# EFFECT OF PROCYANIDIN ON SHELF-LIFE OF PORK PATTIES

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**Abstract – The objective of this study was to assess the effect of procyanidins as natural preservatives in pork meat patties for storage periods. Pork patties were treated with 0, 0.1, or 0.3% procyanidin. The pH, volatile basic nitrogen (VBN), 2-thiobarbituric acid reactive substance (TBARS) values were determined during storage at 4°C for 14 days. Procyanidin treatment reduced pH values significantly ($P < 0.05$). VBN values decreased significantly ($P < 0.05$) with the 0.3% procyanidin treatment and increased significantly ($P < 0.05$) during storage. TBARS values were markedly lower in procyanidin-treated meat than in the untreated control. Our findings suggest that procyanidin could be used as a ~~food~~ natural preservative in pork patties due to its natural antioxidation.**

**Key Words – antioxidant, VBN, TBARS**

## I. INTRODUCTION

Lipid oxidation and microbiological spoilage cause deterioration in quality and diminished nutritional value of meat products [1, 2]. Many additives have been used for centuries to preserve flavor and improve the taste or shelf life of meats, and recently, new natural and artificial additives have been identified as preservatives to prevent or inhibit fat oxidation in terms of food quality.

Grapes are of special interest as a source of antioxidants due to their high content of phenolic compounds. Grape seeds are especially rich in phenolic compounds such as catechin, epicatechin, and dimeric, trimeric, and tetrameric procyanidins [3]. It is a family of proanthocyanidin compounds called flavonoids, which in oligomeric form have antioxidant properties, contained in both seed and the pericarp. Some studies of procyanidin content and structure in foods have addressed the relevance of the antioxidant properties and potential effects of procyanidin additives on pork patties, but their effects have not been well established. Thus, we investigated the effect of procyanidin on shelf-life of pork patty during various storage periods.

## II. MATERIALS AND METHODS

The pork patties were prepared from meats mixed with procyanidin at concentrations of 0.1 and 0.3%. All patties were packaged in low-density polyethylene (LDPE) bags at 4°C for 14 days.

Determination of pH values were performed for all experimental periods using pH meter.

The VBN contents were measured using the Conway microdiffusion method [4]. The VBN contents were determined following the addition of 0.02 N sulfuric acid ($H_2SO_4$) to the inner chamber of the Conway unit.

We monitored the lipid peroxidation (i.e., lipid degradation) in pork patties using a TBARS assay. TBARS values were measured as described previously [5]. The results were calculated as mg of malonaldehyde/kg of the patty sample.

The data are expressed as means ± standard deviation (SD). Differences among mean values determined for different storage days or treatments were evaluated using a generalized linear model (GLM) of the SAS software (SAS Institute, Cary, NC). $P < 0.05$ was considered to reflect statistical significance. All experiments were performed in triplicate or quadruplicate with replicates in each experiment.

## III. RESULTS AND DISCUSSION

The pH values of pork patties treated with procyanidin changed during storage (Table 1). The pork patties treated with 0.1% or 0.3% procyanidin showed significantly lower pH values compared to the untreated control. Furthermore, the pH values of the treated pork patties decreased gradually ($P < 0.05$) with storage time. Changes of

pH values on meat patties are due to the water-holding capacity [6]. Overall, the pH values of the pork patties in this study were influenced by the procyanidin concentration and by the period of chilled storage.

Table 1 Effect of procyanidin on the pH values of pork patty during storage

| Storage time, day | Procyanidin, % | | |
|---|---|---|---|
| | 0 | 0.1 | 0.3 |
| 0 | $6.14 \pm 0.02^{bcA}$ | $6.16 \pm 0.02^{bA}$ | $5.93 \pm 0.03^{cB}$ |
| 1 | $6.37 \pm 0.03^{aA}$ | $6.31 \pm 0.02^{aB}$ | $6.06 \pm 0.02^{aC}$ |
| 3 | $6.20 \pm 0.01^{bA}$ | $6.20 \pm 0.01^{bA}$ | $6.00 \pm 0.02^{bB}$ |
| 7 | $6.16 \pm 0.01^{bcA}$ | $6.17 \pm 0.02^{bA}$ | $5.98 \pm 0.04^{bB}$ |
| 10 | $6.20 \pm 0.14^{bA}$ | $6.07 \pm 0.12^{cAB}$ | $6.06 \pm 0.02^{aB}$ |
| 14 | $6.08 \pm 0.07^{cA}$ | $6.06 \pm 0.09^{cAB}$ | $5.98 \pm 0.03^{bB}$ |

Mean ± SD.
[a-c]Means in the same column with different letters are significantly differ ($P < 0.05$).
[A-C]Means in the same row with different letters are significantly differ ($P < 0.05$).
a, b, c: storage effects. A, B, C: procyanidin effects.

Table 2 showed the VBN values of pork patties after procyanidin addition. The results can be interpreted as an indicator of meat freshness.

The VBN values were significantly higher ($P < 0.05$) in both procyanidin treated and untreated groups compared to the control over all storage time. The VBN values of the procyanidin-treated pork patties increased significantly ($P < 0.05$) during chilled storage and the changes in VBN values were dose-dependent. In this study, lower VBN values were associated with decreased protein breakdown caused by procyanidin, and the decrease in the VBN values of the pork patties during storage was caused by a reduction in the initial levels of common spoilage bacteria. Changes in VBN values are attributable to protein breakdown under aerobic [7]. These results were similar to those for the changes in TBARS and the TBC in the pork patties described below. Thus, our findings suggest that pork patty shelf life can be improved slightly by the addition of 0.3% procyanidin.

Table 2 Effect of procyanidin on the volatile basic nitrogen (VBN) values of pork patties during storage

| Storage time, day | Procyanidin, % | | |
|---|---|---|---|
| | 0 | 0.1 | 0.3 |
| 0 | $14.83 \pm 1.02^{eAB}$ | $14.50 \pm 0.77^{dB}$ | $15.79 \pm 0.87^{cA}$ |
| 1 | $16.61 \pm 0.49^{d}$ | $16.98 \pm 0.54^{c}$ | $16.93 \pm 0.36^{b}$ |
| 3 | $17.30 \pm 0.48^{c}$ | $17.07 \pm 0.83^{c}$ | $16.93 \pm 0.96^{b}$ |
| 7 | $18.07 \pm 0.28^{bA}$ | $18.49 \pm 0.68^{bA}$ | $17.25 \pm 0.81^{bB}$ |
| 10 | $19.45 \pm 0.50^{aA}$ | $19.08 \pm 0.73^{abA}$ | $17.43 \pm 0.42^{bB}$ |
| 14 | $19.81 \pm 0.32^{aA}$ | $19.40 \pm 0.41^{aA}$ | $18.62 \pm 0.27^{aB}$ |

Mean ± SD.
[a-e]Means in the same column with different letters are significantly differ ($P < 0.05$).
[A-B]Means in the same row with different letters are significantly differ ($P < 0.05$).
a, b, c, d, e: storage effects. A, B: procyanidin effects.

The changes in TBARS values during storage of pork meat patties treated with procyanidin are summarized in Table 3. These results showed the lipid peroxidation in pork patties during storage time.

The TBARS values of all the pork patties increased significantly ($P < 0.05$) during storage. However, the TBARS values of the procyanidin-treated samples were significantly lower ($P < 0.01$) than those of the control samples without procyanidin. Overall, the lowest TBARS values were produced by the highest procyanidin concentration. TBARS values were significantly lower ($P < 0.05$) in the procyanidin-treated pork patties than in the control. These results were similar to those of beef meat and meat products treated with different tomato paste and spice extracts [8, 9].

Oxidative changes serve as an indicator of the degree of fresh meat product preservation, and the concentrations of grape antioxidants used in this study were sufficient to maintain the oxidative stability of the meat patties through the control of lipid oxidation. In general, the effect of lipid oxidation varies considerably depending on a complex interaction between various factors including the type and concentration of active compounds and the nature of the food system [10].

Table 3 Effect of procyanidin on the 2-thiobarbituric acid (TBARS) values of pork patties during storage

| Storage time, day | Procyanidin, % | | |
|---|---|---|---|
| | 0 | 0.1 | 0.3 |
| 0 | $0.13 \pm 0.07^{cA}$ | $0.02 \pm 0.01^{bB}$ | $0.03 \pm 0.00^{cB}$ |
| 1 | $0.27 \pm 0.18^{cA}$ | $0.02 \pm 0.00^{bB}$ | $0.04 \pm 0.01^{bB}$ |
| 3 | $0.57 \pm 0.28^{bA}$ | $0.03 \pm 0.00^{bB}$ | $0.04 \pm 0.00^{bB}$ |
| 7 | $0.89 \pm 0.11^{aA}$ | $0.04 \pm 0.01^{bB}$ | $0.04 \pm 0.01^{bB}$ |
| 10 | $0.90 \pm 0.02^{aA}$ | $0.12 \pm 0.03^{aB}$ | $0.07 \pm 0.01^{aC}$ |
| 14 | $0.92 \pm 0.04^{aA}$ | $0.13 \pm 0.02^{aB}$ | $0.08 \pm 0.01^{aC}$ |

Mean ± SD.

[a-c]Means in the same column with different letters are significantly differ ($P < 0.05$).

[A-C]Means in the same row with different letters are significantly differ ($P < 0.05$).

a, b, c: storage effects. A, B, C: procyanidin effects.

## IV. CONCLUSION

In this study, we focused on developing technologies to improve the shelf-life of pork patties using procyanidin from grape by-products. Procyanidin treated samples exhibited significantly lower ($P < 0.05$) VBN and TBARS values compared to control samples during storage. Namely, the addition of procyanidin to pork patties had significant effects on pH, VBN, and lipid oxidation in a time- and dose-dependent manner. The obtained results suggest that procyanidin could be used to improve the shelf life of pork patties and meat products.

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