BOUGAINVILLEA SPECTABILIS AS A POTENTIAL ALTERNATIVE TO NITRITES IN COOKED HAM ELABORATION

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I. INTRODUCTION

Nitrites (NO_2^-) and nitrates (NO_3^-) are commonly used additives aimed at enhancing meat quality. They play an important role by providing an attractive color to meat, enhancing flavor, contributing to the antioxidant properties, and improving antimicrobial characteristics. However, the International Agency for Research on Cancer (IARC) has stated that red and processed meat consumption is associated with cancer risk [1]. Thus, in the last decades, an effort has been made to explore additive alternatives to reduce the use of nitrites in processed meat. In this work the use of *Bougainvillea spectabilis* as an alternative to nitrites in ham is proposed. This flower, commonly used in Mexico as a natural remedy to address respiratory diseases [2], contains compounds such as flavonoids, alkaloids, phenols, and tannins, which contribute to its potential as a natural additive in meat products [2-5].

II. MATERIALS AND METHODS

Three different drying methods were evaluated to obtain the additives from *Bougainvillea spectabilis* bracts and flowers: air drying (BA), foam-mat drying (BF), and oven drying (BO). In foam-mat drying, the flowers were mixed with albumin, maltodextrin, hydroxyethyl cellulose, and Tween-80 as foaming agents and stabilizers, and then dried by application of hot air. Five cooked ham formulations composed by pork (71%), polyphosphates (0.5%), dextrose (0.7%), carrageenan (0.75%), sodium erythorbate (0.05%), and bougainvillea were designed. An injection of 40 % was applied and formulations were cooked to reach 69 °C core temperature. F1 batch contained 0.01% of BF, F2 batch 0.05% of BF, F3 0.25% of BF, F4 0.1% of BA, and F5 0.1% of BO. Two control batches were considered, one containing nitrites (Control NO) and the other without (Control). Each batch was divided into three equal portions, which were vacuum packed and stored at 4°C. Evaluation of meat antioxidant properties, color and organoleptic characteristics were conducted at weeks 0, 4 and 8. The evaluation of the antioxidant profile of the ham was carried out by DPPH, ABTS, and FRAP methodologies. Lipid oxidation was evaluated following the development of thiobarbituric acid reactive substances (TBARS). Nitrite content was determined by the Griess test with slight modifications [7]. Moisture content in ham was measured and CIEL*a*b* parameters were determined. Sensory evaluation of the samples was performed using a 5-point hedonic test conducted by twenty-one trained panelists. Hedonic scores ranged from 1 to 5 from very unpleasant (1) to excellent (5). The test included the evaluation of color, odor, texture, taste, and overall acceptability. Statistical analysis of the data obtained was performed using Minitab 17 software.

III. RESULTS AND DISCUSSION

Three bougainvillea powders were elaborated to provide the reddish color while offering antioxidant and antimicrobial properties to cooked ham as an alternative to nitrite salts (Figure 1). The addition of bougainvillea powders equaled or improved the antioxidant capacity in ham formulations without the presence of nitrite salts in comparison with the nitrite control. This antioxidant effect was affected by storage.

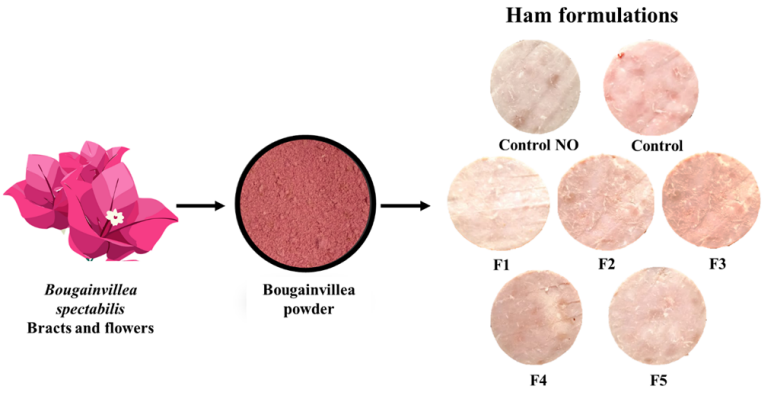

Figure1. *Bougainvillea spectabilis* powder and ham formulations

Nevertheless, the formulations containing the additives continued presenting higher scores of antioxidant activity compared to the control samples. After cold storage, this trend remained. The addition of bougainvillea additives in the formulation prevented the oxidation process of lipids determined by TBARs during storage compared with the control samples. The incorporation of the bougainvillea in ham did not significantly change the moisture content or pH ($p > 0.05$). Sensory evaluation of the ham was carried out on week 0, 4 and 8 of storage. The panelists gave the highest scores to the F4 formulation. After 8 weeks of storage (4°C) no changes in color were appreciated. Also, no unpleasant odors or flavors were perceived.

IV. CONCLUSION

To the best of our knowledge, this is the first work to propose the use of *Bougainvillea spectabilis* as an antioxidant additive in ham. Evaluation through DPPH, ABTS, and FRAP assays demonstrated the efficacy of bougainvillea in mitigating oxidation during storage, enhancing sensory qualities. Among the drying methods investigated, air drying exhibited superior antioxidant and sensory effects. Ham formulations presented a high score in overall acceptability during the sensory evaluation. *Bougainvillea* presents potential to replace the use of nitrite salts in ham elaboration.

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