. On the slide next to the semen was a drop of the eosin-nigrosin solution. To ensure that the two samples were evenly mixed, the slide was gently turned in a circular motion. To create a thin smear on the first slide, a quarter of the portion of another clean slide was put on top of the first sample, and the two slides were carefully and gradually separated. After letting it dry, this was labeled. Each sample was then put on a microscope to count the number of living and dead sperm cells. The idea is that although active sperm cells reject the dye and stay unstained, dead sperm cells accept it and seem stained. Hancock (1951) created the aforesaid approach.

**Chemical analysis**

The proximate analysis of the formulated diet was done using the standard procedures recommended by association of official and analytical chemists (AOAC).

**Statistical analysis**

The obtained feed and nutrient intake, hematological, biochemical, semen characteristics and thermoregulation data were subjected to analysis of variance (ANOVA) in completely randomized design using the SPSS (23.0). Duncan multiple range test (DMRT) of same software was used to test the significant difference between the means at ($p \leq 0.05$ level of significance.

The statistical model is shown below

$Yij = \mu + ti + ei$

Where:

*Yij* = the general response to the specific parameter under investigation,

$\mu$, the general mean peculiar to each observation,

*ti* = the fixed effect of the dietary treatment on the observed parameters and

*ei* = the random error term for each estimate

**Results and Discussions**

**Body thermoregulation of the experimental animals**

Table 2 shows body thermoregulation of experimental animals.

All the vital signs (RT, HR and RR) were not ($P>0.05$) affected by diets and were within the reference ranges of 38.5 – 39.7°C, 70 – 90 bpm and 16 – 34 cpm for RT, HR and RR respectively for healthy sheep (Merck Veterinary Manual, 2010). The results indicate the diets did not compromise normal sheep's vital signs. Generally, normal vital signs of an animal depend on recent activity, feed and water consumptions and the physiological state of the animals (Olafadehan et al. 2023; Anaso et al. 2024b; Anaso and Alagbe, 2025). The normal values obtained for the vital signs are a confirmation of the fact that the diets did not affect the body physiology and health of the

animals, suggesting that that RPCP can safely be used as a feedstuff in the diets of sheep without posing any nutritional or health challenge because lower or higher values than the normal ranges indicate physiological or health problem.

Anaso et al. (2024b) reported that respiratory rate is practical and reliable measure of the heat load and stated that respiratory rate above 25 breath per minute in small ruminant is an indicator of heat stress.

Therefore, the result obtained for heart rate, respiratory rate and rectal temperature after feeding diet containing treated cassava peel with urea-molasses ensiled with cage later droppings showed no significant difference with that of the control diet and was therefore in agreement with research conducted by Kusuma et al. (2017) who reported a non-significant (P>0.05) difference in body thermoregulatory parameters in goat feed a varying protein level on their diet.

**Table 2: Thermoregulatory adaptations of the experimental animals**

| Parameters | Control T 1 | 25% RPCP T 2 | 50% RPCP T 3 | SEM |
|---|---|---|---|---|
| Rectal Temp (°C) | 39.48 | 39.49 | 39.56 | 0.35 |
| Heart rate (bpm) | 83.71 | 84.00 | 83.66 | 0.18 |
| Respiratory rate (cpm) | 22.59 | 22.82 | 22.85 | 0.17 |

Means in the same row are statistically different at (P<0.05), T1 indicates 0% treated cassava peel replacement, T2 indicates 25% replacement of maize with treated cassava peel, and, T3 indicates the replacement of maize with 50% of treated cassava peel, SEM: indicate standard error of the mean

HR: Heart rate, RR: Respiratory rate, EL: Ear lobe temperature, RT: Rectal temperature, TRT: Treatment, RPCP; Replacement of treated cassava peel.

**Semen quality and testicular parameters of experimental animals**

Semen colour was the same (creamy) for the diets. Semen pH and abnormalities were higher ($p<0.05$) in 0 and 25% RPCP than in 50% RPCP. Sperm viability was affected ($p<0.05$) in the order: 50% RPCP > 25% RPCP > 0% RPCP. Semen volume, Semen concentration, progressive motility, live spermatozoa testosterone level, scrotal length and circumference, libido test (measured as the reaction time when exposed to female) followed the same trend and was significantly highest in the 50% replacement diet compared to the 25% replacement group, with no significant difference from the control.

Semen quality evaluation is crucial since adequate fertility in livestock depends on having high-quality semen (Anaso et al. 2023; Anaso et al. 2024a; Anaso et al. 2024d). Male reproductive efficiency is actually determined primarily by sexual activity and the quality of semen (Anaso, 2024). Semen volume, concentration, progressive motility, testosterone level of living spermatozoa, scrotal length and circumference, and libido all showed parallel results, suggesting that RPCP can be added to buck diets without adversely affecting these semen characteristics. Similar semen colors in the bucks are in line with previous research on goats and rams that observed a creamy color feature (Oyeyemi et al., 2011; Ososanyo et al., 2013; Anaso et al. 2024b). Creamy white semen frequently indicates good quality, blood stains and odd hues suggest poor quality or contamination, and translucent semen typically indicates low concentration. The pH of the semen fell within Osinowo's (2016) recommended range. Greater sperm and semen EV concentrations were found in the 50% RPCP, suggesting that the diet significantly influenced spermatogenesis and improved the nutritional status of the rams while they were fed this diet. The increased availability of nutrients for the spermatogenesis process resulting from increased enhanced feed and nutrient intake (especially protein intake) may be the cause of the improved nutritional status. Although not mentioned in this study, the diet may have also enhanced ruminal microbial growth and microbial protein production (Gado et al., 2009) and nutritional digestibility (Gado et al., 2015). Improved nutrient digestibility has been shown to support the nutrition of the seminal fluid and sertoli cells that nurse the germ cells (Anaso et al., 2024b). According to Osinowo (2016), strong, progressive motility is an essential measure of sperm viability and sperm level, which may be high or low. Anaso et al. (2023) explain that motile cells are usually innately viable and viability is crucial in determining non-motile cells that are alive or dead. Therefore, the increase in sperm concentration and volume of rams on 50% RPCP signals the possibility of high fertility during service or insemination (Oyeyemi and Okediran, 2007). Diets improved and affected spermatogenesis and sperm cell viability, according to the marginal influence of diets on sperm viability (Anaso et al. 2024b). Because low-quality or inadequate food has been connected to cases of low-live sperm count, it appears that RPCP is a nutritionally acceptable feedstuff that can be added in rams' diets up to 50% without impairing semen characteristics and fertility. (Anaso and others, 2023).

In rams given diets based on pineapple waste, the sperm abnormalities in all treatment groups did not exceed the previously documented acceptable limit (Ososanya et al., 2013). In general, low quality semen is indicated by high levels of sperm abnormalities. Thus, it may be concluded that the current study found no adverse effects of nutritional therapies on semen quality. The leydig cells of the testes produce testosterone, which is essential for spermatogenesis and masculine traits. Its vascular distribution throughout the body is a significant component in male desire (Sajjad et al., 2007; Sekoni et al., 2010; Anaso et al., 2024b). Although testosterone levels were higher

at 50% RPCP than at 0 and 25% RPCP, they were still within the 2.10–10.8 ng/mL range for small ruminants in Turkey (Polat et al., 2011; Delgadillo et al., 1999), indicating that the 50% RPCP threshold level had no effect on testosterone concentration in the current study. According to Cornwall (2009), low testosterone levels are the cause of poor sperm quality because testosterone has been found to be a crucial component in the production of superior quality semen due to its favorable connection with other semen features. Given that testosterone has been shown to increase male sexual behaviour, it is possible that the higher libido (lower reaction time to doses) in the 50% RPCP is related to testosterone levels. Generally, libido (sex drive) is an important component of male fertility.

Scrotal length and circumference are important indicators when observing animals for breeding soundness. Higher SC and SL of rams fed 50% RPCP diet indicate that the diet may improve the reproductive performance and breeding soundness of the bucks. Earlier studies (Azizunnesa et al., 2013) attributed increased scrotal circumference and growth rate to nutritional plane, implying that 50% RPCP diet is perhaps nutritionally superior to the other diets.

General findings from this study were similar to results presented by Anaso et al. (2024b) who evaluated the effect of substitution of *Pleurotus ostreatus* biodegraded sugarcane scrapings (BSS) for corn bran on the growth performance and reproductive potential of Kano Brown bucks and concluded that that up to 30% biodegraded sugarcane scrapings can be used in a complete diet for bucks without negatively impacting final body weight and semen quality.

**Table 3: Semen quality and testicular parameters of experimental animals**

| Parameters | Control T 1 | 25% RPCP T 2 | 50% RPCP T 3 | SEM |
|---|---|---|---|---|
| Semen colour | Creamy | Creamy | Creamy | |
| pH | 6.56[a] | 6.52[a] | 6.21[b] | 0.07 |
| Ejaculatory volume, mL | 0.24[b] | 0.26[b] | 0.38[a] | 0.02 |
| Progressive motility, % | 74.59[b] | 75.58[b] | 85.49[a] | 0.77 |
| Sperm viability, % | 78.67[c] | 81.33[b] | 88.00[a] | 3.03 |
| Sperm concentration, x $10^6$ | 335.92[b] | 354.96[b] | 396.37[a] | 8.40 |
| Live spermatozoa, % | 71.32[b] | 73.11[b] | 85.78[a] | 1.20 |
| Sperm abnormalities, % | 16.39[a] | 15.63[a] | 10.03[b] | 0.36 |
| Testosterone, ng/mL | 2.89[b] | 3.26[b] | 4.06[a] | 0.22 |
| Libido, seconds | 12.21[b] | 12.51[b] | 15.92[a] | 0.33 |
| Scrotum length, cm | 10.80[b] | 11.01[b] | 13.11[a] | 0.46 |
| Scrotum circumference, cm | 17.45[b] | 17.72[b] | 18.66[a] | 0.29 |

Means in the same row are statistically different at ($P<0.05$), T1 indicates 0% treated cassava peel replacement, T2 indicates 25% replacement of maize with treated cassava peel, and, T3 indicates the replacement of maize with 50% of treated cassava peel, SEM: indicate standard error of the mean

## Conclusion

The result shows that animals fed with 25% and 50% replacement of urea-molasses treated cassava peel ensiled with caged layer droppings showed no significant difference in the heart rate, respiratory rate, earlobe temperature and rectal temperature when compared with that of the control diet. It can be concluded that the different treatments had no effect on the physiology of the animals. The result shows that animals fed with 50% replacement of urea-molasses treated cassava peel ensiled with caged layer droppings gave the highest semen motility, semen live, semen concentration, semen volume, scrotal length, scrotal circumference and libido. It can be concluded that the feed containing 50% replacement of urea-molasses treated cassava peel ensiled with caged layer droppings is best for the animals as it falls within general recommended ranges.

## Recommendation

Based on the finding of this study, the feed containing 50% replacement of urea-molasses treated cassava peel ensiled with caged layer droppings is recommended for diet for ruminant as it does not have any side effect on the physiological response and reproductive performance of the animals.

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