USE OF MESQUITE POD EXTRACT AS AN ADDITIVE TO EXTEND THE SHELF LIFE OF MEAT

Mirian Y. Lorenzo-Justo[1], Víctor M. Rivera-Castro[1], Rey D. Vargas-Sánchez[2], Gastón R. Torrescano-Urrutia[3], and Armida Sánchez-Escalante[3*]

[1]Universidad Autónoma de Guerrero, Cruz Grande, Gro., México; [2]Universidad Autónoma de Sinaloa, Culiacán, México; [3]Centro de Investigación en Alimentación y Desarrollo, A.C., Hermosillo, México.
*Corresponding author email: armida-sanchez@ciad.mx

Abstract – Mesquite trees have been described as an important source of biologically active compounds that exert antioxidant and antibacterial activity. The aim of this work was to evaluate the chemical composition (TPC, total phenolic content; TFC, total flavonoid content) in addition to the antioxidant (antiradical-DPPH• activity; RP, reducing power activity) and antibacterial activity (MIC, minimum inhibitory concentration) of mesquite pod extracts obtained with different solvents (aqueous, aqueous-ethanol and ethanol). The results showed that mesquite pod extracts (aqueous-ethanolic > ethanolic > aqueous) exert great antioxidant and antibacterial activity against Gram-positive and Gram-negative bacteria (>90% inhibition). In conclusion, mesquite pod extracts can possibly be used as antioxidant and antibacterial compounds for extending the shelf life of meat and meat products.

Key Words – Natural extract, antioxidant, antibacterial, meat.

I. INTRODUCTION

Lipid oxidation (LOX) and microbial growth (MG) are the major causes of quality degradation in foods. LOX products and microbial spoilage are responsible for off-odours and flavours in meat and meat products. The processing of shelf-stable meat products involves the use of synthetic antioxidants and antimicrobial additives. In recent years, consumers have become increasingly concerned over the safety of synthetic additives in foods. As a consequence, the use of natural additives extracted from fruits, species, honeybee products, edible mushrooms or plants with antioxidant or antibacterial properties has increased [1,2]. Mesquite is a flowering tree that belongs to the *Fabaceae* family and is widely distributed throughout north-western Mexico (Sonoran Desert). Different parts of the plant are useful for treating many diseases and are also used in animal and human food (leaves and pods) [1, 2]. However, the utilisation of mesquite pods as a natural source of antioxidants and antimicrobial compounds has not been evaluated. Therefore, the objective of this study was to generate mesquite pod extracts (*Prosopis velutina*) and to evaluate their antioxidant and antibacterial activity.

II. MATERIALS AND METHODS

In vitro antioxidant activity was evaluated by determining the total phenolic content (TPC) with Folin-Ciocalteu´s assay and the total flavonoid content (TFC) with $AlCl_3$ assay in addition to free radical scavenging activity (DPPH•, 1,1- diphenyl-2-picrylhydrazyl) and reducing power (RP) using the ferricyanide/prussian blue assay. The antimicrobial activity was evaluated against Gram-positive (*Staphylococcus aureus* and *Listeria innocua*) and Gram-negative (*Escherichia coli* and *Pseudomona aeruginosa*) bacteria, in a micro-dilution assay [2, 3]. An analysis of variance (ANOVA) was used to analyse the data, and the Tukey-Kramer method was used to compare the averages ($P<0.05$).

III. RESULTS AND DISCUSSION

The antioxidant activity of extracts obtained from plants is widely known to be associated with phenolic constituents such as hydroxycinnamic acids, anthocyanins, tannins and flavonoids, which possess the ability to act as free radical scavengers or ion metal chelators. Several standardised methods for quantifying active constituents have been proposed for use in the routine quality control of natural extracts and for measuring the antioxidant capacity of food products and dietary supplements, including the determination of total phenolic or flavonoid content [3, 4]. In this study, the results indicate that aqueous-ethanolic > ethanolic

extract, that showed a higher total phenolic (TPC) and flavonoid content (TFC) (i.e. >60 mg gallic acid equivalent/g and >4.7 mg quercetin equivalents/g, respectively) in comparison to ethanolic extract (P<0.05). According to international norms, the minimum concentrations required for the development of a natural extract product are 50 mg of GAE and 5 mg QE/g of dried extract [5], confirming that mesquite pod extracts meet the established quality requirements.

Table 1. Antioxidant activity of mesquite pod extracts.

Extract	TPC [A]	TFC [B]	DPPH• [C]	RP [D]
Aqueous	31.1 ± 0.7^{a}	1.2 ± 0.2^{a}	62.1 ± 0.6^{b}	0.58 ± 0.01^{a}
1:1	91.4 ± 1.0^{c}	4.7 ± 0.3^{b}	85.3 ± 1.9^{c}	1.18 ± 0.01^{c}
Ethanol	60.3 ± 3.1^{b}	7.3 ± 0.1^{c}	58.0 ± 0.1^{a}	0.63 ± 0.02^{b}

All values represent the mean ± standard deviation of three replicates. [A]TPC, total phenolic content (mg eq. gallic acid/g of extract); [B]TFC, total flavonoid content (mg eq. quercetin/g of extract); [C]DPPH•, expressed as %; [D]RP, reducing power (absorbance at 700 nm). Superscript letters [(a-b)] indicate significant differences between treatments (P<0.05).

The results of antimicrobial activity are shown in Fig. 1. Mesquite pod extracts (500 µg/mL of solution) exhibited great antibacterial properties (>90% inhibition of microbial growth) at 48 h (aqueous ethanolic extract = ethanolic extract = the antibiotic gentamicin > aqueous extract) in comparison with the negative control (P<0.05). These results could be associated with the presence of phenolic constituents in the mesquite pod extracts.

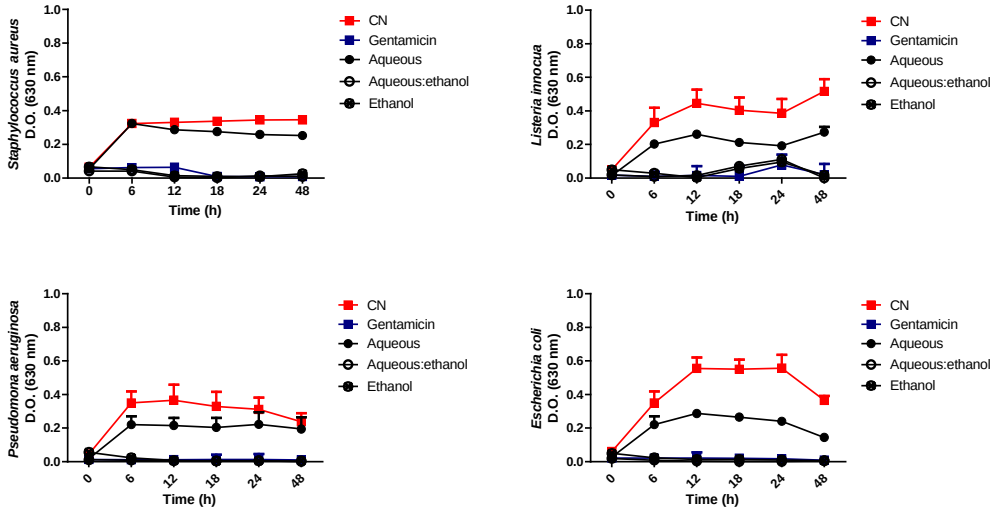

Fig. 1. Antibacterial activity of mesquite pod extracts.

IV. CONCLUSION

The results of this study demonstrated that mesquite pod extracts have a high total phenolic and flavonoid content and exhibit high antioxidant and antimicrobial activity. The aqueous-ethanolic and ethanolic extracts showed the best activities. Therefore, mesquite pod extracts can potentially be used to stabilise oxidative reactions and to reduce the growth of certain pathogenic microorganisms commonly found in meat and meat products.

ACKNOWLEDGEMENTS
The authors are grateful for Dafne Velásquez-Jiménez and her technical assistance during this project.

REFERENCES

1. Faustman, C., Sun, Q., Mancini, R., & Suman, S. P. (2010). Myoglobin and lipid oxidation interactions: Mechanistic bases and control. Meat Science 86(1): 86-94.
2. Almaraz-Abarca, N., da Graça Campos, M., Avila-Reyes, J. A., Naranjo-Jimenez, N., Corral, J. H., & Gonzalez-Valdez, L. S. (2007). Antioxidant activity of polyphenolic extract of monofloral honeybee-collected pollen from mesquite (*Prosopis juliflora*, Leguminosae). Journal of Food Composition and Analysis 20(2): 119-124.
3. Velazquez, C., Navarro, M., Acosta, A., Angulo, A., Dominguez, Z., Robles, R., ... & Astiazaran, H. (2007). Antibacterial and free-radical scavenging activities of Sonoran propolis. Journal of Applied Microbiology 103(5): 1747-1756.
4. Ainsworth, E. A., & Gillespie, K. M. (2007). Estimation of total phenolic content and other oxidation substrates in plant tissues using Folin–Ciocalteu reagent. Nature Protocols 2(4): 875-877.
5. IRAM. (2004). Norma IRAM 15935-1 Scheme 1. Buenos Aires: Instituto Argentino de Normalización-Subcomité de productos agroalimentarios del NOA; 2004.