

# Pomegranate peels phenolics encapsulated in edible fruit fiber: storage stability and ingredient for functional foods

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The prevention of oxidative deterioration in foods is essential if their quality and shelf-life are to be guaranteed. Lipid oxidation generates a series of chemical reactions that can alter physicochemical parameters, sensorial attributes, and shelf-life in food products. In order to overcome the stability problems of oils and fats, synthetic antioxidants, such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and ter-butyl hydroquinone (TBHQ), have been used as food additives. However, recent reports revealed that these compounds may be implicated in many health risks, including cancer and carcinogenesis (Hou, 2003; Prior, 2004). Thus, interest in natural antioxidants, especially of plant origin, has greatly increased in recent years. Among these, extracts rich in phenolic compounds, like those derived from the wine and juice industries, have been reported as good alternatives since they are available in plenty supply as industrial wastes and maintain a potential preservative effect.

Pomegranate has been well documented for its potential health benefits, such as its high antioxidant, anti-mutagenic, anti-hypertension, anti-inflammatory, and anti-atherosclerotic activity (Kim et al., 2002). Since the juice yield of pomegranates is less half of the fruit weight, very large amounts of by-product wastes, such as peels, are formed every year. Pomegranate by-product wastes have been traditionally valorised as animal feed. Recently, a number of studies have proposed that some fruit or vegetable by-products could be a source of natural antioxidants. Many researchers introduced the peels of pomegranate as a rich source of antioxidants, especially phenolic compounds, and several studies have been published to extract phenolics from pomegranate peels with various extraction methods, such as normal stirring, microwave-assisted extraction, pressurized liquid extraction, and ultrasounds (Cheng et al., 2011; Pan et al, 2011; Wang et al., 2011; Veggi et al., 2013). However, because of the presence of unsaturated bonds in their molecular structure, polyphenols are vulnerable to oxidants, light, and heat and can easily deteriorate when exposed to these conditions. Therefore, it would be better to protect pomegranate peel polyphenols from chemical damage before their industrial application. In the food processing field, microencapsulation techniques have been widely used to protect food ingredients against deterioration, volatile losses or interaction with other ingredients.

In a previous work, total phenolics extracted from pomegranate peels by ultrasound-assisted technique were encapsulated by spray drying using orange fiber powder as wall material. Thus, the proposed encapsulation process combined two food wastes that are beneficial to health - the edible fruit fiber and the antioxidant pomegranate peel extract - into one multipurpose functional food. However, in addition to quality loss through processing, the quality of foods may also change during storage and distribution. Moreover, the final step of a successful encapsulation process is that the encapsulated powder can be easily incorporated in foods.

Thus, in this study, the antioxidant capacity and the stability of the crude and the encapsulated pomegranate peels extract were evaluated during storage at different temperatures, using DPPH and Folin–Ciocalteu methods.

A stability trial of the two extracts incorporated into three types of food products for different storage times was also carried out. Milk powder, peanut butter, and juice samples were enriched with crude and encapsulated extract at a phenolics concentration of 5000 ppm (w/w). For the storage study, the juice products were kept under refrigeration at 4 °C. For the milk powder and the peanut butter, due to the time consuming nature of the testing of storage conditions at 40 °C or lower, the simple accelerated method of using oven storage at 63 °C was carried out. Samples were periodically withdrawn during the storage in order to measure, peroxide value (PV), total phenolics content, antioxidant activity, and color.

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