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TAMARIND PULP ON EYE OF ROUND BEEF MARINATION

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I. INTRODUCTION

The global increase in population and purchasing power has led to a growing demand for meat and meat products, encouraging the development of innovative preservation strategies. Brazil is the second-largest beef producer and the leading global exporter [1]. However, meat is highly perishable due to microbial growth and lipid oxidation [2]. Marination is a widely used technique that enhances shelf life, flavor, texture, and color [3]. There has been growing interest in natural marinades using acidic fruit juices due to consumer demand for cleaner-label products [3]. Tamarind (*Tamarindus indica* L.) is an interesting alternative because it is rich in organic acids and phenolic compounds with antioxidant and antimicrobial properties and presents great potential as a natural marination liquid [4]. This study aimed to evaluate the effects of tamarind pulp as a marinade on the physicochemical and microbiological characteristics of the round beef (*Musculus semitendinosus)* during refrigerated storage.

II. MATERIALS AND METHODS

Three treatments were prepared from round beef (*Musculus semitendinosus*): C (control), B (2.5% brine), and BPT (2.5% brine and 100% tamarind pulp). Beef samples (eye of round, 120 g) were marinated by immersion for 20 hours at 4°C. Samples were vacuum sealed and stored at 4 ºC. Lipid oxidation was analyzed using the TBARS method [5], and pH was measured using a digital pH meter [3]. Total viable counts (TVC) and *Enterobacteriaceae* were incubated using Plate Count Agars and Violet Red Bile at 37 ºC for 24 and 48 hours [3], respectively. Statistical analysis was performed using ANOVA in SPSS 25.0 (SPSS Inc., Chicago, IL, USA), and Tukey's test assessed mean differences at a significance level of $p \leq 0.05$.

III. RESULTS AND DISCUSSION

pH and lipid oxidation of beef marinated with tamarind pulp and brine are presented in Table 1. Treatment BPT exhibited the lowest pH (4.01) ($p \leq 0.05$) during all storage. The BPT treatment's lower pH is linked to tamarind pulp's acid pH (2.5) [4]. The pH increase in B treatment probably is associated with proteolysis and salt diffusion during marination [6]. The control group (C) showed the lowest level of TBARs ($p \leq 0.05$) during storage, probably due to the decomposition of MDA in other compounds [3]. BPT treatment presented a significant decrease during the storage, with the lowest value observed on day seven (0.14) ($p \leq 0.05$), this behavior could be due to tamarind pulp being rich in antioxidants like phenolics and flavonoids [4]. Beltrán-Cotta et al., (2023) also observed that the salt concentrations of 1–2% can enhance lipid oxidation in meat [2], while marination helps reduce this effect [3].

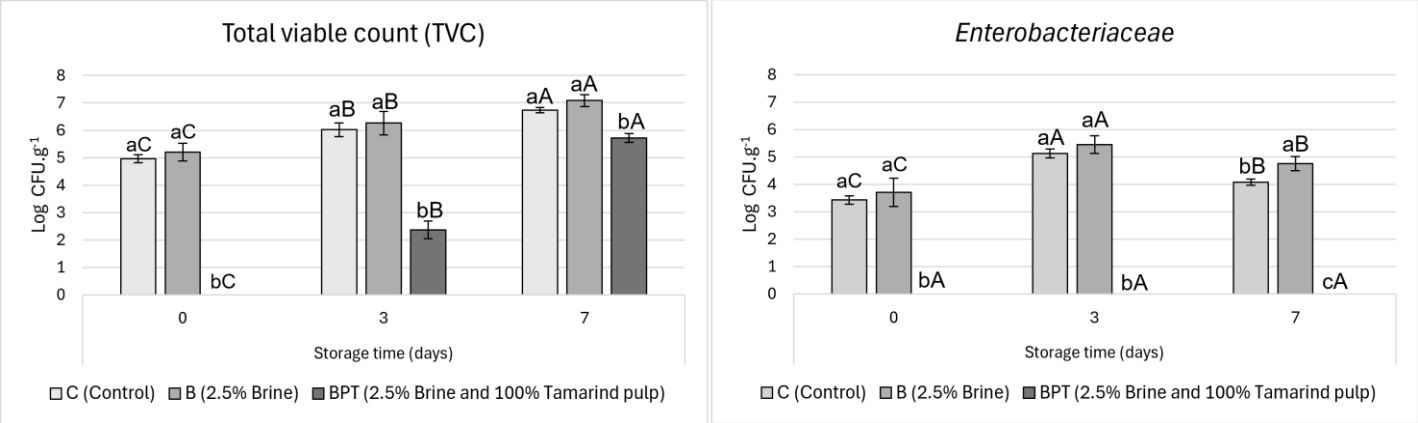
Table 1. – pH and lipid oxidation of eye of round beef samples marinated with tamarind pulp.

		Storage Time (Days)		
	Treatments	0	3	7
pH	C	5.48 ± 0.03^{aA}	5.43 ± 0.01^{bA}	5.28 ± 0.03^{bB}
	B	5.53 ± 0.00^{bA}	5.48 ± 0.01^{aA}	5.35 ± 0.01^{aB}
	BPT	4.17 ± 0.09^{cA}	4.06 ± 0.01^{cB}	4.01 ± 0.02^{cB}
TBARS	C	0.14 ± 0.03^{bA}	0.13 ± 0.05^{bA}	0.11 ± 0.02^{aA}
	B	0.21 ± 0.02^{aA}	0.22 ± 0.02^{aA}	0.20 ± 0.03^{bA}
	BPT	0.27 ± 0.05^{aA}	0.19 ± 0.03^{aB}	0.14 ± 0.02^{aB}

C (control), B (2.5% brine), and BPT (2.5% brine and 100% tamarind pulp)

Means ± standard deviation. Different lowercase letters (a-c) represent differences between treatments ($p \leq 0.05$) for each parameter analyzed. Different uppercase letters (A-B) represent differences between days of storage ($p \leq 0.05$) *for the same treatment*.

B treatment exhibited the highest (7.08) values ($p \leq 0.05$) of TVC, whereas the BPT treatment showed the lowest (5.72) ($p \leq 0.05$) at day 7 (Figure 1). In relation to *Enterobacteriaceae*, there was no growth in BPT treatment ($p \leq 0.05$), while treatment B presented the highest counts (5.45) on day 3 ($p \leq 0.05$). This can be explained by a possible internal contamination caused by the brining and vacuum packing [7]. Lower levels in TVC were observed in samples marinated with tamarind pulp, which is likely attributable to its low pH (2.5), a condition that inhibits bacterial proliferation [4]. Additionally, tamarind is rich in organic acids—particularly gallic, tartaric, and ascorbic acids [4]—that are known to compromise bacterial cell membranes, leading to cell lysis [3]. *Enterobacteriaceae* possess an outer membrane that facilitates molecular exchange with the environment, thereby allowing small organic acids to penetrate the cell and exert antimicrobial activity [3].



Different lowercase letters (a-c) represent differences between treatments ($p \leq 0.05$). Different uppercase letters (A-C) represent differences between days of storage ($p \leq 0.05$).

Figure 1.- Total viable count (TVC) and *Enterobacteriaceae* counts of round beef samples marinated with tamarind pulp.

IV. CONCLUSION

Marination with brine and tamarind pulp (BPT) resulted in lower pH and more stable lipid oxidation of eye of round beef during storage. Additionally, lower TVC and *Enterobacteriaceae* counts during storage were achieved. These findings highlighted the potential of tamarind pulp as a natural and healthy alternative for enhancing beef preservation.

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