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Drying and storage of olive leaf extracts. Influence on polyphenols stability

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ABSTRACT

There is an increasing demand for natural antioxidants in the food, cosmetics and pharmaceutical industries which has led to the search not only for natural extracts but also for strategies with which to increase long-term storage stability. The aim of this work was to assess the influence of the drying and storage of olive leaf extracts on the bioactive potential and stability of polyphenols. Olive leaves were hot air dried (120 °C) and freeze dried. Then the extracts were obtained by maceration (ethanol–water, 80:20, v/v). Afterwards, a part of the extracts was hot air dried at 120 °C and vacuum dehydrated at 55 °C. Thus, the extracts, in liquid and powder forms, were stored at 4, 25 and 35 °C for 4 weeks. During this period, the extracts were characterized by determining the antioxidant capacity (AC), the total phenolic content (TPC) and the concentration of the major phenolic compounds.

The experimental results highlighted that drying the raw material not only influenced the initial extract composition but also the bioactive potential evolution during storage. Regardless of the method used, extract dehydration reduced both the AC and TPC by around 10%. Finally, storage conditions (temperature and extract form) did not have a significant ($p < 0.05$) effect on the extracts' antioxidant potential.

1. Introduction

The health-related benefits of olive oil have mainly been ascribed to both the monounsaturated fatty acids and also to the presence of functional bioactive molecules, including tocopherols, carotenoids, phospholipids and phenolic compounds (Covas, 2008; Covas et al., 2006). Notwithstanding this, polyphenols of low molecular weight and with potential health benefits, such as oleuropein and hydroxytyrosol, have also been found in olive leaves (Aouidi et al., 2012; Dekanski et al., 2011; Raederstorff, 2009). The phenolic compounds present in olive leaves exhibit bioactive properties; they are antioxidant, anti-hypertensive and anti-inflammatory, as well as hypoglycaemic and hypocholesterolemic (Brahmi et al., 2012; Karakaya, 2009). Therefore, exploring the use of olive leaves and their extracts in the medical, cosmetics or food industries could be relevant. Among other things, some of their applications could include the development of new products, such as natural drugs or functional foods, as well as the extension of the shelf life in foodstuffs.

Generally, plant preparations are marketed in the form of liquid extracts, or as powders resulting from the drying of plant material or of the liquid extracts themselves (Souza et al., 2008). On the one hand, it is well known that drying the raw material aids its preservation for longer periods of time and enhances the extraction of phenolic compounds. On the other hand, solid forms (powders) of plant extracts are being used more and more due to the fact that they possess several advantages over fluid extracts: improved stability, cheaper transport and storage and the possibility of achieving higher concentrations (Moreira et al., 2009; Oliveira et al., 2006).

Abbreviations: F, fresh; HAD, hot air drying; HAD-120, hot air drying at 120 °C; FD, freeze drying; A-120, dehydration of extracts at 120 °C using forced air at atmospheric pressure; V-55, dehydration of extracts at 55 °C applying vacuum (0.2 bar); TPC, total phenolic content; GAE, gallic acid equivalents; AC, antioxidant capacity; FRAP, ferric-reducing ability power; TPTZ, 2,4,6-tri(2-pyridyl)-*s*-triazine; HPLC-DAD, high performance liquid chromatography with diode array detection; MS-MS, tandem mass spectrometry; ESI, electrospray ionization; LC–MS, liquid chromatography-mass spectrometry; UV, ultraviolet; 120(L), extracts dehydrated at 120 °C and stored as liquid; 120(P), extracts dehydrated at 120 °C and stored as powder; 55(L), extracts vacuum dehydrated at 55 °C and stored as liquid; 55(P), extracts vacuum dehydrated at 55 °C and stored as powder.

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However, it has been reported that drying can affect the activity and stability of bioactive compounds due to chemical and enzymatic degradation, losses caused by volatization and/or thermal decomposition (Dorta et al., 2012; Faustino et al., 2007).

Previous studies illustrated that the hot air drying of olive leaves at high temperatures (120 °C) is an excellent pre-treatment, even better than freeze drying, prior to obtaining olive leaf extracts rich in bioactive compounds (Ahmad-Qasem et al., 2013a). Nevertheless, how raw material processing affects the subsequent extract stability, as well as the impact of extract dehydration and storage conditions (temperature and extract form: liquid or powder) on the evolution of antioxidant potential have not been explored. Spray drying is commonly used to dehydrate liquid extracts due to the fact that it presents several advantages, such as its operational flexibility and applicability to heat sensitive materials (Filková et al., 2007). However, as a means of minimizing the impact of temperature and/or exploring simpler and cheaper alternative methods of dehydrating, it is worth emphasizing the use of short-time drying at high temperatures and vacuum drying (Lewicki, 2006).

In consequence, the goal of this work was to assess the influence of the drying and storage of olive leaf extracts on the bioactive potential and polyphenol stability.

2. Materials and methods

2.1. Raw material

Olive leaves (*Olea europaea*, var. Serrana) were collected on a farm located in Segorbe (Castellón, Spain), packaged and stored at 4 °C until processed (less than 48 h). Following AOAC method no 934.01, the initial moisture content (0.78 ± 0.02 g w/g dry mat-

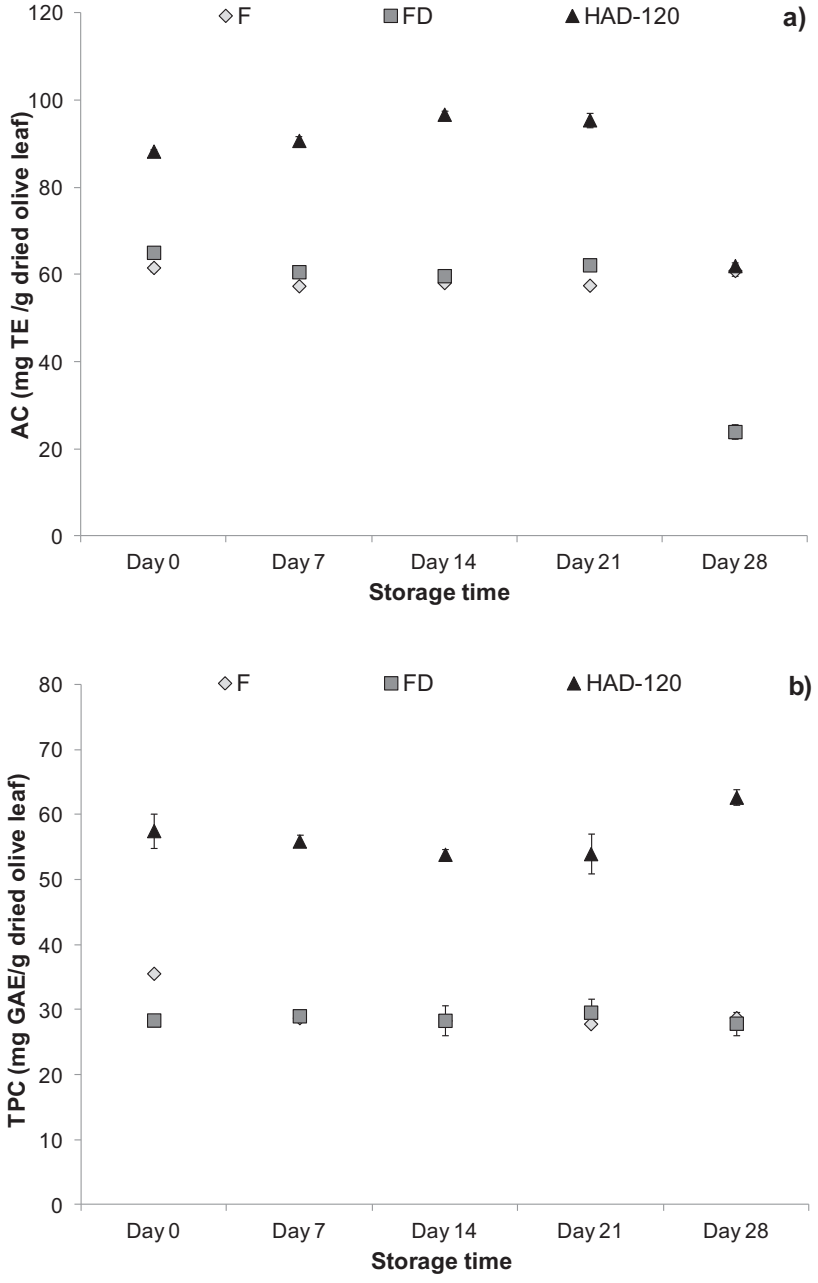

Fig. 1. Evolution of antioxidant capacity (a; AC) and total phenolic content (b; TPC) during storage at 4 °C of extracts obtained from fresh (F), freeze dried (FD) and hot air dried (HAD-120) olive leaves.