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GREEN COFFEE BEAN EXTRACT AS A NATURAL ADDITIVE FOR PRESERVING BEEF

Armida Sánchez-Escalante[1*], Wendy Alejandra Atondo-Echeagaray[1], Brisa del Mar Torres-Martínez[1], Gastón R. Torrescano-Urrutia[1], Nelson Huerta-Leidenz[2], Rey David Vargas-Sánchez[1]

[1] Centro de Investigación en Alimentación y Desarrollo, Coordinación de Tecnología de Alimentos de Origen Animal, Hermosillo, México.

[2] Texas Tech University, Department of Animal and Food Sciences, Lubbock, USA.

*Corresponding author email: armida-sanchez@ciad.mx

I. INTRODUCTION

Beef preservation is a key challenge to the meat industry due to its susceptibility to lipid oxidation and microbial growth, which reduce quality and shelf-life. Natural additives have gained interest as an alternative to synthetic preservatives because the latter may raise consumer concerns [1]. Green coffee beans have been identified as a rich source of bioactive compounds, such as chlorogenic acids, with antioxidant and antibacterial properties [2]. This study evaluates the effect of green coffee bean extract as an alternate additive for the preservation of beef, hypothesizing that its incorporation will become a more natural and sustainable approach for mitigating lipid oxidation and microbial growth.

II. MATERIALS AND METHODS

Green coffee beans (*C. arabica*) were purchased from a local commercial supplier and pulverized (80 mesh). Metabolites from pulverized samples were obtained through ultrasound-assisted extraction (42 kHz/25°C/30 min), using water, ethanol, and a mixture (1:1 ratio) as solvent extraction (1:10 ratio). The resultant solution was filtered (Whatman 1), concentrated (150 rpm/60°C), and dried (20 Pa/-80°C/48 h). The obtained extracts were subjected to evaluation of metabolites (TPHC and CGA, total polyphenol and chlorogenic acids content), antioxidants (DPPH and ABTS, free-radical and radical scavenging activities), and antimicrobial properties (*Staphylococcus aureus* and *Escherichia coli* inhibition) [3]. Minced beef (73.5% *Semimembranosus* m., 20% backfat, 1.5% salt, and 5% water) was homogenized in distilled water (1:10) at 6000 rpm/5°C/1 min, adding 1 mL of antioxidants: 100 µg/g of green coffee bean extracts (water, ethanol, and 1:1 mixture); CN (-), negative control; CN (+), 100 µg/g of ascorbic acid. The samples were heated (52°C/120 min) and subjected to meat quality assays, including pH, lipid oxidation (TBARS), and total mesophilic bacteria count (TBC) [4]. Results are presented as mean ± standard deviation (n=6). Data were subjected to a one-way analysis of variance and the Tukey test ($P<0.05$).

III. RESULTS AND DISCUSSION

Table 1 shows results for the polyphenol content, antioxidant, and antimicrobial activities, indicating that hydroalcoholic and ethanolic extracts present the highest TPHC. In contrast, the hydroalcoholic extract resulted in higher CGA values. Regarding the absorbance capacity, the ethanolic extract showed the lowest values ($p<0.05$) for DPPH, whereas the hydroalcoholic extract presented the lowest absorbance values ($p<0.05$) for ABTS, indicating a more significant inhibition of radicals. Concerning antimicrobial activities, the hydroalcoholic extract shows the weakest absorbances ($p<0.05$), suggesting a lower bacterial growth.

Table 1 – Green coffee bean extracts' polyphenol content, antioxidant and antimicrobial activity.

Extract	TPHC (g GAE/L)	CGA (g CGA/L)	DPPH (Abs 517 nm)	ABTS (Abs 730 nm)	*S. aureus* (Abs 630 nm)	*E. coli* (Abs 630 nm)
Water	101.10 ± 4.51^{a}	82.50 ± 2.35^{b}	0.82 ± 0.01^{c}	0.22 ± 0.01^{d}	0.25 ± 0.01^{c}	0.23 ± 0.01^{c}
Ethanol	125.22 ± 4.70^{b}	45.02 ± 2.65^{a}	0.06 ± 0.01^{a}	0.11 ± 0.01^{c}	0.26 ± 0.01^{c}	0.28 ± 0.01^{d}
1:1	121.60 ± 3.60^{b}	115.20 ± 2.00^{c}	0.35 ± 0.01^{b}	0.07 ± 0.01^{b}	0.20 ± 0.01^{b}	0.17 ± 0.01^{b}
Control (-)			1.15 ± 0.01^{d}	0.80 ± 0.01^{e}	0.27 ± 0.01^{d}	0.32 ± 0.01^{e}
Control (+)			0.05 ± 0.01^{a}	0.04 ± 0.01^{a}	0.09 ± 0.01^{a}	0.10 ± 0.01^{a}

GAE, gallic acid equiv. CGA, chlorogenic acid equiv. Abs, absorbance.

According to our findings, the effect of green coffee bean extracts against DPPH and ABTS radicals has been demonstrated, and it can be associated with the presence of polyphenols, particularly chlorogenic acid [5]. The effect of green coffee bean extract against *S. aureus* and *E. coli* had been previously reported [6].

The results of incorporating additives in heated beef homogenates (Figure 1) reveal a slight reduction of pH values ($p<0.05$) as compared to the control. Adding hydroalcoholic extract resulted in the lowest lipid oxidation and TBC values ($p<0.05$).

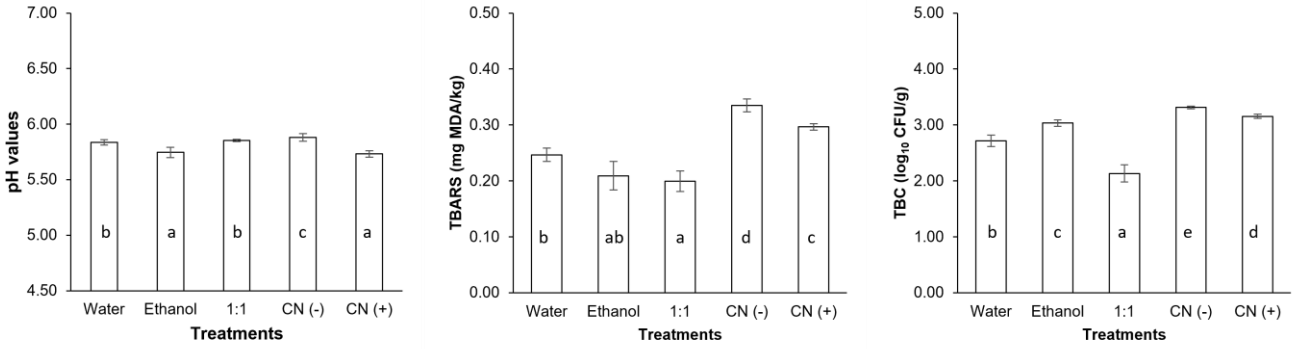


Figure 1. Effect of extract inclusion on pH, TBARS, and TBC values of heated beef meat homogenates.

Experience in the use of green coffee bean extracts as preservatives in meat product formulation is limited. The incorporation of these extracts into minced beef homogenates did not affect their pH values. However, TBARS and TBC values decreased in concentration dependence, which has been associated with its chlorogenic acid content [7]. Incorporating green coffee bean extract into pork patties has decreased TBARS values without affecting the pH of the final product, and again, this effectiveness was associated with the content of polyphenols like chlorogenic acid [8].

IV. CONCLUSION

The addition of green coffee bean extracts to beef homogenates offers promising results in the reduction of both lipid oxidation and microbial growth. Therefore, these extracts can become an alternative source of natural antioxidants and antimicrobial additives for the meat industry.

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