EFFECT OF PARTICLE SIZE ON PHYSICOCHEMICAL AND ANTIOXIDANT ACTIVITIES OF PERSIMMON BY-PRODUCT POWDERS IN PORCINE PATTIES

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Abstract – This study evaluates effect of ball-mill treatment of persimmon by-products on the antioxidant activities in pork patties. Ball-milling for 24 hrs decreased the average median diameter from 83.2 to 19.2 µm for seed powders, 59.6 to 38.7 µm for peel powders and 77.5 to 17.2 µm for calyx powders. As a result, TFC and DPPH radical scavenging ability was increased for all by-products with reduced particle size. Upon incorporation of these superfine powders in pork patties, redness values (a) were increased and yellowness values (b) decreased. Although reducing particle size improved bioactive contents its application in pork patties produced a decreasing tendency in terms of TBARS and POV. This suggests that the superfine powders are suitable for improving physicochemical properties especially in terms of redness values in meat patties. Hence, persimmon by-product powders offer low cost sources of natural antioxidants.

Key Words – Antioxidant, ball-mill, by-products

I. INTRODUCTION

It is known that the three major sensory properties that influence a consumer's purchasing decision are texture, flavor and visual effects [1]. More specifically, appearance of meat products has a greater influence on such a decision. It has also been established that the major reason for loss of meat quality is lipid oxidation, which leads to loss of color, water (drip) and development of off flavors, odors and other toxic compounds [2,3]. Thus, by-products of fruit and vegetable industries offer valuable natural sources. Persimmon (*Diospyros kaki*) by-products such as seed, peel and calyx are known to contain beneficial phytochemicals. However, utilization of the waste materials through extraction processes of physical or chemical nature also usually lead to increased cost along with other demerits such as need for additional treatments and removal of toxic solvents [4]. Thus ball-milling offers an alternative way of utilizing these by-products thereby providing the economical and environmental benefits [5]. Hence, the objective of this study was to evaluate the effect of particle size of persimmon by-product powders on antioxidant activities, color, pH and inhibition of lipid oxidation in pork patties.

II. MATERIALS AND METHODS

Dried calices, peels and seeds (Fig. 1) were ground using a heavy duty kitchen grinder and sieved (mesh 100). The powders were formed by regular grinding and then subjected to ball-milling for 24 hrs at 400 rpm. ZrO_2 balls (6 mm) used in a weight ratio of 5:1 with the by-product powders. The particle size distributions of the persimmon by-product powders were determined using a Malvern Mastersizer 2000. Total phenolic content (TPC), total flavonoid content (TFC) and DPPH radical scavenging activity (RSA) of differently ground powders were evaluated. Physicochemical and antioxidant activities of patties prepared with differently milled by-product powders were also evaluated.

Figure 1. Persimmon by-products

III. RESULTS AND DISCUSSION

Persimmon seed, peel, and calyx powders formed by regular-grinding and ball-milling resulted in different particle size distributions as shown in Table 1. Dv 50, which is considered as the average particle size, was reduced for all by-products after 24 hrs of ball-milling. Span values increased for seed and peel powders, but reduced for calyx powders after ball-milling. Calyx micropowders formed by regular-grinding had higher TPC and TFC than peel and seed powders. The flavonoid content of calyces was also higher than those of seed and peel, which was increased from 0.55±0.01 to 1.56±0.04 g/100 g upon ball-mill treatment.

Table 1 Ball-milling of on mean particle size, span and surface area

	Ball-mill time (h)	Average median diameter (μm)	Span	Surface area (m^2/g)
Seed	0	83.22 ± 3.04[a]	3.31 ± 0.13[b]	0.238± 0.05[c]
	24	19.20 ± 0.17[b]	4.07 ± 0.08[a]	0.791± 0.06[a]
Peel	0	59.62 ± 0.10[a]	2.31 ± 0.02[b]	0.251± 0.01[b]
	24	38.71± 1.07[b]	3.58 ± 0.04[a]	0.345± 0.01[a]
Calyx	0	77.50 ± 4.71[a]	6.25 ± 0.52[a]	0.280±0.01[b]
	24	17.29± 0.12[b]	3.51 ± 0.02[b]	0.947± 0.01[a]

[a-c] Means with different superscripts in the same column are different ($p < 0.05$).

The ball-mill treatment resulted in an increase in the DPPH radical scavenging activity for all the by-product powders ($p < 0.05$). Calyx powders with reduced particle size exhibited the largest increase in scavenging activity followed by seed and peel powders. Such variation was observed even when increase in TPC and TFC for seed and peel was significantly higher and calyx powders increased only in the TFC.

Pork patties with micro and superfine seed powders had lower lightness values than those of the other two by-products. Redness (a), a crucial factor in purchase decision of meat products was highest ($p \leq 0.05$) for seed superfine powders among all the by-products until 10 days of storage. Superfine powders of peel and calyx had lower yellowness (b) values than micropowders. Calyx powders had the highest antioxidant effect on patties with a reduction in TBARS values by 86 %. The superfine powders of seed and peel with reduced particle size were able to create a tendency in lowering the TBARS values in comparison with their respective micropowders.

The peroxide values of all the by-products were lower than control patties and comparable to patties with BHT. However, patties with calyx superfine powders had a decreasing tendency in terms of peroxide values when compared to micropowders

IV. CONCLUSION

Superfine powders seed and calyx can improve color values (redness) and lower yellowness. Ball-milled powders also produced a lowering tendency of TBARS and POV values. Nevertheless, persimmon by-product powders offer cheap sources of natural antioxidants.

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