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EFFECT OF GUANIDINOACETIC ACID ON THE PERFORMANCE AND CARCASS OF FEEDLOT FED NELLORE YOUNG BULLS

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I. INTRODUCTION

Guanidinoacetic acid (GAA), as a feed additive, has been explored as an alternative source of creatine for meat-production animals. Studies conducted with poultry and swine supplemented with GAA have shown that this additive can stimulate protein synthesis and muscle growth, improving weight gain, feed efficiency, and meat quality [1][2]. In taurine beef breeds, recent studies have demonstrated that supplementing 0.6 g of GAA per kg of dry matter (DM) in finishing diets promoted greater weight gain and improved feed efficiency [3][4]. However, studies evaluating GAA supplementation in Zebu cattle, whether during pasture-based growth or feedlot finishing in tropical systems, have not yet been explored. The hypothesis is that feeding increasing levels of GAA would enhance energy metabolism and protein synthesis, improving muscle development and body composition during the finishing phase.

II. MATERIALS AND METHODS

The study was conducted at the School of Animal Science and Food Engineering of University of São Paulo in Pirassununga/SP, Brazil. The Ethics Committee on Animal Use approved the animal management and data collection procedures under protocol CEUA nº 9222010623.

Fifty-two recently weaned Nellore calves (8 ± 2 months of age) were used, distributed into four experimental treatments with different levels of GAA inclusion. During the grazing growing phase, which lasted 280 days, the animals received a daily supplement of 3 g per kg of body weight (BW), containing 3, 6, or 9 g of GAA per kg of dry matter (DM) of the supplement. In contrast, the control group received the supplement without the additive. In the feedlot finishing phase, the treatments were maintained with GAA inclusion in the concentrate at doses of 0.3, 0.6, or 0.9 g per kg of DM, subsequently provided in a total mixed ration (TMR). The control group received the same ration without GAA addition. The inclusion of GAA during the growing and finishing phases was adjusted to ensure that each animal ingested 3, 6, or 9 mg/kg of BW, regardless of the feeding method.

At the end of the growing phase, 51 young bulls (500.5±38 kg of BW; 18±2 months of age) were weighed and reorganized within their respective treatments to form blocks based on BW. The animals were allocated to three collective pens: two pens housed 16 young bulls each (four animals per treatment), while the third pen housed 19 young bulls (initially five per treatment, but one animal was removed during the growing phase). Each young bull was considered an experimental unit. Each pen was equipped with four Intergado® electronic feeders (Betim, MG, Brazil), capable of measuring individual feed intake and drinking troughs integrated with electronic scales to continuously monitor the animals' body weight. The total feedlot period lasted 94 days, including 20 days of adaptation to the facilities and the finishing diet. A "step-up" protocol was used during the adaptation period, progressively adjusting the forage-to-concentrate ratio (100:0, 75:25, 50:50, 25:75) every five days. The final diet was provided once daily at 8:00 a.m. and was adjusted according to the amount of feed refusals from the previous day. In cases of excessive refusals, they were removed, and the feed supply was readjusted. The animals' body weights were recorded at the beginning and end of the feedlot period. Based on individual feed intake data generated by the Intergado® system, dry matter intake (DMI) was determined, and this information was used to calculate average daily gain (ADG) and feed efficiency (FE). After the feedlot period, the animals were slaughtered, and the shrunk BW, back fat thickness (BFT) from *longissimus thoracis*, and hot carcass weight (HCW) were recorded. From the shrunk BW and HCW, the carcass yield was calculated. During slaughter, meat samples were collected for color analysis [5], cooking loss, Warner-Bratzler shear force (WBSF), and myofibrillar fragmentation index (MFI) [6].

Statistical analysis was performed using the SAS software (SAS 9.4, Cary, NC) with the MIXED procedure. Polynomial contrasts were employed to evaluate linear, quadratic, and deviation trends of treatments on the dependent variables. Effects were considered significant when $P \leq 0.05$, and trends were reported for $0.05 > P < 0.10$.

III. RESULTS AND DISCUSSION

During the finishing phase, a linear decreasing effect was identified for ADG (P = 0.032), with a trend toward a reduction in final BW (P = 0.090) as the GAA dose in the diet increased (Table 1). Compared to the CON group, there was a reduction of 222 g/day to 344 g/day in ADG. Other performance variables, such as DMI ($P \geq 0.162$), were not affected by GAA inclusion in the finishing diet, except for a linear trend toward reduced FE with increased GAA dose (P = 0.098). Regarding carcass characteristics, GAA supplementation did not significantly affect any of the variables analyzed ($P \geq 0.122$; Table 1). There was no interaction effect between treatment and aging time for any meat quality variable (Table 1). The treatment had no significant effect, except for cooking loss, which showed a linear decrease (P = 0.015), being lower in the GAA9 treatment compared to CON. Aging time influenced all meat quality variables ($P < 0.001$) except for the L* value (Table 1).

Table 1. Performance, carcass characteristic, and meat quality of Nellore young bulls fed with or without GAA during the finishing phase in the feedlot.

Traits	Treatments[1]				SEM	Pr > F[2]				
	CON	GAA3	GAA6	GAA9		L	Q	Deviation	Aging	T×A
Initial BW, kg	506.6	498.6	490.9	493.6	10.7	0.326	0.618	0.839	-	-
Final BW, kg	642.7	620.3	604.7	612.4	14.0	0.090	0.290	0.800	-	-
Shrunk BW, kg	624.1	621.1	606.0	607.9	12.4	0.245	0.847	0.620		
ADG, kg/d	2.09	1.87	1.75	1.83	0.09	0.032	0.125	0.822	-	-
DMI, %BW	1.75	1.70	1.86	1.90	0.08	0.107	0.557	0.430	-	-
FE, kg ADG/kg DM GAA	0.20	0.18	0.18	0.18	0.01	0.098	0.157	0.610	-	-
Hot carcass weight, kg	362.7	354.7	348.7	348.3	7.10	0.122	0.595	0.913	-	-
Back fat thickness, mm	2.77	2.83	2.70	2.79	0.29	0.962	0.960	0.752		
Carcass yield, %	58.1	57.1	57.5	57.3	0.27	0.149	0.191	0.168	-	-
Lightness (L*)	37.53	37.10	36.91	36.74	0.40	0.153	0.755	0.900	0.273	0.832
Redness (a*)	22.79	22.67	22.74	23.24	0.36	0.370	0.869	0.869	<0.001	0.665
Yellowness (b*)	15.69	15.25	14.97	15.80	0.41	0.974	0.129	0.612	<0.001	0.712
Cooking loss, %	28.00	27.64	27.07	27.11	0.28	0.015	0.512	0.501	<0.001	0.887
WBSF, N	57.59	56.68	58.45	58.80	1.10	0.260	0.563	0.412	<0.001	0.746
MFI	76.33	77.07	76.37	74.46	2.24	0.523	0.556	0.982	<0.001	0.802

[1]CON: Without adding guanidinoacetic acid (GAA) and GAA3, GAA6 and GAA 9: addition of 0.3, 0.6, and 0.9 g/kg of DM GAA, respectively.
[2]L: linear effect; Q: quadratic effect; Deviation: Quadratic deviation; T×A: treatment × aging interaction.

IV. CONCLUSION

Including different GAA doses in the finishing diet reduced ADG, with a trend toward lower FE. However, carcass characteristics were not influenced by GAA supplementation. Regarding meat quality, GAA supplementation reduced cooking loss. Further studies using rumen-protected GAA for cattle are recommended to enhance its effects.

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