Sun-dried pears: phenolic compounds and antioxidant activity

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Abstract

Two different regional varieties of pears, S. Bartolomeu and Amêndoa, were analyzed fresh and after sun-drying. The total phenolic composition and antioxidant capacity of these pears were determined. The total antioxidant capacity was compared using two different methods: DMPD (*N*,*N*-dimethyl-*p*-phenylenediamine) and the method of ABTS (2,2'-azinobis(3-ethylbenzothiazoline-6-sulfonic acid)) radical scavenging. The ABTS method, when compared with the DMPD method, showed a better correlation between the content of phenolic compounds of the pears and their antioxidant activity. The fresh pear possessed higher amounts of phenolic compounds and higher antioxidant capacity when compared to sun-dried pear. The antioxidant efficiency was expressed as Trolox equivalent and as ascorbic acid equivalent. For both methods, the Trolox equivalent was higher than the ascorbic acid equivalent.

Keywords: pears, sun-drying, phenolic compounds, antioxidant activity

1. Introduction

The sun-dried pear used in this study is a Portuguese agricultural product, which is highly appreciated by the consumer due to its singular organoleptic characteristics (Ferreira *et al.*, 2002).

Phenolic compounds may influence the color and flavor of sun-dried pears and consequently the quality of the dried fruit. For example, astringency is related to the presence of polyphenols (procyanidins) as described for cider apples (Lea and Arnold, 1978). Brown compounds generally result from the oxidation and polymerization of phenolic compounds under the effect of phenoloxidases or peroxidases (Macheix *et al.*, 1990). Manzocco *et al.* (2001) suggested that partially oxidized polyphenols can exhibit higher antioxidant activity than non-oxidized phenols. The intake of antioxidant compounds present in food is claimed to be an important health-protecting factor (Fogliano *et al*, 1999).

Several methods were developed recently for measuring total antioxidant capacity of food and beverages. These assays differ with respect to the chemistry employed and in the determination of end points (Pellegrini *et al.*, 1999).

The aim of this study was to evaluate the phenolic composition and antioxidant activity of fresh and sun-dried pears of different regional varieties, S. Bartolomeu and Amêndoa (*Pyrus communis* L.). A possible relationship between the phenolic composition and antioxidant activity of these pears was investigated.

2. Materials and methods

Samples: Two different regional varieties of pears were used, S. Bartolomeu (SB) and Amêndoa (A) (*Pyrus communis* L.). For each variety, the pears were peeled and allowed to sun-dry for five days. Then the pears were laid in baskets and covered with a cloth for two days. After this, the pears were subjected to a second sun-drying process over three days. The final product was a small dried pear with a reddish-brown color. The fresh (F) and sun-dried pears (S) were frozen, freeze-dried, and then analyzed.

Determination of total phenolic composition: Total phenolic composition was detemined according to the Folin-Ciocalteu method using gallic acid as a standard. The results were expressed as milligrams of gallic acid equivalents (GAE) per gram of dried extract.

Measurement of antioxidant capacity by the DMPD method: The antioxidant capacity was measured according to Fogliano *et al*. (1999) A 100 mM solution of DMPD in deionized water (1 mL) was added to 100 mL of 0.1M acetate buffer, (pH 5.25) and 0.4 mL of a solution of 0.05 M ferric chloride. The absorbance of this solution at 505 nm was measured.

Standard solutions. Solutions of ascorbic acid (1 mg/mL) and Trolox (1 mg/mL) were used as standard antioxidants. The standard antioxidant or pear extract (50 μL) were stirred for 10 min at 25 °C and the absorbance at 505 nm was measured. The buffered DMPD solution was used as reference.

A dose-response curve was derived for Trolox, or ascorbic acid by plotting the absorbance at 505 nm as percentage of the absorbance of the uninhibited radical cation solution (blank) according to the equation

$$\% \text{ inhibition of } A_{505nm} = (1-A_f/ A_0) \times 100$$

where A_0 is the absorbance of uninhibited radical cation and A_f is the absorbance measured 10 min after the addition of antioxidant samples.

The antioxidant capacity of extracts was expressed as Trolox equivalent antioxidant capacity (TEAC) and as ascorbic acid equivalent antioxidant capacity (CEAC) using calibration curves plotted with different amounts of Trolox (0.2 to 200 μg/μL) and ascorbic acid (0.05 to 150 μg/μL).

Measurement of antioxidant capacity by the ABTS method. The measurement of the antioxidant capacity of pear extracts was carried out as described by Miller and Rice-Evans (1997). The ABTS radical cation ($ABTS^{\bullet+}$) solution was prepared by mixing equal parts of ABTS (7 mM) and $K_2O_8S_2$ (2.45 mM) to obtain an optical density of 0.800 (A_0) at 734 nm. 980 μL of $ABTS^{\bullet+}$ solution and 20 μL of sample were stirred for 1 hour, and the absorbance was measured.

A dose-response curve was plotted for Trolox or ascorbic acid, and the antioxidant capacity was expressed as TEAC and as CEAC using calibration curves plotted with different amounts of Trolox (0.0 to 10 μg/μL) and ascorbic acid (0.02 to 5.2μg/μL).

3. Results and discussion

Figure 1 shows the amounts of total phenolic content expressed as milligram of gallic acid equivalent (GAE) per gram of dry material of S. Bartolomeu and Amêndoa pears.

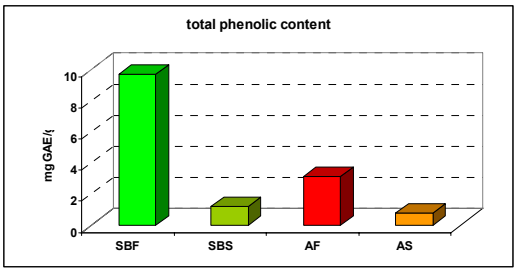

Figure 1: Total phenolic content (mg GAE/g) of fresh and sun-dried S. Bartolomeu and Amêndoa pears.

The fresh S. Bartolomeu pear (SBF) contained a total phenolic content of 9.7 mg and the sun-dried S. Bartolomeu pear (SBS) a total phenolic content of 1.2 mg, while the fresh Amêndoa pear (AF) and the sun-dried Amêndoa pear (AS) contained only 3.1 mg and 0.8 mg, respectively. The results showed that the S. Bartolomeu variety exhibited higher amounts of total phenolic content when compared to Amêndoa variety. The total phenolic content of sun-dried pears was lower by 88% for SB and 76% for A.

The total antioxidant capacity (TAC) is shown in Table 1. In general, the DMPD method furnished a higher antioxidant capacity than the ABTS method. For both methods, the efficiency was higher when expressed as TEAC.

Table 1: Total antioxidant capacity of fresh and sun-dried S. Bartolomeu and Amêndoa pears, determinated by ABTS and DMPD methods, expressed as CEAC (µg ascorbic acid/g of dry material) and as TEAC (µg Trolox equivalent /g of dry material) .

	ABTS		DMPD	
Extracts	CEAC	TEAC	CEAC	TEAC
SBF	9.8 ± 2.1	16.3 ± 3.5	7.9 ± 0,3	33.5 ± 1.2
SBS	0.5 ± 0.7	0.9 ± 1.1	8.0 ± 0,9	30.2 ± 3.8
AF	2.3 ± 0.1	4.0 ± 0.3	7.4 ± 0,4	31.2 ± 1.5
AS	0.4 ± 0.1	0.8 ± 0.2	5.0 ± 0,0	17.4 ± 0.0

Data are expressed as mean ± standard deviation.

The results obtained by the ABTS method, either expressed as CEAC or TEAC, reveals that the TAC of fresh pears is higher than the corresponding sun-dried pears. It should be noted that the difference is more pronounced for the S. Bartolomeu pears. In fact, for the sun dried pears the TAC value decreases around 94% in SB variety and 81% in A variety. In DMPD results, the SBF, SBS and AF pears had similar antioxidant activity.

When the total antioxidant capacity was plotted against the total phenolic content it was possible to observe a good linear correlation between them, in ABTS assay. The value of the correlation coefficient was 0.9903 when the TAC was expressed as Trolox equivalent, or as ascorbic acid.

4. Conclusions

S. Bartolomeu pears exhibited higher amounts of total phenolic compounds when compared to Amêndoa pears. For both varieties, the fresh pears possessed higher amounts of total phenolic compounds than the dried ones.

In the methodology (ABTS and DMPD), the pears exhibit a higher antioxidant activity when express as Trolox equivalent, compared to ascorbic acid. In ABTS assay was verified a good linear correlation between the total phenolic content and the total antioxidant capacity of the samples.

5. Referencies

FERREIRA, D.; GUYOT, S.; MARNET, N.; DELGADILLO, I.; RENARD, C. M. G. C.; COIMBRA, M. A. 2002. Composition of phenolic compounds in a Portuguese pear (Pyrus communis L. var. S. Bartolomeu) and changes after sun-drying. *J. Agric. Food Chem*., 50, 4537-4544.

FOGLIANO, V.; VERDE, V.; RANDAZZO, G.; RITIENI, A. 1999. Method for measuring antioxidant activity and its application to monitoring the antioxidant capacity of wines. *J. Agric. Food Chem.*, 47 (3): 1035-1040.

LEA, A. G.; ARNOLD, G. M. 1978. The phenolics of ciders: bitterness and astringency. *J. Sci. Food Agric.*, 29: 478-483.

MACHEIX, J-J; FLEURIET, A.; BILLOT, J. 1990. The main phenolics of fruit. In *Fruit Phenolics*, CRC Press Inc.: Boca Raton, Florida, pp. 17-41.

MANZOCCO, L.; CALLIGARIS, S.; MASTOCOLA, D.; NICOLI, M. C.; LERICI, C. R. 2001. Review of non-enzymatic browning and antioxidant capacity in processed foods. *Trends in Food Science & Technology*, 11: 340-346.

MILLER, J.N.; RICE-EVANS,C.A. 1997. Factors influencing the antioxidant activity determined by ABTS radical cation assay. *Free Radical Res*., (26), 195-199.

PELLEGRINI, N., Re, R., YANG, M.; RICE-EVANS, C. A. 1999. Screening of dietary carotenoids and carotenoid-rich fruit extracts for antioxidant activities applying the 2, 2' -azobis(3-ethylenebenzothiazoline-6-sulfonic) acid radical cation decolorizatien assay. *Methods Enzymol,* 299: 379-389.