71st ICoMST
GIRONA - CATALONIA - SPAIN
3rd-8th August - 2025

ACEROLA (*MALPIGHIA EMARGINATA*) EXTRACT AS A NATURAL PRESERVATIVE IN MERTOLENGA D.O.P. BEEF HAMBURGERS: IMPACT ON QUALITY AND SHELF LIFE

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I. INTRODUCTION

Meat provides essential high-quality protein and its global consumption is consistently growing [1,2]. However, the processing of ground meats, like hamburgers, significantly increases their perishability due to the expanded surface area, promoting rapid microbial growth and quality decline [3]. Consequently, the food industry is actively seeking natural alternatives to synthetic additives to improve food safety and extend shelf life [4]. This study evaluated the potential of *Malpighia emarginata* (acerola) extract as natural antioxidant in Mertolenga D.O.P. beef hamburgers. The acerola fruit (*Malpighia emarginata*) originates from the Yucatan Peninsula and subsequently spread throughout the Americas [5]. Increasingly recognized for its valuable health-promoting properties, acerola is gaining appreciation as a functional food ingredient due to its high content of ascorbic acid (vitamin C) and various antioxidant compounds, including carotenoids and anthocyanins [5,6]. Acerola fruit powder is a notable source of phenolic compounds, and has demonstrated both antioxidant and anti-inflammatory properties [5,7,8]. The main goal of this research was to evaluate whether the inclusion of this natural additive could positively influence the sensory and microbiological characteristics of hamburgers, and consequently, prolong their shelf life.

II. MATERIALS AND METHODS

Beef samples, specifically the semitendinosus and semimembranosus muscles, were sourced from three male Mertolenga D.O.P. animals at 4 days post mortem. These samples were used to prepare beef hamburgers, which were then divided into three experimental groups: control (no additives), salt (containing 1% salt), and acerola (1% salt + 0.3% acerola extract). Each hamburger was individually packaged in a modified atmosphere (70% O2: 30% CO2) and stored at 2°C. They were subjected to a comprehensive analysis that included microbial counts (total mesophilic and psychrotrophic populations, *Enterobacteriaceae*, *Pseudomonas* spp., *Brochothrix thermosphacta*, lactic acid bacteria, fungi, *Salmonella* spp., *Listeria monocytogenes*, and *Escherichia coli*), physicochemical properties (pH, water activity, and instrumental color – L*a*b* parameters), and sensory analysis, on days 1, 3, 5, 7, and 10.

III. RESULTS AND DISCUSSION

Microbiological analysis indicated the presence of mesophiles, psychrotrophs, *Enterobacteriaceae*, *Pseudomonas* spp., *Brochothrix thermosphacta*, lactic acid bacteria, and fungi throughout the storage period across all tested conditions. Overall, while acerola-added samples consistently exhibited a lower microbial load compared to the salt and control samples, these differences were not statistically significant ($p > 0.05$), suggesting that acerola did not significantly alter total microorganism counts. Acerola addition resulted in the lowest pH values throughout the analysis, suggesting its potential to lower pH in beef, likely due to its high ascorbic acid content [9]. Similarly, the acerola-added samples consistently had the lowest water activity throughout the study, followed by salt-treated and the control samples, with no significant differences observed between the groups. This supports the established principle that sodium chloride and other ions lower a_w in meat [10]. Analysis of the color parameters revealed no statistically significant differences between the acerola, salt, and control samples, indicating that acerola did not significantly affect the color of the hamburgers. However, sensory analysis demonstrated a positive impact of *Malpighia emarginata*, particularly in color stability and overall freshness (Figure 1). Notably, a significant decrease in deteriorated smell was observed in the acerola-treated samples at the final time point compared to the control ($p < 0.01$). This reduction in deterioration odor may be attributed to its potential to inhibit the growth of spoilage microorganisms, such as *Pseudomonas* spp [11]. Based on these sensory improvements, *Malpighia emarginata* is considered to increase the shelf life by one day compared to the control, as shown in Figure 1. The enhancement of sensory factors with acerola addition, coupled with the lack of significant physical changes, highlights its potential as a natural preservative.

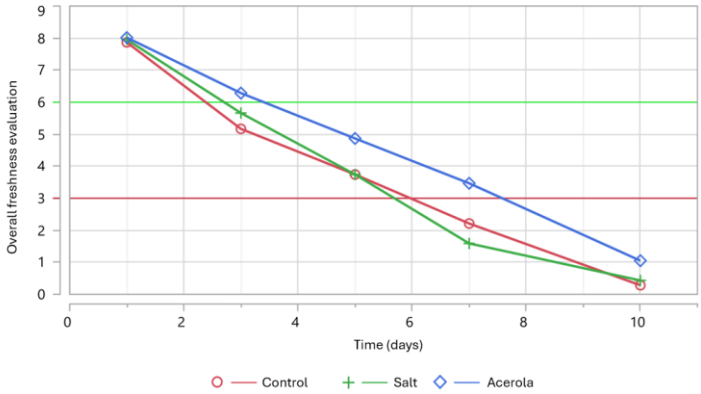


Figure 1. Overall Freshness Evaluation evolution in hamburgers under different treatments (control, salt, acerola), with freshness category thresholds marked by green (fresh/semi-fresh) and red (semi-fresh/spoiled) lines.

IV. CONCLUSION

The results of this study indicate that acerola is a promising natural antioxidant for application in meat products. Its inclusion in Mertolenga D.O.P. beef hamburgers led to improvements in key sensory attributes, including enhanced color stability, overall freshness, and a reduction in metallic off-odors. These positive effects on sensory quality suggest a potential extension of product shelf life. Further investigation should focus on precisely determining the optimal concentration and application strategies for acerola to fully leverage its benefits and ensure no detrimental effects on the overall quality of the final product

ACKNOWLEDGEMENTS

This work was supported by the project AgriFood XXI (NORTE-01-0145-FEDER-000041) and the Animal and Veterinary Research Center (CECAV).

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