PERFORMANCE CHARACTERISTICS AND NITROGEN UTILIZATION OF WEST AFRICAN DWARF RAMS FED DIET CONTAINING GARLIC (*Allium sativum*) MEAL

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ABSTRACT

This study aimed to evaluate the growth performance and nitrogen metabolism of West African Dwarf (WAD) rams fed diets containing Garlic (Allium sativum) meal. A total of 25 WAD rams were used in a 14-week experiment, following a completely randomized design. The experimental diets were formulated to include garlic meal at inclusion levels of 0.0%, 0.5%, 1.0%, 1.5%, and 2.0%, designated as treatments 1, 2, 3, 4, and 5 respectively. Data collected on performance characteristics including final weight, weight gain, feed intake, and feed conversion ratio (FCR), were analyzed using one-way analysis of variance (ANOVA). The results showed that the final weight of the rams ranged from 22.25 to 24.72 kg, with no significant differences observed across the garlic inclusion levels. However, dry matter concentrate intake was significantly influenced by garlic supplementation, with the highest intake of 348.51 g/day recorded at the 2% inclusion level. The lowest FCR value of 8.54 was achieved at the 1.0% garlic inclusion level, indicating improved feed efficiency. Nitrogen intake varied significantly, ranging from 10.50 to 17.52 g/day, with higher levels of garlic inclusion leading to increased nitrogen retention, which ranged from 57.56% to 68.78%. Based on these findings, it was concluded that garlic meal can be included in the diets of WAD rams at levels of up to 2.0% to enhance nitrogen utilization and overall performance. This suggests that garlic meal is a viable feed additive for improving the productivity and nutrient efficiency of WAD rams.

Keywords: Growth, Garlic, Nitrogen balance, Meal, Rams

INTRODUCTION

The West African Dwarf (WAD) ram is a highly adaptable small ruminant species that plays a crucial role in livestock farming across West Africa (Awobajo,2018), owing to its resilience in diverse environmental conditions. With increasing demands for sustainable animal production, there is a growing need to explore dietary strategies that enhance performance traits and optimize nutrient utilization. One promising approach is the use of functional feed additives, such as garlic (*Allium sativum*), in animal diets. Garlic is renowned for its medicinal and nutritional properties, attributed to its bioactive compounds, including allicin and sulfur-containing compounds (Martins *et al*., 2016). These components possess antimicrobial, antioxidant, and immune-enhancing properties, which have been linked to improved growth performance, feed efficiency, and nutrient absorption in livestock (Patra *et al*., 2006). However, despite the well-documented benefits of garlic supplementation in other livestock species, limited research has been conducted on its effects on the performance and nitrogen utilization of WAD rams. This study investigates the effects of dietary garlic meal inclusion on the performance characteristics and nitrogen utilization of West African Dwarf rams. By evaluating key parameters such as feed intake, weight gain, feed conversion ratio, and nitrogen metabolism, the research aims to shed light on the potential of garlic meal as a natural and sustainable feed additive for enhancing the productivity of WAD rams.

MATERIAL AND METHODS

The study was conducted at the small ruminant unit of the Federal College of Animal Health and Production Technology, located in Moor Plantation, Ibadan, Nigeria. This site lies within the southwestern region of Nigeria, situated in the rainforest ecological zone at coordinates 7°–27° N longitude and 3°–25° E latitude, with an elevation ranging from 220 to 300 meters above sea level. The area experiences an average annual rainfall of approximately 1250 mm, with relative humidity and temperature ranging from 76% to 84% and 30°C to 35°C, respectively.

Fresh garlic bulbs were sourced from a reputable market in Ibadan, Oyo State, Nigeria. The bulbs were identified and authenticated at the Forest Research Institute of Nigeria (FRIN) Herbarium in Ibadan. After authentication, the garlic bulbs were rinsed in sterile water, sliced, and air-dried at room temperature for two weeks. The dried garlic was then milled into a fine powder and incorporated into the experimental diets at inclusion levels of 0%, 0.5%, 1.0%, 1.5%, and 2.0%, corresponding to treatments 1 through 5, as shown in Table 1.

Twenty-five (25) West African Dwarf (WAD) rams were purchased from a reputable market in Ibadan. Before the animals' arrival, the pens were thoroughly cleaned and disinfected. Upon arrival, the rams were acclimatized for 14 days before the experiment began. Following the acclimatization period, the animals were weighed and evenly distributed into five treatment groups based on their body weight. Each ram was housed in an individual pen for the duration of the study.

Table 1 Gross composition of experimental diets containing varying levels of garlic (*Allium sativum*) meal

	Inclusion levels of Garlic meal (%)				
Ingredients (%)	**0 % ASM**	**0.5 % ASM**	**1.0 % ASM**	**1.5 % ASM**	**2.0 % ASM**
Cassava peel	30.00	30.00	30.00	30.00	30.00
Groundnut cake	6.00	6.00	6.00	6.00	6.00
Palm kernel cake	20.00	20.00	20.00	20.00	20.00
Urea	0.50	0.50	0.50	0.50	0.50
Molasses	5.00	5.00	5.00	5.00	5.00
Rice bran	30.00	30.00	30.00	30.00	30.00
Salt	1.00	1.00	1.00	1.00	1.00
Limestone	4.00	4.00	4.00	4.00	4.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Premixes	1.00	1.00	1.00	1.00	1.00
ASM	–	+	++	+++	++++
Total	100	100	100	100	100
Calculated analysis					
Crude protein (%)	13.50	13.52	13.52	13.53	13.54
Metabolizable energy (MJ/kg)	10.84	10.86	10.87	10.87	10.88

ASM – *Allium sativum* meal*;*

Data collection

At the beginning of the experiment, each West African Dwarf ram was weighed individually. Throughout the study, weekly body weight changes were recorded by weighing the rams before their morning feeding. Daily feed intake was calculated by subtracting the amount of feed left uneaten from the total feed provided to each ram per day. The feed conversion ratio (FCR) was determined by dividing the total feed intake by the weight gain achieved by each animal. Nitrogen utilization was assessed immediately following the feeding trial. The rams were moved into individual metabolic cages designed to separately collect urine and feces over a seven-day period. They were given seven days to adjust to the cages before data collection began. Daily records were kept of the feed provided, leftover feed, feces excreted, and urine output. Urine samples from each ram were collected daily into sample bottles containing 10 mL of concentrated sulfuric acid to prevent nitrogen loss and were refrigerated until further analysis. Feces and urine collected daily were pooled separately, and a 10% aliquot was taken from the total fecal and urinary output to serve as representative samples for chemical analysis.

Nitrogen balance for the West African Dwarf rams was calculated as the difference between nitrogen intake and the total nitrogen excreted in feces and urine. Nitrogen retention percentage was determined by expressing the nitrogen balance as a percentage of the nitrogen intake (Ososanya *et al*., 2014).

RESULT AND DISCUSSION

Table 2 presents the performance characteristics of West African Dwarf rams fed diets containing garlic meal. Most of the parameters evaluated were not significantly influenced by garlic meal, except for dry matter concentrate intake and total daily dry matter intake. The diet with a 2% garlic inclusion level recorded the highest values of 348.51 g/day and 789.42 g/day for dry matter concentrate intake and total daily dry matter intake, respectively. In contrast, the control diet (0% garlic inclusion) recorded the lowest values of 215.27 g/day and 605.58 g/day, respectively. These values are higher than those reported by Odedire *et al*. (2023), who recorded 233.50 g/day and 409.18 g/day for dry matter concentrate intake and total daily dry matter intake,

respectively, in WAD sheep fed garlic and ginger. This difference may be attributed to the specific ingredients used in the experimental diets.

Table 3 shows the nitrogen balance of West African Dwarf rams fed diets containing garlic meal. All parameters evaluated were significantly influenced by the inclusion level of garlic, except for nitrogen in feces. Rams fed the 2% garlic inclusion diet recorded the highest values for nitrogen intake (17.52 g/day) and nitrogen in urine (1.01 g/day), while those fed the 0.5% garlic inclusion diet recorded lower values of 0.74 g/day for nitrogen in urine. Similarly, rams fed the 2% garlic inclusion diet also recorded the highest nitrogen retention value of 68.78%, compared to the control diet (0% garlic inclusion), which recorded the lowest value of 57.56%. Total nitrogen losses were highest at 5.74 g/day for the 2% garlic inclusion diet, while the lowest value of 5.09 g/day was observed in rams fed the 1% garlic inclusion diet. Nitrogen balance is considered a reliable indicator of the protein value of a diet (Babayemi and Bamikole, 2006). The higher nitrogen intake observed in animals fed 1.5% and 2.0% garlic inclusion levels may be attributed to the diets' crude protein content, which exceeded the 10% CP level recommended by Bengaly *et al*. (2007) for minimum growth in ruminants. This likely reduced the production of endogenous nitrogen, thereby improving apparent nitrogen digestibility (Jorgensen et al., 1996). All diets in this study resulted in positive nitrogen balances, indicating that the protein requirements for maintenance were adequately met. However, the nitrogen balance in this study was higher than the 4.07 g/day reported by Odedire *et al*. (2023) in sheep fed garlic and ginger.

CONCLUSION

It can be concluded from this study that garlic meal could be added up to 2% inclusion level for better nitrogen utilization feed intake in the diet of West African Dwarf rams.

Table 2: Performance characteristics of West African Dwarf Rams fed diet containing garlic meal

	Inclusion levels of garlic meal (%)					
Parameters	**T1 (0)**	**T2 (0.5)**	**T3 (1.0)**	**T4 (1.5)**	**T5 (2.0)**	**SEM**
Initial weight (kg)	17.30	17.39	17.34	17.40	17.45	0.04
Final weight (kg)	22.25	23.27	24.73	23.39	23.63	0.75
Weight gain (kg)	4.95	5.34	7.39	5.93	6.17	1.47
Metabolic weight ($W^{0.75}$)	3.32	3.52	4.45	3.81	3.91	1.50
Daily weight gain (g/day)	58.93	62.57	87.94	71.15	73.49	1.52
Daily dry matter grass intake (g/day)	387.31	351.14	384.66	408.38	440.91	1.26
Dry matter concentrate intake (g/day)	215.27^{c}	267.89^{b}	313.64^{a}	330.36^{a}	348.51^{a}	21.14
Total daily dry matter intake (g/day)	605.58^{b}	619.02^{b}	698.30^{b}	738.73^{a}	789.42^{a}	6.09
Feed conversion ratio	10.23	9.89	8.54	10.71	10.97	0.87

a–c means along the same row with different superscripts are significantly different $p<0.05$.

Table 3: Nitrogen balance of West African Dwarf Rams fed diet containing garlic meal

	Inclusion levels of garlic meal (%)					
Parameters	0.0	**0.5**	**1.0**	**1.5**	**2.0**	**SEM**
Nitrogen intake (g/day)	13.74^{b}	13.37^{b}	15.50^{ab}	16.39^{a}	17.52^{a}	1.23
Nitrogen in faeces (g/day)	4.74	4.74	4.33	4.67	4.45	0.27
Nitrogen in urine (g/day)	0.99^{a}	0.74^{b}	0.76^{b}	0.91^{a}	1.01^{a}	0.01
Total N- loses (g/day)	5.74^{a}	5.21^{bc}	5.09^{c}	5.57^{bc}	5.45^{abc}	0.24
N-balance (g/day)	7.99^{b}	8.16^{b}	10.41^{ab}	10.82^{a}	12.07^{a}	1.29
Nitrogen retention (%)	57.56^{c}	60.98^{bc}	67.06^{ab}	65.88^{ab}	68.78^{a}	3.83

a–c means along the same row with different superscripts are significantly different $p<0.05$.

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