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Effects of Degree of Roast and Application Form of Incorporated Coffee on Inhibition of Oxidation in Raw Refrigerated Minced Pork and Sensory Analysis of Cooked Pork Patties with Added Coffee

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Antioxidant Capacity of Coffee in Raw Refrigerated Minced Pork and Sensory Analysis of Cooked Pork with Added Coffee

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INTRODUCTION

Lipid and protein oxidation (LOX and POX) play significant roles in altered flavor and color of raw pork, as the degradation of polyunsaturated fatty acids generates free radicals (Fig. 1). Adverse changes in and among proteins also occurs, including the conversion of oxymyoglobin to metmyoglobin (MetMb), causing meat discoloration (1). Coffee beans naturally contain antioxidants; however, these levels decline as Maillard reaction products (MRPs) form during roasting. Metal chelating properties and free radical scavenging abilities of phenolic compounds in coffee contribute to its inhibition of LOX (2).

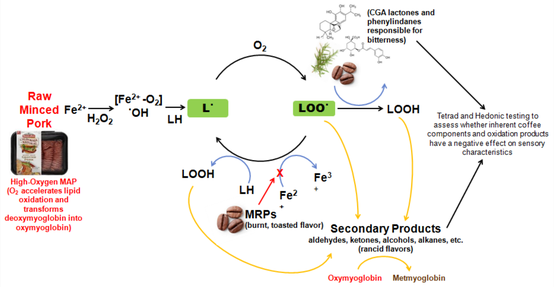

Fig. 1. Lipid and protein oxidation in pork are inhibited by coffee and rosemary components

Coffee may be a more practical choice compared to other natural antioxidants used in the pork industry such as rosemary extract. The US is the #1 importer of coffee, and it can be incorporated into pork with minimal processing beforehand (3). The possibility of using spent coffee, a form of coffee which can negatively impact the environment when disposed of as solid waste, could also be a sustainable practice for the coffee and meat industry (4).

Hedonic and tetrad tests are also needed to determine whether sensory attributes are sacrificed when coffee is added to pork. The tetrad test has been shown to produce more precise estimates of differences between samples compared to triangle and duo–trio protocols, other popular discrimination tests (5). If coffee can be incorporated as an antioxidant in the meat industry, consumers, grocers, and food corporations will have another natural method of prolonging quality and shelf life of ground pork by inhibiting lipid oxidation-induced rancidity and spoilage.

EXPERIMENTAL OBJECTIVES

- Determine the antioxidant effect of 0.1% w/w roasted coffee with varying roast degree (light, dark) and application form (lyophilized brew, spent, ground) on LOX and POX in chilled minced pork
- Compare the antioxidant capacity of coffee to rosemary
- Determine whether pork with added coffee would be accepted by consumers

SAMPLE PREPARATION and KEY ASSAYS

Sample storage

Fig. 2 Minced pork treatments were stored in MAP packaged trays with 74-84% O_2 and 16-26% CO_2. An unopened tray was used on each day of data collection.

CONTROL (no coffee or rosemary)

LIGHT ROAST Lyophilized brewed coffee, Lyophilized spent coffee, Ground coffee, 1 g coffee/kg pork

DARK ROAST Lyophilized brewed coffee, Lyophilized spent coffee, Ground coffee, 1 g coffee/kg pork

ROSEMARY oleoresin 0.2 g/kg pork

Packaged under high-oxygen MAP (Fig. 2), refrigerated at 4 °C for 20 days

Days 2, 7, 12, 14, 17, and 20
- MAP Gas Analysis
- TBARS assay
- Thiol Oxidation Assay
- Color (CIE L*, a*, b*)

Days 12, 14, 17, and 20
- % Metmyoglobin

Days 1 and 3
- Hedonic and Tetrad Sensory Analysis

KEY FINDINGS

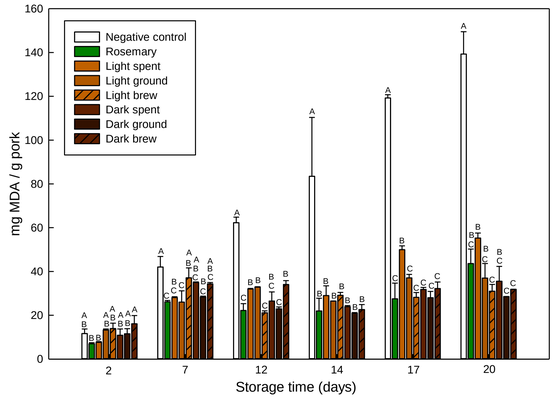

Fig. 3. TBARS levels for negative control and pork with added coffee. [ab]

- All treated pork had TBARS levels significantly lower ($p<0.05$) than that of the negative control after day 7. However, no consistent significant differences among TBARS levels of treated pork samples were detected (Fig. 3).
- Over days 12-20, percent MetMb of each treatment did not change significantly; by day 20 dark brew had the highest percentage of MetMb (Fig. 4).
- Along with rosemary, pork treated with light ground, dark spent, and dark ground coffee had higher thiol levels than the negative control at the end of the study (Fig. 5).
- Insignificant color variation was seen throughout storage, and treatment did not significantly affect L*, a*, or b* values (data not shown).
- Although participants could detect a difference between pork with and without added coffee after 3 days of storage (Table 1), it did not affect their degree of liking (Table 2).

Table 1. Results of the tetrad discrimination test , showing that participants could only tell the difference between pork with and without added coffee on day 3 of storage ($p<0.05$).

Day	Correct	Total	pHat	SE pHat	d′	SE d′	Pc	Pd	Likelihood root statistic	p-value
1	20	49	0.41	0.07	0.66	0.33	0.41	0.11	1.1	0.14
3	22	41	0.54	0.08	1.1	0.27	0.54	0.30	2.7	0.0038

Table 2. Results of the hedonic sensory evaluation, showing that participants' degree of liking was not affected by the addition of coffee to pork patties ($p<0.05$).

Day 1 of Storage Mean ± SD values								
	Tenderness	p-value	Juiciness	p-value	Overall flavor	p-value	Overall Liking	p-value
No coffee	6.75 ± 1.72	0.215	3.33 ± 1.73	0.369	6.83 ± 1.64	0.369	6.81 ± 1.58	0.393
Added Coffee	7.00 ± 1.34		3.44 ± 1.46		6.73 ± 1.25		6.73 ± 1.28	
Day 3 of Storage Mean ± SD values								
	Tenderness	p-value	Juiciness	p-value	Overall flavor	p-value	Overall Liking	p-value
No Coffee	6.22 ± 1.68	0.377	3.73 ± 1.47	0.233	6.32 ± 1.71	0.500	6.27 ± 1.67	0.478
Added Coffee	6.10 ± 1.76		3.98 ± 1.60		6.32 ± 1.62		6.29 ± 1.54	

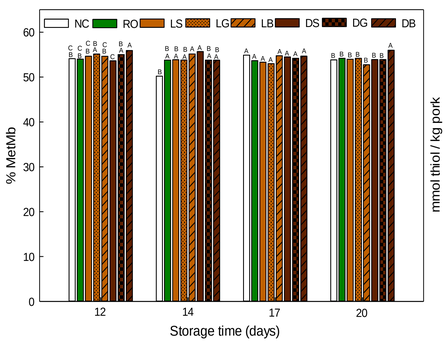

Fig. 4. Percent metmyoglobin (MetMb) in pork samples from day 12-20. [ab]

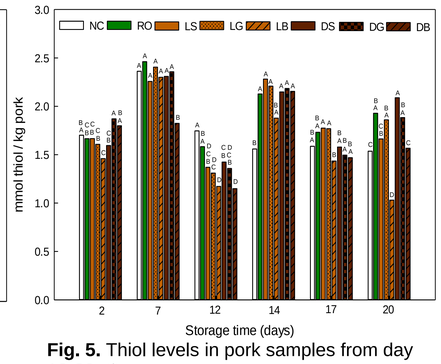

Fig. 5. Thiol levels in pork samples from day 12-20. [ab]

[a] NC=negative control RO=rosemary LS/DS=light/dark spent LG/DG=light/dark ground LB/DB=light/dark brew
[b] All means on the same day with the same letters are not significantly different from each other (Duncan's multiple range test, $p<0.05$)

CONCLUSIONS

- Compared to pork without any added antioxidant, coffee inhibits lipid oxidation and does not promote protein oxidation.
- While consumers may be able to discriminate between pork with and without added coffee, their degree of liking remains the same.

SIGNIFICANCE OF FINDINGS

- Light or dark roasted coffee in lyophilized brewed, spent, or ground forms could be comparable to rosemary oleoresin as an antioxidant when added to raw minced pork.

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