Enhancing Quality of Pork Patties with Procyanidin Powder during Refrigerated Storage

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Abstract— **Effect of procyanidin powder (PP) on quality of pork patties during refrigerated storage was studied. Frozen and thawed pork meat was used for pork patties. Five treatments groups were as follows: Control (-) (pork patties without antioxidant), PP 0.1 (pork patties with 0.1% PP), PP 0.3 (pork patties with 0.3% PP), PP 0.5 (pork patties with 0.5% PP), and Control (+) (pork patties with 0.01% butylhydroxytoluene). The water holding capacity was not changed by PP in all storage days. Cooking loss of pork patties with 0.1% PP showed no difference compare to patties with BHT. Lightness (L*) of pork patties significantly decreased with increase of PP at day 1 and 3. However, redness (a*) was increased dose dependently at day 1. Yellowness (b*) of pork patties was lower than control. In texture analysis, pork patties with 0.1% PP showed higher springiness at storage day 1. In this result, procyanidin powder from grape seed could be used to enhance storage stability of meat products without adverse effect.**

Keywords— **Procyanidin powder, quality, pork patties.**

I. INTRODUCTION

Phenolic compounds of plant origin have attracted considerable attention owing to their antioxidant and antimicrobial activity. Grape seeds are a particularly rich source of proanthocyanidins, and only the procyanidin-type of proanthocyanidins have been detected in the seeds (Santos-Buelga et al., 1995; Fuleki and Ricardo da Silva, 1997). A few monomeric flavanols have been also detected, but other flavonoid compounds such as anthocyanins and flavonols are not contain in the seeds (Waterhouse and Walzem, 1998) the proanthocyanidins from grape seeds contain procyanidin oligomers and polymers. Oxidation is one of the most important free-radical producing process in food, chemicals and in living organism. These compounds not only extend shelf-life of foods by inhibition of lipid peroxidation, but also act in the scavenging of free radical and can protect the human body against damage caused by them (Cicerale et al., 2009). Synthetic antioxidants, such as butylated hydroxyanisole (BHA) and butylated hydroxytoluene, have restricted use in foods as these synthetic antioxidants are suspected to be carcinogenic (Madahavi & Salunkhe, 1995). Therefore the search for natural antioxidants, for reduction or elimination of chemically synthesized additives is a current demand in food industry.

The objective of this work was to evaluate the effect of procyanidin from grape seed extract on quality of pork patties during cold storage.

II. MATERIALS AND METHODS

Procyanidin Powder(PP): Grape seed extracts were obtained from ethanol. The extracts were condensed by rotary evaporation and freeze dried. The dried sample was extracted by ethylacetate and condensed. The condensed sample was freeze dried and used as sample.

Pork patty preparation: Pork loins (*longissimus dorsi*) were minced through 13 mm plate followed by 4 mm plates using mincer. The minced pork (73.5%) was assighned to one of the following four treatments: Control (-) (pork patties with no added PP), PP 0.1 (pork patties with 0.1% PP), PP 0.3 (pork patties with 0.3% PP), PP 0.5 (pork patties with 0.5% PP), and Control (+) (pork patties with 0.01% butylhydroxytoluene). Also, 20% of pork fat, 1.5% of salt, and 0.5% of ice were added in pork meat batter. After well mixing, patties were formed as described by Kim et al., 2008) with a diameter of 10 cm and thickness of 2.0 cm using laboratory dishes. The patties were aerobically packaged in polyethylene bags individually and stored in refrigerator during experiment.

Water holding capacity: One gram of pork patty was placed on a plate with small holes in 2 mL plastic tube. This tube centrifuged at 920×*g* for 10 min. The released water contents was subtracted from the patty weight and calculated as a percentage of the initial weight.

Cooking Loss: For cooking loss, 200 g of pork patty was placed in 220℃ electric oven until an internal temperature became 70℃. The cooked pork patty was cooled at room temperature and the meat weight expressed as a percentage of the initial weight.

Color: Meat color values, CIE L*, a*, and b* values, were determined five times on a freshly cut surface of meat after 30 min of blooming at 1℃ using a Minolta Chromameter (CR301, Minolta, Osaka, Japan). The chromameter was calibrated against standard plate (L*=89.2, a*=0.921, b*=0.783) before use.

Texture analysis: Texture characteristics of pork patty with procyanidin were determined by rheometer (Sun Scientific Co., LTD, CR-500DX-LII).

Statistical Analysis: An analysis of variance was performed using the General Linear Model (GLM) procedure of the SAS statistical package (SAS, 2001). Duncan's multiple range test ($p<0.05$) was used to determine significant differences among means.

Table 1. Formulations of pork patties containing procyanidin powder

%	Treatment [1)]				
	CON(-)	PP0.1	PP0.3	PP0.5	CON(+)
pork loin	73.5	73.5	73.5	73.5	73.5
Pork fat	20	20	20	20	20
Salt	1.5	1.5	1.5	1.5	1.5
ICE	0.5	0.5	0.5	0.5	0.5
PP[2)]	-	0.1	0.3	0.5	-
BHT [3)]	-	-	-	-	0.01

[1)]CON(-): pork patties without antioxidant powder, PP 0.1: pork patties with 0.1% proanthocyanidin powder, PP 0.3: pork patties with 0.3% proanthocyanidin powder, PP 0.5: pork patties with 0.5% proanthocyanidin powder, CON (+): pork patties with 0.01% butylhydroxytoluene (BHT).
[2)] PP : Procyanidin powder
[3)] BHT: butylhydroxytoluene

III. RESULTS AND DISCUSSION

Table 1 indicated that pork patties formula with procyanidin powder. The manufacturing procedure of pork patties was also shown in Figure 1. Water holding capacity of pork patties showed no significant difference compare to that of control (-) during storage (Table 2). Cooking loss was significantly reduced by addition of PP 0.3 and 0.5 on day 1 and 3 (Table 3). In color, 0.3 and 0.5% procyanidin powder decrease the lightness of pork patties during whole storage (Table 4). However, PP 0.3 and 0.5 significantly increased the redness of pork patties compare to that of control (-). Interestingly, PP 0.1 sowed lower yellowness than control (-) during storage. Hardness of pork patties with PP 0.3 and 0.5 showed no significant difference compare to control during storage day 1 and 3. Springiness of pork patties with PP 0.1 showed higher value on storage day 1(Table 5).

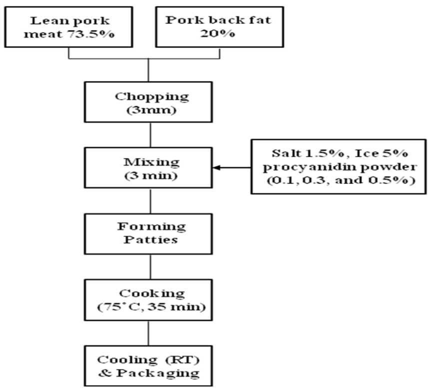

Figure 1. Manufacturing procedure of pork patties containing procyanidin.

Table 2. Water holding capacity (WHC, %) of pork patties containing procyanidin during storage at 4 for 7 days.

Treatment[1)]	Storage days		
	1	3	7
CON(-)	51.01 ± 0.881^{ab}	49.39 ± 2.521	49.22 ± 2.257
PP 0.1	52.58 ± 1.745^{Aa}	49.55 ± 1.039^{AB}	48.62 ± 1.926^{B}
PP 0.3	51.18 ± 1.872^{ab}	47.99 ± 1.537	49.53 ± 2.156
PP 0.5	48.44 ± 2.829^{b}	50.37 ± 1.113	48.03 ± 1.730
CON(+)	52.02 ± 1.728^{Aab}	50.06 ± 1.396^{AB}	48.20 ± 1.060^{B}

[A-B] Means within rows with different superscript letters are significantly different ($p<0.05$).
[a-b] Means within columns with different superscript letters are significantly different ($p<0.05$).
[1)]Refe to Table 1.

Table 3. Cooking loss (%) of pork patties containing procyanidin during storage at 4 for 7 days

Treatment[1)]	Storage days		
	1	3	7
CON(-)	31.11±0.765^{a}	30.78±0.225^{a}	30.00±0.542^{a}
PP 0.1	30.23±0.436^{ab}	29.63±1.041^{abc}	28.90±0.945^{ab}
PP 0.3	27.90±0.920^{c}	28.62±0.137^{c}	28.32±2.089^{ab}
PP 0.5	29.53±0.386^{Ab}	29.06±0.686^{Abc}	27.65±0.754^{Bab}
CON(+)	30.23±0.644^{ab}	29.89±0.664^{ab}	26.56±2.990^{b}

$^{A\text{-}B}$ Means within rows with different superscript letters are significantly different (p<0.05).
$^{a\text{-}c}$ Means within columns with different superscript letters are significantly different (p<0.05).
[1)]Refer to the Table 1.

Table 4. Color of pork patties containing procyanidin during storage at 4 for 7 days

	Treatment	Storage days		
		1	3	7
L*	CON(-)	65.73 ± 1.115^{Ba}	69.81 ± 3.291^{Aa}	68.98 ± 4.178^{Aa}
	PP 0.1	60.92 ± 3.550^{Bb}	63.94 ± 3.056^{ABc}	67.26 ± 5.560^{Aa}
	PP 0.3	58.65 ± 1.516^{ABc}	57.73 ± 3.315^{Bd}	59.22 ± 2.811^{Ab}
	PP 0.5	55.60 ± 1.677^{ABd}	55.00 ± 0.803^{Be}	56.53 ± 1.440^{Ab}
	CON(+)	63.85 ± 1.761^{a}	66.65 ± 2.322^{b}	66.23 ± 3.845^{a}
a*	CON(-)	9.52 ± 0.384^{Ad}	7.09 ± 1.722^{Bc}	5.92 ± 0.611^{Cc}
	PP 0.1	9.38 ± 0.698^{Ad}	8.93 ± 1.138^{Ab}	6.06 ± 1.672^{Bc}
	PP 0.3	11.98 ± 0.788^{Ab}	11.81 ± 0.775^{Aa}	10.03 ± 0.743^{Bb}
	PP 0.5	13.25 ± 0.320^{Aa}	12.69 ± 0.366^{Ba}	11.21 ± 0.568^{Ca}
	CON(+)	10.25 ± 0.901^{Ac}	8.77 ± 1.231^{Bb}	6.55 ± 1.818^{Cc}
b*	CON(-)	11.57 ± 0.400^{Ba}	12.19 ± 1.279^{ABab}	12.89 ± 1.729^{Aa}
	PP 0.1	10.59 ± 0.459^{b}	10.72 ± 1.145^{Cc}	11.26 ± 1.935^{b}
	PP 0.3	11.21 ± 0.915^{a}	11.33 ± 1.348^{bc}	12.23 ± 0.902^{ab}
	PP 0.5	11.40 ± 0.442^{Aa}	10.72 ± 0.407^{Bc}	11.42 ± 0.598^{Aab}
	CON(+)	11.72 ± 0.416^{a}	12.56 ± 0.988^{a}	12.71 ± 1.794^{ab}

$^{A\text{-}C}$ Means within rows with different superscript letters are significantly different (p<0.05).
$^{a\text{-}c}$ Means within columns with different superscript letters are significantly different (p<0.05).
[1)]Refer to the Table 1.

Table 5. Texture profile of pork patties containing procyanidin during storage at 4 for 7 days

	Treatment	Storage days		
		1	3	7
Hardness (kg/ cm^2)	CON(-)	4.33 ± 0.511^{Bb}	4.11 ± 0.511^{Bab}	4.66 ± 0.460^{Aa}
	PP 0.1	4.88 ± 0.850^{a}	4.41 ± 0.850^{ab}	4.48 ± 0.841^{ab}
	PP 0.3	4.32 ± 0.551^{Bb}	4.56 ± 0.551^{ABa}	4.83 ± 0.715^{Aa}
	PP 0.5	4.55 ± 0.772^{Aab}	3.98 ± 0.772^{Bb}	4.17 ± 0.702^{ABb}
	CON(+)	4.78 ± 0.606^{Aa}	4.28 ± 0.606^{Bab}	4.39 ± 0.609^{Bab}
Springiness	CON(-)	89.17 ± 1.679^{b}	88.05 ± 1.679	91.03 ± 1.117^{a}
	PP 0.1	98.78 ± 6.058^{Aa}	89.69 ± 6.058^{B}	89.42 ± 1.826^{Bb}
	PP 0.3	86.79 ± 3.403^{b}	89.05 ± 3.403	88.32 ± 1.346^{c}
	PP 0.5	86.02 ± 1.646^{Cb}	87.50 ± 1.646^{B}	89.23 ± 1.305A^{bc}
	CON(+)	89.88 ± 8.735^{b}	89.21 ± 8.735	89.18 ± 1.216^{bc}
Adhesiveness(g)	CON(-)	-0.72 ± 2.595^{ab}	-1.56 ± 2.595^{ab}	-1.39 ± 2.500^{a}
	PP 0.1	-0.06 ± 0.000^{a}	0.00 ± 0.000^{a}	-0.28 ± 1.179^{a}
	PP 0.3	-0.50 ± 3.445^{Aab}	-2.89 ± 3.445^{Bb}	-2.00 ± 2.970^{ABa}
	PP 0.5	-0.33 ± 3.064^{Aab}	-1.72 ± 3.064^{Aab}	-3.89 ± 4.129^{Bb}
	CON(+)	-1.22 ± 1.543^{b}	-0.83 ± 1.543^{a}	-0.89 ± 1.779^{a}

$^{A\text{-}B}$ Means within rows with different superscript letters are significantly different (p<0.05).
$^{a\text{-}c}$ Means within columns with different superscript letters are significantly different (p<0.05).
[1)]Refer to the Table 1.

IV. CONCLUSIONS

The procyanidin powder from grape seed extract using ethanol could be used in meat industry without negative effects.

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