Comparisons of the antioxidant activity of fresh, dried and infused herbal extract of Feijoa Fruit

Sahar Kabiri[1], Farzad Gheybi[2], Maryam Jokar[1], Shadi Basiri[2]

[1-]Department of Food science and technology, Islamic Azad University, Damghan, Iran
[2-] Assistant Professor, Food Science and Technology, Khorasan-e-Razavi Agricultural and Natural Resources Research and Education Center, Mashad - Iran
sahar.kabiri88@gmail.com

Abstract: In the present study fresh, dried and herbal infusion of feijo fruit (Feijoa sellowiana) were compared to their total phenol content, reducing power, DPPH and total antioxidant activity. Fresh fruit were found to be a good source of antioxidants and had the highest total phenol content, reducing power, DPPH and total antioxidant activity. A significant ($p<0.05$) amount of antioxidants was lost after sun-drying of feijoa, whereas the herbal infusion of feijoa had the same total antioxidant activity with fresh fruit. These results suggest that all feijoa types serve as a good source of natural antioxidants and could potentially be considered as a functional food or functional food.
[Sahar Kabiri, Farzad Gheibi, Maryam Joker, Shadi Basiri. **Comparisons of the antioxidant activity of fresh, dried and infused herbal extract of Feijoa Fruit.** *Rep Opinion* 2016;8(10):5-8]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 2. doi:10.7537/marsroj081016.02.

Keywords: Feijoa, antioxidant, infused herbal extract, tropical, drying

1. Introduction

The feijoa (*Acca sellowiana*) is an evergreen bush or small tree that originates from the highlands regions of South America but nowadays is widely distributed and cultivated in many countries. The fruit of feijoa has a smooth and soft green skin, the flesh is white and sweet and has a sweet, aromatic flavor. Many volatile compounds, including terpenes, tannins, quinones, steroidal saponins, flavonoids and both methyl and ethyl benzoate, which account for approximately 90% of the volatile fraction, are responsible for the strong feijoa-like character of the fruit (Bose & Mitra, 1990; Canhoto & Cruz, 1996; Hardy & Michael, 1970; Schotsmans, East, Thorp, & Woolf, 2011). The fruits are rich in vitamin C, polyphenols, terpenes, tannins, steroidal, saponins, flavonoids hydrocarbons, minerals, iodine and both methyl and ethyl benzoate (Hardy & Michael, 1970; Pasquariello, Mastrobuoni, Di Patre, Zampella, Capuano, Scortichini, et al., 2015)Feijoa has shown potent antimicrobial and antifungal activities and anti-cancer activities so used for medical and pharmaceutical purposes (Clerici & Carvalho-Silva, 2011; Sun-Waterhouse, Wang, Waterhouse, & Wadhwa, 2013; Taylor, Gaysinsky, Davidson, Bruce, & Weiss, 2007; Weston, 2010) Moreover, an antioxidant activity of feijoa plant has been described (Vuotto et al., 2000). According to (Hernández, Alegre, Van Breusegem, & Munné-Bosch, 2009), plant-derived antioxidants are molecules, which donate electrons or hydrogen atoms. These compounds are able to form less reactive antioxidant-derived radicals, which are efficiently quenched by other electron or hydrogen sources to prevent cellular damage therefore, they help delay and inhibit lipid oxidation, protect human cells against oxidative damage, leading to a reduced risk of several oxidative-stress associated degenerative diseases, such as cancer, cardiovascular or neurodegenerative diseases (Scalbert, Manach, Morand, Rémésy, & Jiménez, 2005) and when added to foods tend to minimize rancidity, retard the formation of toxic oxidation products, help to maintain the nutritional quality and increase their shelf life (Fukumoto & Mazza, 2000). Since there are few studies on the antioxidant activity of feijoas, the general objective of this study was to evaluate antioxidant activity tests such as, the total antioxidant activity of fresh, dried and traditionally consumed (aqueous) herbal infusions, instead of plant extracts.

2. Materials and methods

2-1-Materials

Feijoa fruits were collected from botanical gardens of experimental institute in Ramsar, Mazandaran province, Iran. All the chemicals and solvents used in this study were supplied by Sigma, Merck and Aplichem.

2-2-Methods

2-2-1-Sample preparation

Fresh fruit peels were coarsely grounded before extraction. A known amount of each part was extracted at room temperature, using the by percolation method, with methanol and water; methanol/ water (80:20, 400 mL × 3 times) as the extraction solvent. The resulting extract was concentrated in a rotary vacuum, until a crude solid extract was obtained. The extract was freeze-dried for complete solvent removal. Air dried feijoa was conducted in an oven (DK63, Yamato, Japan) at 80 °C

for 2 h and then shifted to 60 °C for 6 h. the products were then ground to powder and extraction process was done as above. to prepare infusions, the friut (1.5 g) was mixed with 100 ml of boiling water for 5 min, with constant shaking and the samples were then filtered through Whatman No. 1 filter paper and freeze-dried for further experiments.

2-2-2- Total phenol content

Determination of total phenolic content in was carried out using a Folin-Ciocalteau colorimetric method, calibrating against gallic acid as the reference standard and expressing the results as gallic acid equivalents (GAE) using the following linear equation based on the calibration curve: (Di Majo, La Guardia, Giammanco, La Neve, & Giammanco, 2008).

$A = 0.023\ C + 0{:}109, \quad R^2 = 0.99$ [1]

Where A is absorbance at 760 nm and C is concentrations of gallic acid equivalents (μg/ml).

2-2-3- Reducing power

The ability of extracts to reduce iron (III) was evaluated using the method of Yildirim *et al* (Yildirim, Mavi, & Kara, 2001) Samples (1 ml) were mixed with 2.5 ml of phosphate buffer (0.2 M, pH 6.6) and 2.5 ml of potassium ferricyanide (K_3Fe (CN) 6; 10 g l^{-1}) and incubated for 30 min at 50 °C. Then 2.5 ml of trichloroacetic acid (100 g l^{-1}) were added to the solution and centrifuged for 10 min. Finally, 2.5 ml of supernatant was combined with 2.5 ml of distilled water and 0.5 ml $FeCl_3$ (1 g l^{-1}). The absorbance of samples was measured at 700 nm. Higher absorbance means higher reducing power.

2-2-4- DPPH radical scavenging activity

The radical scavenging ability was determined as described by Mensor *et al* with slight modification (Mensor, Menezes, Leitão, Reis, Santos, Coube, et al., 2001). Briefly, one ml from 0.3 mM alcohol solution of DPPH was added to 2.5 ml from the samples with. The samples were kept at room temperature in the dark and after 30 min the absorbance of each sample was measured at 517 nm and the percentage of scavenging activity calculated from the following equation:

$$DPPH\ scavenging\ activity\ (\%) = \frac{\text{Absorbance of control} - \text{Absorbance of sample}}{\text{Absorbance of control}}$$

2-2-5- Total antioxidant capacity

This assay is based on the reduction of Mo (VI) to Mo (V) by the sample and the subsequent formation of a green phosphate/Mo (V) complex at acidic pH (Prieto, Pineda, & Aguilar, 1999). The assay was done using the method of Prieto et al. (1999). 0.1 ml of sample was mixed with 1 ml of reaction solution (0.6 M sulphuric acid, 28 mM sodium phosphate, and 4 m Mammonium molybdate) and incubated for 90 min at 95 °C and the absorbance of samples was measured at 695 nm.

2-2-6-Statistical Analysis

All data are reported as mean±standard deviation of three replicates. One-way analysis of variance (ANOVA) was used to compare the means of all evaluated parameters. Differenceswere considered significant at $P<0.05$. Calculations weredone by SAS 9.1.3 Portable software.

3. Results and discussion

Phenols are important components due to their hydroxyl groups and scavenging properties and may have a direct relation with antioxidant activity (Bidchol, Wilfred, Abhijna, & Harish, 2011). according to Table 1 a significant ($P<0.05$) difference between total phenol contents of these three extracts were observed. The highest amount of total phenols was given by fresh fruit, dried fruit the least total phenolic content. This result concurred with the reports of Rhim et al. who reported that most drying methods have an undesired effect on antioxidant activity (Rhim, Xi, Jeong, Ham, Chung, & Kim, 2009). Shahidi and Naczk also reported that drying, in general, is regarded as unfavorable due to the possibility of inducing oxidative decomposition either enzymatically by polyphenol oxidase and glycosidase or by thermal degradation of phenolic compounds (Naczk & Shahidi, 2004).

Reducing properties are generally related to the ability of reductants to donate a hydrogen atom and thereby break a radical chain. Furthermore, reductants react with peroxide precursors and prevent the formation of peroxides (Bidchol, Wilfred, Abhijna, & Harish, 2011). Thus, samples with higher reducing powers are more able to donate electrons. Fresh fruit extract showed significantly ($P<0.05$) higher reducing power (Table 1). This result was in agreement with some previous studies (Jiménez-Escrig, Jiménez-Jiménez, Pulido, & Saura-Calixto, 2001; Larrauri, Rupérez, & Saura-Calixto, 1997; Madrau, Piscopo, Sanguinetti, Del Caro, Poiana, Romeo, et al., 2009; Santos, Guiné, & Barros, 2014; Spigno, Tramelli, & De Faveri, 2007; Vashisth, Singh, & Pegg, 2011).

DPPH scavenging activity assay is widely used to evaluate the ability of compounds to scavenge free radicals or donate hydrogen, and determine the antioxidant activity in foods (Bidchol, Wilfred, Abhijna, & Harish, 2011). There were no significant differences between scavenging activity of all treatments.

Extracts with higher electron donating activity can terminate the radical chain and turn free radicals into more stable products (Pan et al. 2011). The extracts in the present study were shown to have considerable amounts of phenolic compounds that can donate electrons. However, the highest antioxidant

activity was found for extracts from both fresh and infusion on feijoa.

Table 1- Content of total phenolics (by the Folin–Ciocalteu method), l Reducing power, DPPH and total antioxidant capacity of feijoa (fresh, dried and infusion) (means±SD).

	Total phenol content[1]	Reducing power[2]	DPPH (%)	Total antioxidant activity[3]
Fresh fruit	76.15±4.20[a]	0.91±0.34[a]	83.87±0.12[a]	0.83±0.23[a]
Dried fruit	46.76±0.91[b]	0.79±1.3[b]	82.88±0.33[a]	0.68±0.11[b]
Infusion extract	59.74±0.20[c]	0.73±2.0[b]	81.39±1.82[a]	0.79±0.22[a]

Values in the same column followed by different letters are significantly different (P<0.05)

1. g of gallic acid per 100 g (dry weight) of extract
2. absorbance at 700 nm
3. absorbance at 695 nm

4- Conclusion

Present data showed that *feojoa* fruit extracts possessed high phenolic content, and exhibited strong free radical scavenging activity indicates that the extract has good potential as a source for natural antioxidants to prevent free radical mediated oxidative damage. Antioxidant activities of natural antioxidants in this study were related to their total phenols. Fresh fruit had the highest antioxidant activity. Results from present study indicate that feijoa whether fresh, dried or herbal infusion can be used as appropriate substitutes for the synthetic antioxidant.

Refrences:

1. Bidchol, A. M., Wilfred, A., Abhijna, P., & Harish, R. (2011). Free radical scavenging activity of aqueous and ethanolic extract of Brassica oleracea L. var. italica. *Food and Bioprocess Technology*, *4*(7), 1137-1143.
2. Bose, T. K., & Mitra, S. K. (1990). *Fruits: tropical and subtropical*: Naya Prokash.
3. Canhoto, J. M., & Cruz, G. S. (1996). Feijoa sellowiana Berg (Pineapple Guava). In Y. P. S. Bajaj (Ed.), *Trees IV*, vol. 35 (pp. 155-171): Springer Berlin Heidelberg.
4. Clerici, M. T. P. S., & Carvalho-Silva, L. B. (2011). Nutritional bioactive compounds and technological aspects of minor fruits grown in Brazil. *Food Research International*, *44*(7), 1658-1670.
5. Di Majo, D., La Guardia, M., Giammanco, S., La Neve, L., & Giammanco, M. (2008). The antioxidant capacity of red wine in relationship with its polyphenolic constituents. *Food Chemistry*, *111*(1), 45-49.
6. Fukumoto, L., & Mazza, G. (2000). Assessing antioxidant and prooxidant activities of phenolic compounds. *Journal of Agricultural and Food Chemistry*, *48*(8), 3597-3604.
7. Hardy, P. J., & Michael, B. J. (1970). Volatile components of feijoa fruits. *Phytochemistry*, *9*(6), 1355-1357.
8. Hernández, I., Alegre, L., Van Breusegem, F., & Munné-Bosch, S. (2009). How relevant are flavonoids as antioxidants in plants? *Trends in plant science*, *14*(3), 125-132.
9. Jiménez-Escrig, A., Jiménez-Jiménez, I., Pulido, R., & Saura-Calixto, F. (2001). Antioxidant activity of fresh and processed edible seaweeds. *Journal of the Science of Food and Agriculture*, *81*(5), 530-534.
10. Larrauri, J. A., Rupérez, P., & Saura-Calixto, F. (1997). Effect of drying temperature on the stability of polyphenols and antioxidant activity of red grape pomace peels. *Journal of Agricultural and Food Chemistry*, *45*(4), 1390-1393.
11. Madrau, M. A., Piscopo, A., Sanguinetti, A. M., Del Caro, A., Poiana, M., Romeo, F. V., & Piga, A. (2009). Effect of drying temperature on polyphenolic content and antioxidant activity of apricots. *European Food Research and Technology*, *228*(3), 441-448.
12. Mensor, L. L., Menezes, F. S., Leitão, G. G., Reis, A. S., Santos, T. C. d., Coube, C. S., & Leitão, S. G. (2001). Screening of Brazilian plant extracts for antioxidant activity by the use of DPPH free radical method. *Phytotherapy research*, *15*(2), 127-130.

13. Naczk, M., & Shahidi, F. (2004). Extraction and analysis of phenolics in food. *Journal of chromatography A*, *1054*(1), 95-111.
14. Pasquariello, M. S., Mastrobuoni, F., Di Patre, D., Zampella, L., Capuano, L. R., Scortichini, M., & Petriccione, M. (2015). Agronomic, nutraceutical and molecular variability of feijoa (Acca sellowiana (O. Berg) Burret) germplasm. *Scientia Horticulturae*, *191*(0), 1-9.
15. Prieto, P., Pineda, M., & Aguilar, M. (1999). Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphomolybdenum complex: specific application to the determination of vitamin E. *Analytical biochemistry*, *269*(2), 337-341.
16. Rhim, J.-W., Xi, Y., Jeong, W.-C., Ham, K.-S., Chung, H.-S., & Kim, E.-S. (2009). Effect of Drying Method on Antioxidant Activity of Jiwhang (Rehmannia glutinosa). *Food Science and Biotechnology*, *18*(6), 1464-1469.
17. Santos, S. R. V. L., Guiné, R. F., & Barros, A. (2014). Effect of drying temperatures on the phenolic composition and antioxidant activity of pears of Rocha variety (Pyrus communis L.). *Journal of Food Measurement and Characterization*, *8*(2), 105-112.
18. Scalbert, A., Manach, C., Morand, C., Rémésy, C., & Jiménez, L. (2005). Dietary polyphenols and the prevention of diseases. *Critical reviews in food science and nutrition*, *45*(4), 287-306.
19. Schotsmans, W. C., East, A., Thorp, G., & Woolf, A. B. (2011). Feijoa (Acca sellowiana [Berg] Burret). In E. M. Yahia (Ed.), *Postharvest Biology and Technology of Tropical and Subtropical Fruits*, (pp. 115-135e): Woodhead Publishing.
20. Spigno, G., Tramelli, L., & De Faveri, D. M. (2007). Effects of extraction time, temperature and solvent on concentration and antioxidant activity of grape marc phenolics. *Journal of Food Engineering*, *81*(1), 200-208.
21. Sun-Waterhouse, D., Wang, W., Waterhouse, G. N., & Wadhwa, S. (2013). Utilisation Potential of Feijoa Fruit Wastes as Ingredients for Functional Foods. *Food and Bioprocess Technology*, *6*(12), 3441-3455.
22. Taylor, T. M., Gaysinsky, S., Davidson, P. M., Bruce, B., & Weiss, J. (2007). Characterization of Antimicrobial-bearing Liposomes by ζ-Potential, Vesicle Size, and Encapsulation Efficiency. *Food Biophysics*, *2*(1), 1-9.
23. Vashisth, T., Singh, R. K., & Pegg, R. B. (2011). Effects of drying on the phenolics content and antioxidant activity of muscadine pomace. *LWT - Food Science and Technology*, *44*(7), 1649-1657.
24. Weston, R. J. (2010). Bioactive products from fruit of the feijoa (Feijoa sellowiana, Myrtaceae): A review. *Food Chemistry*, *121*(4), 923-926.
25. Yildirim, A., Mavi, A., & Kara, A. A. (2001). Determination of antioxidant and antimicrobial activities of Rumex crispus L. extracts. *Journal of Agricultural and Food Chemistry*, *49*(8), 4083-4089.

10/17/2016