

Effects of Garlic (*Allium sativum*) Powder Supplementation on Water Intake and Thermoregulation in Yankasa Rams

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Abstract

This study evaluated the effects of dietary garlic (*Allium sativum*) powder on water intake, water intake patterns, and thermoregulatory responses in Yankasa rams. Eighteen rams were assigned to three dietary treatments: Control (0% garlic), Low garlic (1.5% of dry matter [DM]), and High garlic (3.0% DM) over a 90-day trial. Garlic supplementation significantly reduced mean daily water intake by up to 18% ($p < 0.05$), particularly during midday. Supplemented rams also showed modest but significant reductions in rectal temperature ($\sim 0.3^{\circ}\text{C}$) and respiration rate (~ 10 breaths/min). These improvements in thermotolerance may be attributed to garlic's effects on rumen fermentation, microbiota modulation, and metabolic efficiency. Garlic supplementation thus represents a promising nutritional strategy to enhance water use efficiency and resilience to heat stress in ruminant systems.

Keywords: Garlic, water intake, thermoregulation, Yankasa rams, feed additives

Description of Problem

The reliance on antibiotic growth promoters in livestock production has raised concerns regarding antimicrobial resistance and residues in animal products, prompting interest in natural alternatives. Garlic (*Allium sativum*), rich in bioactive organosulfur compounds such as allicin, has been shown to improve growth performance, modulate rumen fermentation, and reduce methane emissions in ruminants (4). Despite these established benefits, the influence of garlic supplementation on water intake behaviour and thermoregulation have received limited attention. This gap is critical, particularly for breeds such as Yankasa rams that are frequently managed in hot, water-limited environments of Nigeria. Heat stress compromises feed efficiency, increases water demand, and reduces animal welfare (2).

We hypothesised that garlic supplementation would improve rumen fermentation efficiency, reduce metabolic heat production, and consequently lower water intake and improve thermotolerance in Yankasa rams.

Materials and Methods

Study Location and Animals

The experiment was conducted at the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Zaria, Nigeria. Eighteen (18) healthy adult Yankasa rams (25 ± 2 kg) were used.

Experimental Design

Animals were housed in open-sided pens under a completely randomised design and had *ad libitum* access to clean water. Feed was offered at 4% body weight daily (1.5% concentrate and 2.5% hay). Rams were randomized into three dietary treatments ($n = 6$ per group):

Control: 0% garlic powder (DM basis)

Low garlic: 1.5% garlic powder (DM basis)

High garlic: 3.0% garlic powder (DM basis)

Measurements

Daily water intake: Recorded from calibrated troughs.

Diurnal water intake pattern: Logged hourly to capture fluctuations, particularly during hot periods (08:00–14:00).

Thermoregulatory indicators: Rectal temperature and respiration rate were measured daily in the afternoon (13:00–14:00).

Ambient climate: Temperature and relative humidity were recorded to characterise heat stress conditions.

Statistical Analysis

Data were analysed using one-way ANOVA. Treatment means were separated by Tukey's test. Significance was declared at $p < 0.05$.

Results and Discussion

Effect of garlic supplementation on water intake and thermoregulatory parameters in Yankasa Rams

Garlic supplementation reduced mean daily water intake relative to Control ($p < 0.05$) (Table 1). Control rams exhibited two pronounced peaks (morning: 08:00; afternoon: 14:00). Garlic-supplemented rams showed attenuated afternoon peaks, with the High garlic group exhibiting the flattest profile. Garlic supplementation improved

thermotolerance, with reductions in both rectal temperature and respiration rate (Table 2).

This study demonstrates that garlic supplementation reduces daily water intake and attenuates midday drinking peaks in Yankasa rams while improving thermoregulatory indicators (5). The reduced water demand may reflect decreased metabolic heat production, consistent with garlic's reported effects on enhancing propionate production, reducing methane losses, and improving rumen efficiency. Lower heat increment likely reduces evaporative cooling needs (panting, sweating), thereby lowering thirst and water consumption (3). The modest reduction in rectal temperature ($\sim 0.3^\circ\text{C}$) and respiration rate (~ 10 breaths/min) confirms improved heat tolerance. These results align with previous studies showing garlic enhances rumen fermentation, immunity, and performance in lambs (1). Potential concerns regarding feed palatability at higher garlic levels were not observed in this study, but further research is warranted.

Table 1. Effect of garlic powder supplementation on daily water intake in Yankasa rams.

Treatment	Water intake (L/day)	% Change vs. Control
Control	4.81 ± 0.14	–
Low garlic	4.21 ± 0.12	–12.5%
High garlic	3.94 ± 0.11	–18.1%

Table 2: Effect of garlic supplementation on thermoregulatory parameters in Yankasa rams

Treatment	Rectal Temp. ($^\circ\text{C}$)	Respiration Rate (breaths/min)
Control	39.5 ± 0.2	42.3 ± 1.1
Low garlic	39.2 ± 0.2	34.1 ± 1.0
High garlic	39.1 ± 0.1	32.4 ± 0.9

Conclusion and Application

Garlic powder supplementation at 1.5% and 3.0% of dietary DM significantly reduced daily and midday water intake in Yankasa rams while modestly improving thermoregulatory parameters. These effects are likely mediated by improved rumen fermentation and metabolic efficiency. It is therefore recommended to:

1. Evaluate intermediate garlic levels (e.g., 2%) for optimal balance of performance and thermoregulation.
2. Extend trial duration to assess long-term effects on growth, reproduction, and health.
3. Conduct rumen fermentation profiling (VFA patterns, microbiota analysis) to elucidate mechanisms.

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