Scientia Horticulturae 129 (2011) 694–701

Contents lists available at ScienceDirect

Scientia Horticulturae

journal homepage: www.elsevier.com/locate/scihorti

Total phenolics and flavonoids and total antioxidant capacity in pistachio (*Pistachia vera* L.) nuts in relation to cultivars and storage conditions

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ARTICLE INFO

Article history:
Received 21 March 2011
Received in revised form 28 April 2011
Accepted 30 May 2011

Keywords:
Pistachio kernels
Total phenolics
Total flavonoids
Total antioxidant capacity
Drying
Storage conditions

ABSTRACT

The effects of cultivar, drying and storage conditions on total phenolics (TP), total flavonoids (TF) and total antioxidant capacity (TAC), measured with ferric reducing antioxidant power (FRAP) and radical scavenging capacity (2,2-diphenyl-1-picrylhydrazyl or DPPH) assays, of in-shell and unpeeled kernels of ripe pistachios were investigated. Drying was carried out at 45 °C for 34 h to approximately 5% moisture in kernels and storage of dried nuts in packaging atmosphere of dry air or N_2 at 1 °C or 20 °C for 6 or 12 months. At harvest, each cultivar showed its highest values for each measured variable and TP ranged from 16.2 to 7.9 mg gallic acid equiv. g^{-1} d.w., TF from 7.2 to 3 mg catechin equiv. g^{-1} d.w., FRAP from 132.5 to 58.8 μmol Trolox equiv. g^{-1} d.w., and DPPH from 122.6 to 45.7 μmol Trolox equiv. g^{-1} d.w. Drying resulted in losses in all cultivars that averaged approximately 14.2%, 14.1%, 11.9% and 12.2% for TP, TF, FRAP and DPPH, respectively, while during 12-month storage the corresponding losses in dried kernels averaged approximately 24.7%, 21.8%, 30.3% and 32.4%. Decreases in all measured variables were advanced by storage time, but prevented by low temperature and packaging in N_2 atmosphere. Among the studied cultivars, Pontikis, Aegina, Bronte and Cerasola showed higher values of TP, TF and TAC than Sirora, Kerman, Joley and Mumtaz in all cases, while Pontikis the highest in most cases. The effects of cultivar, time, temperature and packaging atmosphere during storage were all significant on TP, TF, FRAP and DPPH. Strong correlations were also found among the measured variables.

1. Introduction

There has been an increasing interest in nutritional components of nuts, including fatty acids, minerals, vitamins, sterols and phenolics (Brufau et al., 2006; Ryan et al., 2006). Beside the positive effect of nut consumption on human health, most research has been recently focused on the phenolic and antioxidant content (Arcan and Yemenicioglu, 2009; Blomhoff et al., 2006; Kornsteiner et al., 2006). Due to climatic changes, emphasis has also been given to cultivation of species that tolerate unfavorable conditions. Pistachio (*Pistachia vera* L.) is the sole nut tree that can be cultivated under hot, arid and saline conditions (Metheney et al., 1998). Pistachios are popular nuts and usually consumed as snacks because of their nice flavour and crispness. Moreover, they are appreciated for benefit on human health since they regulate cholesterol levels and have a positive effect on cardiovascular disease (Edwards et al., 1999; Gebauer et al., 2008), but also for their antioxidant concentrations according to recent studies (Bolling et al., 2010b; Tomaino et al., 2010; Yang et al., 2009).

Proper harvesting and postharvest handling are key operations in obtaining maximum yield of good quality (Kashani Nejad et al., 2003). Handling stages usually include dehulling, washing, drying or roasting, packaging and storing for some months. However, these stages might deteriorate both nut nutritional value and taste. It is well known that many factors, such as a high drying temperature or prolonged storage under air and/or at a relatively high temperature and humidity have negative effects on various nut quality attributes. However, most pistachio reports were focused on attributes other than antioxidants in relation to drying and storage conditions, such as oil stability (Bellomo et al., 2009; Leufven et al., 2008; Maskan and Karatas, 1999) or kernel texture and mould development (Raei et al., 2010). Furthermore, studies on pistachio antioxidants are limited to few cultivars, such as Kerman, Bianca and Bronte (Ballisteri et al., 2009; Tavakolipour et al., 2010; Tomaino et al., 2010) or even to samples of unknown ones (Yang et al., 2009). Great variations in phenolics and other antioxidants are observed among studies. This could be related to cultivar effect and/or the unknown fate of the product from harvest until sampling from the market (Kornsteiner et al., 2006).

Abbreviations: CE, catechin equivalents; DPPH, radical scavenging capacity (1,1-diphenyl-2-picrylhydrazyl); FRAP, ferric reducing antioxidant power; GAE, gallic acid equivalents; TAC, total antioxidant capacity; TE, Trolox equivalents; TF, total flavonoids; TP, total phenolics.

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doi:10.1016/j.scienta.2011.05.020