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

PLEUROTUS GENUS EXTRACTS AS A NATURAL ANTIOXIDANT AND ANTIBACTERIAL ADDITIVE IN BEEF

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I. INTRODUCTION

Beef is an important source of proteins, lipids, and essential micronutrients; however, its lipidic and nitrogen compounds make it susceptible to lipid oxidation and microbial growth, affecting its quality. Synthetic additives have been widely used, but their potential impact on health has driven the search for natural alternatives [1,2]. Edible mushrooms of the *Pleurotus* genus possess antioxidant and antimicrobial properties due to their bioactive compounds [3]. This study evaluates the effectiveness of *Pleurotus citrinopileatus*, *Pleurotus ostreatus*, and *Pleurotus djamor* extracts as functional preservatives of the beef quality. It is hypothesized that its incorporation will reduce lipid oxidation and microbial counts, which could offer a natural and sustainable alternative to synthetic additives.

II. MATERIALS AND METHODS

Pleurotus spp. were purchased from a local commercial supplier, dried (50°C/24 h), and pulverized (80 mesh). The mushroom powder was subjected to ultrasound extraction (42 kHz/25°C/30 min), using a mixture of aqueous-ethanol solution as solvent extraction (1:10 ratio). The resultant mixture was filtered (Whatman 1), concentrated (150 rpm/60°C), and dried (20 Pa/-80°C/48 h). The obtained aqueous-ethanol extract was assayed for polyphenols (TPHC and CGA, total polyphenol and chlorogenic acids), antioxidants (DPPH and ABTS, free-radical and radical cation scavenging activities), and antimicrobial properties (*Staphylococcus aureus* and *Escherichia coli* inhibition) [4]. Minced beef (73.5% *Semimembranosus* m., 20% backfat, 1.5% salt, and 5% water) was homogenized with distilled water (1:10 ratio/6000 rpm/5°C/1 min) and subsequently with 1 mL of antioxidants. Samples included each aqueous-ethanol extract from *Pleurotus* spp. (200 ppm); negative control [CN (-)], and ascorbic acid (200 ppm) as a positive control [CN (+)]. The samples were heated in a water bath (52°C/120 min) and subjected to meat quality assays, including pH, lipid oxidation (TBARS), and total mesophilic bacteria count (TBC) [5]. Results are presented as mean ± standard deviation (n=6). Data were subjected to a one-way analysis of variance and the Tukey test for mean separation ($P<0.05$).

III. RESULTS AND DISCUSSION

The presence of polyphenols in the aqueous-ethanol extracts from *Pleurotus* spp was confirmed. Concerning antioxidant and antimicrobial assays (Table 1), DPPH and ABTS radicals show lower absorbance values ($p<0.05$) than the negative control, indicating a more significant radical inhibition.

Table 1 – Polyphenol content, antioxidant, and antimicrobial activity of *Pleurotus* spp extracts.

Treatment	TPHC (g GAE/100g)	CGA (g CGA/100g)	DPPH (Abs 517 nm)	ABTS (Abs 730 nm)	*S. aureus* (Abs 630 nm)	*E. coli* (Abs 630 nm)
P. citrinopileatus	1.65 ± 0.09^{b}	2.24 ± 0.08^{a}	0.39 ± 0.01^{c}	0.27 ± 0.01^{c}	0.08 ± 0.01^{a}	0.15 ± 0.01^{b}
P. djamor	1.70 ± 0.13^{b}	2.31 ± 0.04^{b}	0.38 ± 0.01^{c}	0.28 ± 0.01^{c}	0.09 ± 0.01^{a}	0.13 ± 0.01^{b}
P. ostreatus	1.34 ± 0.22^{a}	2.26 ± 0.11^{ab}	0.09 ± 0.01^{b}	0.04 ± 0.01^{a}	0.08 ± 0.01^{a}	0.14 ± 0.01^{b}
Control (-)			0.54 ± 0.01^{d}	0.34 ± 0.01^{d}	0.18 ± 0.01^{b}	0.35 ± 0.01^{b}
Control (+)			0.04 ± 0.01^{a}	0.20 ± 0.01^{b}	0.08 ± 0.01^{a}	0.11 ± 0.01^{a}

Abs, absorbance.

Regarding antimicrobial properties, the extracts present low absorbance values ($p<0.05$) for both strains as compared to the negative control, indicating lower bacterial growths. Previous research [6] had demonstrated the effects of *Pleurotus* spp. extracts (*P. levis*, *P. ostreatus*, *P. tuber-regium*, and *P. pulmonarius*) against DPPH and ABTS radicals, which are associated with the presence of polyphenols. Also, the effect of *P. citrinopileatus* extracts against pathogenic bacteria such as *S. aureus*, *L. monocytogenes*, *B. supbtilis*, *E. coli*, *S. typhi*, and *P. aeruginosa* has been reported [6,7].

With the only exception of the heated samples of meat homogenates added with *P. djamor* extract (Table 2) the treated samples present the lowest pH values; as well as the lowest lipid oxidation (TBARS) and total aerobic mesophilic count (TBC) values ($p<0.05$).

Table 2 – Effect of extract inclusion on pH, TBARS, and TBC values of heated beef meat homogenates.

Treatment	pH value	TBARS (mg MDA/kg)	TBC (Log_{10} CFU/g)
P. citrinopileatus	5.76 ± 0.01^{a}	0.24 ± 0.01^{a}	2.43 ± 0.04^{a}
P. djamor	5.91 ± 0.01^{c}	0.25 ± 0.02^{a}	2.49 ± 0.02^{a}
P. ostreatus	5.76 ± 0.02^{a}	0.25 ± 0.01^{a}	2.80 ± 0.01^{b}
Control (-)	5.86 ± 0.02^{b}	0.35 ± 0.01^{b}	3.54 ± 0.01^{c}
Control (+)	5.83 ± 0.03^{b}	0.34 ± 0.01^{b}	3.49 ± 0.07^{c}

Abs, absorbance.

These findings are like those of previous studies in which *P. pulmonarius* extracts in pork burgers slightly reduced pH and attenuated changes in pH, TBARS, and TBC following oxidation induction [7]. The addition of *Pleurotus djamor* flour (5%) to stored beef burgers (-20 °C/12 days) decreased pH, TBARS, and microbial count, which were attributed to its anti-radical properties and polyphenol content [8].

IV. CONCLUSION

The aqueous-ethanolic extract of *Pleurotus* spp. shows high antioxidant and antimicrobial capacity, reducing radical formation and bacterial growth. Its inclusion in meat homogenates decreases pH, lipid oxidation, and microbial load, demonstrating its potential as a natural additive to improve the quality and stability of fresh beef products.

ACKNOWLEDGEMENTS

The authors thank SECIHTI for the fellowship from the "*Investigadoras e Investigadores por México program*" (Project 739).

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