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PITHOCELLOBIUM DULCE FRUIT SHELL EXTRACT: ENHANCING ANTIOXIDANT AND ANTIBACTERIAL ACTIVITY OF BEEF

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I. INTRODUCTION

Beef quality and safety are critical concerns in the meat industry, as they are directly influenced by lipid oxidation and the proliferation of pathogenic microorganisms. Plant-derived extracts have emerged as promising natural alternatives to synthetic preservatives due to their antioxidant and antimicrobial properties [1,2]. *Pithocellobium dulce*, a leguminous species widely found in tropical regions, contains bioactive compounds with antioxidant and antibacterial potential [3]. This study assesses the impact of *P. dulce* fruit shell extract on beef, specifically evaluating its ability to mitigate lipid oxidation and bacterial growth. The findings may support the utilization of this extract as a natural meat preservative, contributing to the development of healthier, longer-lasting meat products without synthetic additives.

II. MATERIALS AND METHODS

P. dulce fruit shells were collected (26°15'53" N, 105°57'23" W; 140 masl), dried (50°C for 24 h), and ground (80 mesh). The powder underwent ultrasound-assisted extraction (42 kHz, 25°C, 30 min) using an aqueous-ethanol solvent mixture (1:10 powder-to-solvent ratio). The extract was subsequently filtered (Whatman No. 1 paper), concentrated (150 rpm, 60°C), and freeze-dried (20 Pa, -80°C, 48 h). The obtained aqueous-ethanol extract was analyzed for total polyphenol content (TPHC) and chlorogenic acid content (CGA), along with antioxidants (DPPH, ABTS assays) and antimicrobial (*Staphylococcus aureus* and *Escherichia coli* inhibition) activities [4]. Fresh minced beef (73.5% *Semimembranosus* muscle, 20% backfat, 1.5% salt, and 5% water) was homogenized with distilled water (1:10 ratio, 6000 rpm, 5°C, 1 min), followed by the addition of 1 mL of antioxidants: Extract (200 ppm of *P. dulce* fruit shell aqueous-ethanol extract), CN (-) (negative control), and CN (+) (200 ppm of ascorbic acid). The samples were heated in a water bath (52°C, 120 min) and subjected to meat quality analyses, including pH measurement, lipid oxidation (TBARS assay), and total mesophilic bacterial count (TBC) [5]. Results are expressed as mean ± standard deviation (n=6). Statistical analyses were conducted using one-way ANOVA followed by Tukey-Kramer mean separation test ($P < 0.05$).

III. RESULTS AND DISCUSSION

The polyphenol content and bioactivity analysis (Table 1) demonstrated that *P. dulce* fruit shell extract contains phenolic compounds and chlorogenic acid (3.02 ± 0.06 g GAE/100 g and 23.20 ± 0.34 g CAC/100 g, respectively). Furthermore, it exhibited significantly lower absorbance values ($p < 0.05$) in the DPPH and ABTS radical scavenging assays compared to the negative control, indicating a higher capacity for radical inhibition.

Table 1 – Polyphenol content, antioxidant, and antimicrobial activity of *P. dulce* fruit shell extract.

Treatment	DPPH (Abs 517 nm)	ABTS (Abs 730 nm)	*S. aureus* (Abs 630 nm)	*E. coli* (Abs 630 nm)
Extract	0.09 ± 0.01^{b}	0.04 ± 0.01^{a}	0.08 ± 0.01^{a}	0.16 ± 0.01^{b}
Control (-)	0.65 ± 0.01^{c}	0.46 ± 0.01^{c}	0.17 ± 0.01^{b}	0.35 ± 0.02^{c}
Control (+)	0.06 ± 0.01^{a}	0.17 ± 0.02^{b}	0.09 ± 0.01^{a}	0.10 ± 0.01^{a}

Abs, absorbance.

Regarding antimicrobial activity, the extract also showed significantly lower absorbance values ($p < 0.05$) in both *S. aureus* and *E. coli* assays compared to the negative control, suggesting reduced bacterial proliferation. Although limited studies have investigated the composition and properties of *P. dulce* fruit shell, prior research aligns with our findings, reporting that its leaves and fruit possess antioxidants and antimicrobial properties (effective against *S. aureus*, *B. subtilis*, and *E. coli*), likely attributable to their phenolic content [3,6].
The results for *P. dulce* extract in heated meat homogenates (Table 2) indicate that treated samples exhibited the highest pH values and the lowest lipid oxidation (TBARS) and total aerobic mesophilic count (TBC).

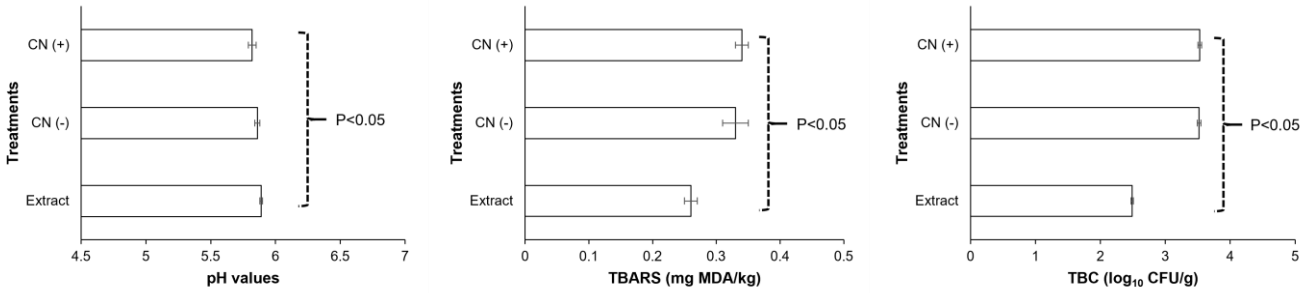


Figure 1. Effect of adding *P. dulce* fruit shell extract on pH, TBARS, and TBC values of heated beef homogenates.

Although research on *P. dulce* as an antioxidant and antimicrobial agent for meat products is scarce, previous studies have reported that plant-derived fruit peel extracts enhance meat products' oxidative and microbiological stability [7,8].

IV. CONCLUSION

The aqueous-ethanol extract of *P. dulce* fruit shell exhibits potent antioxidants and antimicrobial properties, effectively inhibiting radical formation and bacterial growth. When incorporated into beef homogenates, it reduces pH, lipid oxidation, and microbial load, demonstrating its potential as a natural preservative for improving meat quality and shelf-life.

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