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GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY OF YANKASA RAMS FED BIURET-TREATED *Brachiaria molato II*

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ABSTRACT

The study investigated the impact of varying levels of biuret-treated *Brachiaria molato II* on the growth performance and nutrient digestibility of Yankasa rams. The research aimed to assess the potential of using biuret, a synthetic non-protein nitrogen compound, to enhance the nutritional value of *Brachiaria molato II* and improve the growth and nutrient digestibility parameters of ruminants. Twenty healthy Yankasa rams approximately one year old were randomly assigned to four dietary treatments with different biuret inclusion levels (0g, 5g, 10g, and 15g per kg of grass). The trial lasted for 84 days, followed by 21 days digestibility trial, during which growth metrics and feed intake were recorded, followed by a 21-day digestibility trial. Significant ($p<0.05$) improvements in final weight, average daily weight gain, and feed conversion ratio were observed with increasing biuret inclusion, with the highest gains in the 15 g group. Similarly, digestibility of dry matter, crude protein, crude fiber, ether extract, and acid detergent fiber increased significantly ($p<0.05$) with biuret supplementation, while neutral detergent fiber digestibility remained unaffected. These findings suggest that biuret-treated *Brachiaria molato II* has a positive effect on the growth performance of Yankasa rams, enhancing nitrogen retention and microbial protein synthesis in the rumen, thereby improving feed efficiency and growth rates.

Key words: Biurate; *Brachiaria molato II* ; Yankasa Ram; Non-Protein Nitrogen

INTRODUCTION

Ruminants are animals with a unique digestive system that sets them apart from most other animals. While most animals have a single stomach, ruminants have four compartments and engage in "cud-chewing" behavior. There are many species of ruminants found around the world, including cattle, sheep, goats, buffalo, deer, elk, giraffes, and camels. Among the smaller ruminants, goats and sheep are the only ones that have been domesticated. They were the first ruminants to be domesticated in southwestern Asia and have since spread to various regions around the globe (Mustapha *et al.*, 2024). Small ruminants, such as sheep and goats, hold significant importance in the nutritional, social, and economic lives of many Nigerians. While they are not primarily raised solely for household meat consumption or as a steady source of income, their role is more akin to a "savings account" or an "insurance policy." They are often sold when urgent cash is needed. Additionally, small ruminants play a specific role in social and cultural events, such as weddings and other festivities, where they are given as gifts or slaughtered to provide meat for ceremonial occasions. This dual role highlights their value beyond mere livestock production.(Garba *et al.*, 2023).

Brachiaria is a grass species native to the savannas of Eastern Africa and is widely utilized as livestock feed. It includes both annual and perennial varieties, with most species lacking rhizomes. It is recognized as one of the most important forage grasses in tropical regions (Singh, 2009), Brachiaria is particularly prominent in South America, where Brazil is the leading user. The grass grows rapidly, especially during the wet season, and is known for its compatibility with legumes like *Stylosanthes humilis* and *Stylosanthes hamata*, as well as its ease of establishment (Ahmed *et al.*, 2022). However, delayed harvesting can lead to reduced digestibility, necessitating treatments such as the use of non-protein nitrogen to enhance its nutrient content.

Biuret has been proven to be a safe and nutritionally effective source of nitrogen for ruminant animals. Unlike urea, biuret can be safely used to treat low-quality forages, which are common in many parts of the world. This is because biuret releases ammonia (NH3) slowly in the rumen, reducing the risk of toxicity. The slow release of ammonia is attributed to biuret's low solubility compared to urea. However, there is no documented evidence on biuret's solubility in the rumen to confirm whether its solubility or the rate of biuretolysis limits ammonia release (Currier *et al.*, 2004; Tiwari *et al.*, 1973). Due to its slow degradation in the rumen, biuret provides a steady and continuous supply of ammonia (Ribeiro *et al.*, 2011).

Adding non-protein nitrogen (NPN) to high-quality hay did not enhance the live weight gains of cattle and sheep, nor did it affect the voluntary intake of roughage by sheep. However, when animals were fed a low-quality hay diet, supplemented with NPN regardless of the source maintained their weight, while the unsupplemented control group experienced significant weight loss. Additionally, daily or alternate-day supplementation of biuret to ruminants consuming low quality forage did not negatively impact forage intake, nutrient digestibility, digestion site,

or microbial efficiency compared to animals that were not supplemented (Currier *et al*., 2004). The aim of the research is to determine the effect of Congo-signal grass (*Brachiaria molato II*) treated with synthetic non-protein nitrogen compound (Biuret) on growth performance and nutrient digestibility of Yankasa rams.

Research Materials and Methodology

Experimental site

The experiment was conducted at Small Ruminant Unit of Prof. Lawal Abdu Saulawa Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma, Katsina State, Nigeria. The Farm is situated within the latitude 12°27ˈ18ˈ north and 7°29ˈ29ˈ east and 605 meters above sea level with an annual average rainfall of 700mm and situated in the Sudan savannah ecological zone (Garba, *et al.*, 2024)

Management of experimental animals

Twenty (20) apparently healthy growing Yankasa rams of about one year old and similar weight (19-23±0.5 kg) were used for this study. The animals were sourced from Dutsinma market in Dutsin-Ma Local Government Area of Katsina State. The pens were cleaned and the metabolic cages, feeding troughs and drinkers were thoroughly washed and disinfected before the arrival of the animals. The animals were vaccinated against Pes Des Petite Ruminante` (PPR) and treated against endo- and ecto-parasites, using *Ivomec* at recommended dose (0.5ml/10kg body weight) subcutaneously and treated against any sign of infection during the adjustment period of 14 days.

Preparation of Test Ingredient and Experimental Diets

Fresh *Brachiaria molato II* was purchased from the National Animal Production Research Institute (NAPRI) Zaria, Kaduna State and air-dried to a moisture content of 10-13%, the synthetic non-protein nitrogen (Biuret) was produced at Federal University Dutsin-Ma chemistry laboratory. The dried grass was treated and fermented by applying a diluted biuret at a ratio of 0g, 5g, 10g and 15 per Kilogram of *Brachiaria molato II* was dissolved into 10 liter of water and sprinkled over *Brachiaria molato II* hay for fermentation under anaerobic condition for 21 days. Other feed ingredient like maize offal, wheat offal, cowpea husk, cotton seed cake and salt were purchased locally from Dutsin-Ma Market. Diets and water were offered to the animals *ad libitum* twice. All routine management practices and medications were strictly carried out. The feeding trial last for a period of 84 days.

Gross Composition of the Experimental Diet

The gross composition of the experimental diets is shown in Table 1 below presenting the formulation of the experimental diets used in the study, with varying levels of biuret supplementation (0 g, 5 g, 10 g, and 15 g). Across all treatment groups, the inclusion levels of the core ingredients such as maize offal (33.76%), cotton seed cake (10.62%), cowpea husk (10.62%), *Brachiaria molato II* (15.00%), wheat offal (27.00%), bone meal (2.00%), and common salt (1.00%).

Table 1: Experimental Diet Formula and Level of Inclusion in Percentage (%)

Ingredients (%)	0g	5g	10g	15g
Maize offal	33.76	33.76	33.76	33.76
Cotton seed cake	10.62	10.62	10.62	10.62
Cowpea husk	10.62	10.62	10.62	10.62
Brachiaria molato II	15.00	15.00	15.00	15.00
Wheat offal	27.00	27.00	27.00	27.00
Bone meal	2.00	2.00	2.00	2.00
Common Salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

Chemical composition Biuret

Table 2 shows the elemental composition of biuret, highlighting its high nitrogen content at 40.78%. Revealing significant feature, as nitrogen is a key nutrient that supports microbial protein synthesis in the rumen of ruminants. The presence of carbon (23.00%) and hydrogen (4.89%) reflects the organic nature of the compound, while oxygen (31.03%) contributes to its stability and solubility. The high nitrogen proportion makes biuret a promising non-protein nitrogen (NPN) source, suitable for slow-release nitrogen supplementation in ruminant diets.

Table 2: Chemical Components	**Percentages (%)**
Carbon (C)	23
Hydrogen	4.89
Nitrogen	40.78
Oxygen	31.03
Total	100

National Center for Biotechnology Information (2024).

Data Collection

Growth Performance

Initial weight of the animals was determined at the beginning of the experiment by measuring their body weight. Feed intake (Kg), average daily feed intake (g), weight gain (Kg), average daily weight gain (g), feed conversion ratio and final weight (Kg) were determined using the following formulae outline as follows

Feed intake: The feed intake was determined by subtracting the mount of the leftover from the feed served the following morning:

$$\textbf{Feed intake} = \text{Feed served} - \text{left over}$$

Total body weight gain: The average daily live weight gain indicates the average amount of weight that an animal gains each day for a given period of time. It is mathematically calculated as;

Total body weight gain = Final weight – Initial weight

$$\textbf{Average daily weight Gain} = \frac{\text{Total in body weight}}{\text{Number of days}}$$

Feed conversion ratio: The feed intake data was used to calculate the feed conversion ratio. The feed conversion ratio was calculated as;

$$\textbf{Feed Conversion Ratio} = \frac{\text{Amount of Feed Consumed}}{\text{Total weight gained}}$$

Digestibility

At the end of the feeding trial, two rams were randomly selected from each treatment and allocated to metabolic cage for easy collection of faecal and urine sample for laboratory analysis. The samples were collected daily, weighed, recorded and sub-sample taken for analysis. The trial lasted for 21 days with the the first 14 days serving the purpose of acclimatization after which faecal samples were collection was followed in the subsequent 7 days (Osuji *et al*., 1993). Faecal samples were collected daily for seven (7) days.from each animal.

A 5% subsample was taken, weighed\and oven-dried at 105°C for 48 hours. They were re-weighed to determine dry matter content, ground using a 1 mm screen, and prepared for proximate analysis by AOAC (2005). After the laboratory analysis the result was computed using the following formula;

$$\textbf{N}\text{utrient Digestibility} = \frac{\text{Nutrient in Feed} - \text{Nutrient in feaces}}{\text{Nutrient in Feed}} \times 100$$

Experimental Design

A total number of twenty (20) Yankasa rams of approximately similar weight were randomly allotted into four dietary treatments and fed with graded levels of biuret treated *Brachiaria molato II* at 0g, 5g, 10g and 15g inclusion levels, consisting of five replications. The animals were housed individually inside a pen measuring 2m x 2m, in a Completely Randomized Design (CRD).

Data Analysis

Data collected for the experiment was subjected to the analysis of variance (ANOVA) using General Linear Model Procedure of the software GENSTAT 2015 V.17.1. At ($P<0.05$) Significant level, treatment means was separated using Duncan Multiple Range Test (DMRT) of the same statistical package.

RESULTS AND DISCUSSION

Proximate Composition of *Brachiaria molato II* Treated with Non-Protein Nitrogen (Biuret)

The proximate composition of the experimental diet were presented in Table 3 below. The crude protein content obtained in the experimental diet fall within the crude protein content ranges (12 –26%) of grower rams recommended by NRC (2000).

Table 3: Proximate Composition of *Brachiaria molato II* treated with Non-Protein Nitrogen (Biuret)

Parameters	T1(0g)	T2(5g)	T3(10g)	T4(15g)
%DM	74.57	75.39	76.21	73.29
%ADF	29.39	27.23	35.93	25.02
%NDF	48.16	43.13	49.19	42.32
%CP	13.69	15.81	16.88	18.06
%CF	24.24	17.82	18.34	19.67
%OIL	12.69	12.04	8.74	10.42
%ASH	3.72	2.04	8.74	10.42
%NFE	41.83	46.68	49.91	52.69

DM= Dry Matter, CP= Crude Protein, CF= Crude Fibre, NFE= Nitrogen Free Extract, EE= Ether Extract

Effect of *Brachiaria molato II* Treated with Biuret on Growth Performance of Yankasa Rams

Table 4 presents the result on the effect of *Brachiaria molato II* treated with biuret on the growth performance of Yankasa rams.

The result shows that the initial weights of the rams ranged from 20.00 to 20.33 kg across all treatments, with no significant differences ($p > 0.05$). This suggests that the rams were evenly distributed among the treatment groups at the beginning of the experiment. The final weight shows significant variation ($p < 0.05$) among the groups, in which the highest was recorded at T4 (25.57) and T3 (25.57), followed by T2 (23.67), and the lowest was observed in T1 (22.53). The result supports the findings of Sweeny *et al*. (2014), which say the use of NPN-like urea and its derivatives as supplementation promotes increased feed intake to help sheep maintain their body condition, thus improving their final body weight gain. Indicating that the treated *Brachiaria mulato II* has a positive influence on the growth of the animals, also the final weight of animals obtained in this study is higher than the final weight of Yankasa Rams of Garba *et al.* (2023), who reported 22.51-23.16 kg. Significant differences ($p < 0.05$) were observed in weight gain among the treatment groups. Rams in T4 achieved the highest weight gain (5.567kg), followed by T3 (5.233 kg), T2 (3.333 kg), and T1 (2.533 kg). The findings imply that supplementing with biuret, particularly at higher concentrations, significantly enhances weight gain in ruminants. Studies indicate that non-protein nitrogen (NPN) sources like biuret and urea improve growth performance by optimizing the efficiency of dietary protein utilization, thereby stimulating weight gain as described by Wahyono *et al*. (2022). The increase in weight observed in the biuret-supplemented groups could be attributed to improved nitrogen retention, which promotes better microbial protein synthesis in the rumen and supports key metabolic processes for growth. The total feed intake was significantly higher ($p<0.05$) in T2 (65.99 kg), T3 (66.38 kg), and T4 (66.80 kg) than in T1 (62.18 kg). This suggests that biuret

supplementation likely enhanced the feed's palatability or nutritional quality, leading to increased consumption, and the finding aligns with the results of Finangwai and Dafur (2014), who reported a significant ($p < 0.05$) increase in feed intake when 50% urea-treated Acha straw was fed to growing Yankasa. Similarly, the result supports the findings of Currier *et al*. (2004), which say the addition of biuret to low-quality forages does not adversely affect feed intake of sheep. Furthermore, Xu *et al*. (2019) reports that increased feed intake in response to NPN supplementation, regardless of source, may bring about the mechanism of N and C synchronization utilization in the rumen, which can increase the rate of microbial growth, thereby enhancing better microbial protein synthesis. The FCR improved significantly ($p<0.05$) with biuret supplementation, with T4 (0.9052) showing the highest efficiency, followed by T3 (0.8994) and T2 (0.8942), compared to T1 (0.8425). The higher FCR indicates better utilization of feed for growth, which aligns with the observed increases in weight gain and average daily weight gain.

Result on the effect of *Brachiaria molato II* Treated with Non-Protein Nitrogen (Biuret) on Nutrient Digestibility of Yankasa Rams

Table 4: Effect of *Brachiaria molato II* Treated with Biuret on Growth Performance of Yankasa Rams

Parameters	T1 (0g)	T2 (5g)	T3 (10g)	T4 (15g)	SEM
Initial Weight (kg)	20.00	20.33	20.17	20.00	1.267
Final Weight (kg)	22.53^{b}	23.67^{ab}	25.57^{a}	25.57^{a}	0.928
Weight Gain (kg)	2.533^{b}	3.333^{ab}	5.233^{a}	5.567^{a}	1.004
Average Daily Weight Gain (kg)	0.03089^{b}	0.04065^{ab}	0.06382^{a}	0.06789^{a}	0.01224
Feed Intake (kg)	62.18^{b}	65.99^{a}	66.38^{a}	66.80^{a}	1.136
Average Daily Feed Intake (g)	0.7583^{b}	0.8048^{a}	0.8095^{a}	0.8147^{a}	0.01385
Feed Conversion Ratio	0.8425^{b}	0.8942^{a}	0.8994^{a}	0.9052^{a}	0.01539

a,b,c means in the same row with different superscripts are significantly different ($P<0.05$), SEM= Standard error of mean

The data presented in the Table 5 shows the result on the effects of feeding *Brachiaria molato II* treated with varying levels of biuret on the nutrient digestibility in Yankasa rams.

Studies on the digestibility of ruminant feeds are crucial because they enable the estimation of the nutrients that are truly available for ruminant nutrition. The traditional and direct method for estimating feed digestion by ruminants is nutrient digestibility in growing animals (Yashim *et al*., 2016). Digestibility values for dietary dry matter (DM), crude protein (CP), crude fibre (CF), acid detergent fibre (ADF), ether extract (EE), ash and nitrogen free extract (NFE) were generally high and significantly ($P<0.05$) differed among the treatment. Enhanced nutrient digestibility suggests improved rumen health, which promotes more efficient fermentation processes (Putri *et al*., 2021).The result reveals that dry matter digestibility was significantly ($P<0.05$) higher in rams fed biurate treated *Brachiaria* diets at T2 (73.66%) and T4 (73.74%) compared to those T3 biuret (72.68%), suggesting that moderate to high levels of biuret enhance DM utilization. According to Mijinyawa *et al*. (2022) high DM digestibility suggests sufficient availability for energy and nutrient for animal use. Additionally high dry matter digestibility (DMD) may indicate high palatability and acceptability of the diet Gabriel *et al*. (2018). Ash digestibility increased significantly ($P<0.05$) at T4 (74.08) biuret treatment, which may reflect improved mineral bioavailability, whereas the lowest digestibility occurred at the T2 (57.73). Ether extract (EE) digestibility improved significantly ($p<0.05$) with increasing biuret levels, reaching peak values at T3 (78.08) and T4 (80.69), indicating enhanced lipid metabolism potentially due to increased microbial lipolytic activity. Crude fibre (CF) digestibility exhibited a marked increase across all biuret-treated groups T2 (22.27) to T4 (26.51) compared to the control T1 (11.00), highlighting the positive impact of biuret on fiber

degradation, likely mediated by enhanced ruminal microbial activity. The result align with Ajagbe *et al*. (2020) who reports that high CF digestibility asserted that the rumen bacteria were able to rapidly hydrolyze cellulose from the dietary supplements in this study there- by converting the end products to volatile fatty acids which form important part of ruminant energy intake. Crude protein (CP) digestibility rise progressively from T1 (45.95) in the control to T4 (80.40) at 15g biuret supplementation, reflecting improved nitrogen utilization from biuret as a non-protein nitrogen source for microbial protein synthesis as reported by (Xu *et al*. 2019). The apparent digestibility of CP observed in treatments with high biuret concentration in this study is higher than the results 60% of CP digestibility reported by Yeshambel Mekuriaw and Bimrew Asmare (2018). Acid detergent fibre (ADF) digestibility followed a similar trend, increasing from T1 (11.55) in the control to T4 (24.50) at 15g biuret, indicative of improved breakdown of lignocellulosic components. However, neutral detergent fibre (NDF) digestibility did not differ significantly ($p>0.05$) across treatments, suggesting that hemicellulose and cellulose digestibility remained relatively stable irrespective of biuret level, this could be attributed to the biuret nature for slow but continuous release of ammonia for rumen microbes to enhance degradation and breaks cellulose as reported by (Ribeiro *et al.,* 2011), sampling nitrogen-free extract (NFE) digestibility improved with increasing biuret, with the highest value observed at T4 (70.59), indicating enhanced digestibility of readily fermentable carbohydrates and a potential increase in energy availability.

Table 5: Effect of *Brachiaria molato II* Treated with Biurate on Yankasa Rams Nutrient Digestibility

Parameters (%)	T1 (0g)	T2 (5g)	T3 (10g)	T4 (15g)	SEM
DM	69.44^{b}	73.66^{a}	72.68^{ab}	73.74^{a}	1.079
ASH	67.78^{ab}	57.73^{b}	64.91^{ab}	74.08^{a}	3.77
EE	67.65^{ab}	59.75^{b}	78.08^{a}	80.69^{a}	4.85
CF	11.00^{b}	22.27^{a}	26.51^{a}	26.51^{a}	2.783
CP	45.95^{b}	60.71^{ab}	72.29^{a}	80.40^{a}	7.67
ADF	11.55^{b}	20.21^{a}	18.50^{ab}	24.50^{a}	2.206
NDF	17.50^{a}	19.50^{a}	17.50^{a}	21.00^{a}	4.33
NFE	55.51^{b}	61.38^{ab}	67.06^{ab}	70.59^{a}	4.25

ADF= Acid Detergent Fibre, CF= Crude Fibre, CP= Crude Protein, DM= Dry Matter, EE= Ether Extract, NDF= Neutral Detergent Fibre, NFE= Nitrogen Free Extract

CONCLUSION

The supplementation of *Brachiaria molato II* with biuret significantly enhanced the growth performance of Yankasa rams. Higher levels of biuret (10g and 15g per kg) result in improving feed intake, increased weight gain, , and better feed conversion efficiency compared to the control group. The study supports the potential of using biuret as an effective non-protein nitrogen source to improve the quality of low-nutrient forages like *Brachiaria molato II*, thus promoting better growth and digestibility in Yankasa rams. These findings suggest that biuret supplementation could be a viable strategy for improving the productivity of small ruminant production systems, particularly in regions with limited access to high-quality forages. It could be recommended to incorporate 15 g/kg of biuret into *Brachiaria molato II* for optimal growth and feed efficiency in Yankasa rams.

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