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Nutritional and mineral composition of persimmon fruits (*Diospyros kaki* L.) from Central and Southern Italy

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ABSTRACT

In this study, the nutritional and mineral composition of *Diospyros kaki* fruits from Apulia, Campania, Lazio, Sardinia and Sicily regions was evaluated. Dietary fiber, mineral, pectin, polyphenol, and protein contents were evaluated. Particularly high are the contents of the dietary fiber and pectins. The mineral elements profile was interesting due to its modest content of sodium and high potassium concentration. Protein amounts were in line with the quantities for this fruit. The total polyphenol content of the fruits analysed was very variable, interesting for the quantities found both total and gallic acid. The results obtained confirmed the nutritional value of this fruit even for special dietary regimens such as hypertension and heart diseases and the genuineness of its cultivation in Central-Southern Italy.

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Diospyros kaki; persimmon; composition; dietary fiber; mineral; pectin; polyphenol; protein

1. Introduction

Fruit is a fundamental part of a healthy and balanced diet, its regular intake as demonstrated by the Mediterranean diet may contribute to the prevention and reduction of multiple disease risk factors (Widmer et al., 2015; Metro et al., 2018; 2020).

Persimmon (*Diospyros kaki* L.) is a plant belonging to *Ebenaceae* family, more than 249 species are within the genus *Diospyros*. According to the botanical characteristics,

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D. kaki plants are tall deciduous trees with dark grey barks. The leaves are simple, alternate, ovate-elliptic. Flowers are hermaphrodite. The cyme belongs to male flowers and female flowers are solitary in distal leaf axil. Corolla is campaniform and yellow-white. The fruits are berries orange-yellow, ovoid or vary in other shapes. Persimmon is native to China and widely cultivated in warm regions worldwide. In Europe, persimmon cultivation is suitable thanks to the mild Mediterranean climate and the consumers' acceptability and increasing demand (Xie et al., 2015). Persimmon fruit is an important and peculiar functional food because of its high nutritional and commercial values. Indeed, persimmon fruits have been traditionally used for many medicinal purposes such as against coughs, hypertension, frostbite, burns and bleeding, because it contains many bioactive compounds. Previous reports showed that persimmon fruits are a good source of both primary and secondary metabolites, respectively, sugars, pigments, polyphenols and vitamins (Pu et al., 2013; Jiménez-Sánchez et al., 2015). Many phenolics are known to possess antioxidant, anti-inflammatory, cytotoxic, cardioprotective, and neuroprotective activities (Albergamo et al., 2017; Tardugno et al., 2018; Fejér et al., 2019; Durazzo et al., 2019a, 2019b). Persimmon fruit skin is highly rich in carotenoids and polyphenols, and its characteristic colour is related to these secondary metabolites. The carotenoid, polyphenol, sugar, tannin and vitamin contents in persimmon fruits have been deeply investigated not only for the beneficial effects but also for flavouring and marketing purposes (Takekawa and Matsumoto, 2012; Pu et al., 2013; Zhu et al., 2014; Jiménez-Sánchez et al., 2015). In addition to the above-mentioned important metabolites, persimmon fruits are a good source of dietary fibers, minerals, pectins and few investigations have been reported on these fields. These constituents also play an important role to confirm the nutritional value and the health claims of *D. kaki* fruits. Indeed, a suitable mineral intake from foods play a key role in human health. In Italy, persimmons are very well adapted to a wide range of environments, and their modern cultivation started at the beginning of the 20th Century in the Campania region (Giordani and Nin, 2013). Given the nutritional and commercial worth of *D. kaki*, it is important to understand their variability. Indeed, the plant ability to produce primary and secondary metabolites is influenced by environmental and agronomic conditions (Tardugno et al. 2020). Despite the importance of *D. kaki*, the nutritional and mineral analysis of Italian persimmon cultivation has rarely been examined. The main purpose of this study was to determine dietary fiber, mineral, pectin, polyphenol and protein contents of persimmon fruits from different areas in Central and Southern Italy, to better understand their intrinsic value and genuineness.

2. Results and discussion

In this study, the nutritional and mineral characterisation of *D. kaki* fruits obtained from plants grown in the area of Central and Southern Italy was carried out. In particular dietary fiber, mineral, pectin, polyphenol and protein contents were evaluated and discussed in Tables S1–S5.

Total dietary fiber can be divided into two main fractions according to their solubility in water. In Table S1, the *D. kaki* fruits total dietary fiber (soluble and insoluble)

content expressed as % is shown. The total amount of dietary fiber ranged from 4,34 to 3,55%, with a mean content of 3,9% confirming that the dietary fiber content in these fruits is high. In Table S2, the soluble fiber pectin content is presented expressed as mg/kg. The pectin amount ranged from 3877 to 5131,9 mg/kg with a mean content of 4311 mg/kg. These data are of considerable interest in light of the beneficial effects recognised to this component, which are associated with the improvement of intestinal functions, the reduced risk of coronary heart disease and type 2 diabetes and the improvement of weight maintenance (EFSA, 2010; Hauner et al., 2012; Domínguez Díaz et al., 2020).

The mean concentration of elements Ca, Cu, Fe, K, Mg, Mn, Na, Se and Zn found in persimmon fruit samples are shown in Table S3 expressed as mg/kg. Ca amounts ranged from 40,1 to 83,9 mg/kg, respectively, for Sardinia and Sicily samples, with a mean value of 51 mg/kg. Cu ranged from 0,3 to 3,6 mg/kg, respectively, for Sardinia and Apulia samples, with a mean value of 2,0 mg/kg. Fe ranged from 1,2 to 7,5 mg/kg, respectively, for Sicily and Lazio samples, with a mean value of 2,6 mg/kg. K ranged from 1670,1 to 229,6 mg/kg, respectively, for Campania and Sardinia samples, with a mean value of 2022,8 mg/kg. Mg ranged from 186,5 to 258,7 mg/kg, respectively, for Campania and Sardinia samples, with a mean value of 231,2 mg/kg. Mn ranged from 0,2 to 1,3 mg/kg, respectively, for Apulia-Sardinia and Lazio samples, with a mean value of 0,6 mg/kg. Na ranged from 21,7 to 35,9 mg/kg, respectively, for Lazio and Sicily samples, with a mean value of 28,5 mg/kg. Se contents were low ranging from $<$0,1 to 0,2 mg/kg for all samples. Zn ranged from 0,4 to 2,2 mg/kg, respectively, for Campania and Lazio samples, with a mean value of 0,9 mg/kg. All mineral data were comparable and in agreement with the literature with only slight modification to Domínguez Díaz et al. (2020) and USDA (2021) while significant differences were found by comparing with Mir-Marqués et al. (2015). Persimmon fruits mineral profile were variable across the region, nevertheless, it might be assumed that these fruits are a good source of potassium with low levels of zinc and sodium. The intake of the other mineral elements was adequate to the Recommended Daily Allowance (RDA). Thank to this mineral profile these fruits could be a healthy option for people with heart diseases and hypertension (Mir-Marqués et al., 2015).

In Table S4, the *D. kaki* fruits protein content express as % is shown. The total amount of proteins ranged from 0,2 to 0,9%, respectively, for Sardinia and Campania samples, with a mean content of 0,46%, it is a modest protein content in agreement with the literature nutritional data for this fruit (Jiménez-Sánchez et al., 2015; USDA).

The results regarding the total phenolic and gallic acid content are reported in Table S5. The data were variable, ranging between 186 and 45 mg/kg, respectively, for Sicily and Sardinia with a mean value of 88 mg/kg. Gallic acid was quantified by UFLC/MS with values among 56 and 8 mg/kg, respectively, for Sicily and Campania. These findings were in agreement with total phenolic and gallic acid contents found by Pu et al., 2013. According to Pu et al. (2013), all the samples might be considered belonging to a persimmon group with low phenolic content and consecutively a weak antioxidant activity. Persimmon intake can contribute to the achievement of the polyphenolic recommended daily dose (Del Bo' et al., 2019). Indeed, polyphenols including phenolic acids are often included in the human diet and have been

extensively studied due to their biological activities such as antioxidant, antimicrobial and cardiovascular benefits (Del Bo' et al., 2019). Gallic acid, in addition to having astringent uses, also has several declared bioactivities, such as bacteriostatic and antioxidant properties (Heleno et al. 2015).

Further studies should be addressed to investigate possible fruit contamination by secondary metabolites from mycotoxins since they may occur in commodities, food and raw agricultural products, at pre-and post-harvest steps since they can colonise a wide variety of food and may represent a risk for health (Santini et al., 2009; Mikušová et al., 2013).

3. Experimental

Experimental details related to this article are available online (see supplementary data).

4. Conclusions

The present experimental work highlights interesting results on the nutritional and mineral composition of *D. kaki* cultivated in Central and Southern Italy. The dietary fiber, mineral, pectin, polyphenol and protein contents were evaluated. Good levels of all chemical analysed were found in all the collection sites, confirming the genuineness of the cultivation of this fruit in the Italian sites. A certain variability has been observed mainly due to environmental pedoclimatic condition. Valuable contents in dietary fiber and pectins were found, confirming this fruit suitable for special regimens such as weight maintenance, cardiovascular diseases and diabetes and their related possible health claims. The mineral profile with its high level of potassium and low level of sodium could be introduced in the dietary regimen for subjects with cardiovascular and heart diseases.

The rational analysis of the phytochemical profile with respect to agronomical and nutritional data allows achieving quality food production of healthy important food such as *D. kaki* fruits.

Disclosure statement

The authors declare no conflict of interest.

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