Antioxidant Activity of Methanolic Extracts of Peanut Hulls from Various Cultivars

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ABSTRACT: The antioxidant activities of methanolic extracts of peanut hulls (MEPH) from various cultivars (Spanish, Valencia, Runner, and Virginia) were investigated. The luteolin content in MEPH for Spanish, Valencia, Runner, and Virginia was 3.16, 2.47, 0.95, and 0.75 mg/g of hulls, and the total phenolic content was 10.2, 10.1, 6.6, and 4.2 mg/g of hulls, respectively. MEPH from various cultivars showed similar and strong antioxidant activity as a result of a high content of total phenolic compounds. Based on these results, the hulls of Spanish cultivar were selected as the best antioxidant material among the four cultivars because of the cultivar's highest content in both luteolin and total phenolic compounds.
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KEY WORDS: Antioxidant activity, methanolic extracts of peanut hulls, various cultivars.

Lipid peroxidation can result in rancidity in the finished products and make them unacceptable to consumers. Furthermore, oxidation can cause other degrading effects, e.g., discoloration, vitamin destruction, nutritional losses, and polymerization. For these reasons, extensive research has been performed to enhance the stability of lipids and lipid-containing foods. The addition of antioxidants to foods is one of the most effective means of retarding fat oxidation. The safety of synthetic antioxidants, however, has been a concern (1) and has stimulated evaluation of the effectiveness of naturally-occurring compounds with antioxidative properties.

Many attempts to replace synthetic antioxidants with natural ones have been reported (2). Recently, the antioxidant activity of hull extracts, e.g., navy bean hulls (3), and peanut hulls (4), has received significant attention. Yen *et al.* (5) noted that high total phenolic content in peanut hulls of the Spanish cultivar was associated with a high antioxidant activity. However, some reports revealed that the amounts of fatty acids and tocopherols in Virginia, Runner, and Spanish peanut cultivars varied from each other (6,7). On the basis of these results, investigation of the antioxidant activity of various peanut cultivars is needed. Thus, the objective of this study was to compare the antioxidant activity of methanolic extracts of peanut hulls (MEPH) from four cultivars of peanuts.

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MATERIALS AND METHODS

Materials. Four cultivars of peanuts, i.e., Spanish, Valencia, Runner, and Virginia, were obtained from Taiwan Agriculture Research Institute (Taichung, Taiwan, R.O.C.). All cultivars were grown under the same standard cultural practices and conditions. The peanuts were harvested 140 d after planting. After harvesting, peanuts were dried under sunlight for three days, and the hulls were hand-shelled. Peanut hulls were ground into a fine powder in a mill (Tecator Cemotec 1090 Sample Mill; Tecator, Hoganas, Sweden), sealed in a plastic bottle and stored at 4°C until used.

Extraction procedure. Peanut hull powder (PHP) (5 g) was extracted with 50 mL methanol overnight in a shaking incubator at room temperature. The extract was filtered, and the residue was reextracted under the same conditions. The combined filtrate was evaporated in a vacuum below 40°C on a rotary evaporator to a final volume of 5 mL.

Determination of moisture and color value. The percentage of moisture in PHP was determined by AOAC method 14.062 (8). Color values, L, a, and b of PHP were measured with a color difference meter (Color and Color Difference Meter Model TC-3600; Tokyo Denshoku Co., Ltd., Tokyo, Japan). The instrument was standardized against the beige ceramic tile. The PHP was held in a cuvette with an optical glass bottom for reading the Hunter L, "a", and "b" values, and each reported reading is the average of three replicate analyses.

Determination of antioxidant activity. Antioxidative activity was carried out by using the linoleic acid system (9). Experimental conditions were the same as those previously described (4,5). All test data are the average of triplicate analyses.

Quantitative analysis of luteolin. The luteolin in peanut hulls was determined by high-performance liquid chromatography as described by Yen *et al.* (5). Data of the peak areas were used for the calculation, and a regression analysis was used to quantitate the content of luteolin in the peanut hulls. Triplicate samples were run for each set.

Determination of total phenolic compounds. The total phe-

nolic compounds present in the peanut hulls were determined spectrophotometrically by using the Folin-Denis reagent described in AOAC method 9.112 (8). The concentration of total phenolic compounds in the peanut hulls was determined by comparison with the absorbance of the standard, catechin (Sigma Chemical Co., St. Louis, MO), at different concentrations.

Statistical analysis. Statistical analysis involved the use of the Statistical Analysis Systems (Cary, NC) software package. Analysis of variance was performed by analysis of variance procedures. Significant differences between means were determined by Duncan's Multiple Range tests.

RESULTS AND DISCUSSION

In this study, peanuts were dried under sunlight for three days, and hulls were hand-shelled. The characteristics of PHP and antioxidant activity of the MEPH from four cultivars of peanut are summarized in Table 1. Moisture of PHP from various cultivars ranged from 5.6 to 5.8% and was not significantly ($P > 0.05$) different among the PHP samples. Significant ($P < 0.05$) differences, however, in L, a, and b values were found. Among four cultivars, the PHP of Spanish and Valencia were less in L, a, and b values than were Runner and Virginia. The mature period of Runner and Virginia cultivars was approximately 140–160 d and lasted longer than those of Spanish and Valencia (approximately 120–130 d). Yen *et al.* (5) reported that the peanut hulls of the Spanish cultivar, 114 d after planting, produced a dark flour (lower Hunter L and lower b values), meaning that they were mature. In the present work, the harvesting time of all four cultivars was 140 d. The color of both Spanish and Valencia peanuts was dark brown; however, Runner and Virginia were light brown. This indicates that the cause of the color differences among the four cultivars of peanuts may be a result of different cultivars, as well as maturity. As shown in Table 1, 9.6 mg of methanolic extracts of peanut hulls of all four cultivars exhibited approximately 96.0% inhibition of peroxidation of linoleic acid. Furthermore, no differences ($P > 0.05$) occurred in antioxidant activity among the four cultivars, indicating that MEPH of the various cultivars displayed a similarly strong antioxidant activity.

The luteolin content of peanut hulls from various cultivars differed significantly ($P < 0.05$) and in the order of Spanish > Valencia > Runner > Virginia. Yen *et al.* (5) indicated that luteolin content found in peanut hulls increased with peanut maturity. In the present work, the 140-d harvesting time was a fully mature period for Spanish and Valencia. The greater luteolin content in both Spanish and Valencia may be attributed mostly to maturity with minor differences because of cultivar differences.

Gutfinger (10) discovered that a high polyphenol content was associated with high resistance to oxidation of olive oils. Yen *et al.* (5) reported that a high total phenolic content in peanut hulls was associated with a high antioxidant activity. These investigations (5,10) suggest that total phenolic compounds are closely related to antioxidant activity. Table 1 shows that the amounts of total phenolic compounds in Spanish and Valencia peanut hulls were the greatest among the four cultivars with no difference ($P > 0.05$) found between Spanish and Valencia cultivars. In addition, the amount of total phenolic compounds was significantly higher in hulls of Runner than of the Virginia cultivar, indicating that differences in the amounts of total phenolic compounds among the four cultivars may be mostly a result of maturity, with minor differences due to cultivar. This finding correlates with that reported by Ramarathnam *et al.* (11), in that the content of total phenolic compounds in rice hulls varied with various cultivars, and in that reported by Yen *et al.* (5), in which the content of total phenolic compounds in peanut hulls increased with the maturity of the peanuts. In addition, the fact that the amount of total phenolic compounds in Spanish and Valencia cultivars was significantly higher than that of Runner and Virginia, may be attributed to the full maturity of Spanish and Valencia cultivars.

The range of the amounts of total phenolic compounds from various cultivars was 4.2–10.2 mg/g of hull. Yen *et al.* (5) reported that peanut hulls with total phenolic contents greater than 0.1671 mg/g of hulls displayed strong antioxidant activity. Consequently, MEPH from various cultivars exhibited similar and strong antioxidant activity during oxidation of linoleic acid in an aqueous dispersion as a result of high levels of total phenolic compounds. Moreover, the hulls of Spanish cultivar were selected as the best antioxidant material among the four cultivars because they contained the greatest content of both luteolin and total phenolic compounds.

TABLE 1
Characteristics of Peanut Hull Powder (PHP), Peanut Hulls, and Antioxidant Activity of the Methanolic Extracts of Peanut Hulls (MEPH) from Four Cultivars of Peanut[a]

Cultivars	Moisture of PHP (%)	Color of PHP			Antioxidant activity of MEPH (%)[b]	Luteolin (mg/g of hulls)	Total phenolics, (mg/g of hulls)
		Lightness	Red	Yellow			
Spanish	5.7 ± 0.09a	48.2 ± 0.28d	11.8 ± 0.26c	15.3 ± 0.05d	96.1 ± 0.91a	3.16 ± 0.165a	10.2 ± 0.122a
Valencia	5.8 ± 0.04a	50.5 ± 0.62c	11.4 ± 0.57c	16.0 ± 0.29c	96.8 ± 0.19a	2.47 ± 0.031b	10.1 ± 0.361a
Runner	5.7 ± 0.05a	55.0 ± 0.17b	12.6 ± 0.29b	17.5 ± 0.28b	96.1 ± 0.56a	0.95 ± 0.038c	6.6 ± 0.179b
Virginia	5.6 ± 0.25a	56.7 ± 0.21a	13.6 ± 0.53a	18.0 ± 0.05a	96.6 ± 0.32a	0.75 ± 0.046d	4.2 ± 0.050c

[a]Values are means ± standard deviation of three replicate analyses. Means within a column with different lower case letters are significantly different ($P < 0.05$).
[b]The antioxidant activity of extract (9.6 mg) was determined by the thiocyanate method, and is reported as percentage inhibition of peroxidation of linoleic acid.

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