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Physico-chemical characteristics of apricot (*Prunus armeniaca* L.) grown in Northern Areas of Pakistan

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ABSTRACT

In order to ascertain physico-chemical, functional and geometrical traits of apricot fruit from Northern Areas of Pakistan, six predominantly grown varieties namely, Alman, Habi, Khakhas, Mirmalik, Neeli and Shai were selected in this study. Proximate composition as crude fat (2.1–3%), crude protein (6.18–8.7%), crude fiber (11.85–13.6%), ash (9.45–12.1%) and total sugars (56.8–64.9%) were determined on dry weight basis. The data showed variations among the investigated parameters in all varieties. Functional properties of apricot fruit viz. ascorbic acid (67.39–90.94 mg/100 g), total phenolic compounds (4590–7310 mgGAE/100 g), total carotenoids (10.09–18.13 mg/100 g β-carotene) and antioxidant activity (56.84–82.33%) were also recorded. The data pertaining to mineral contents (mg/100 g) revealed K as the predominant element (2040–3000) followed by P, Mg, Ca, Na and Fe among all the tested samples. Furthermore, geometrical characters of apricot varieties were also determined as important sensory and technological attributes on fresh weight basis. The result from the present study showed that all the tested varieties are highly nutritious and rich in functional components.

1. Introduction

Apricot, *Prunus armeniaca* L., a member of the Rosaceae family; is one of the most important stone fruit of South East Asia. Pakistan is the 3rd major producer of apricot with an annual production of 0.5 million Mt (FAO, 2008; DOA, 2008). The major ecological zones in Pakistan for apricot production are the Northern Areas (Gilgit-Baltistan), Malakand division of NWFP and upper parts of Balochistan province (Jasra and Rafi, 2002).

Apricot is the major fruit crop of the Northern Areas, having 1.8 million fruit bearing trees with an annual production of 0.11 million Mt. It contributes to 62% share of total fruit production of the area. Nearly 60 varieties are grown in this region. Among them, Alman, Habi, Halman, Shakanda and Khakhas are the most important in terms of bulk production and general acceptance. The apricots presently grown in this region are known for their unique characteristic color, flavor, taste and overall quality (MFC, 2005; DOA, 2008).

"Apricot to the Northern Areas could be what Banana is to the banana republics". Apricot is synonym to the area and has remained as traditional part of diets of the people and an important economic crop for centuries. Favorable environmental conditions of this region enable the production of quality apricots with high dry matter and sugar contents (MFC, 2005). Owing to the perishable nature of this fruit and limited marketing opportunities, a large proportion of the fruit is wasted during glut season and the losses are as higher as 44% of total fresh produce (FAO and DOA, 2007).

Nutritionally, it is a rich source of sugars, fibers, minerals, bioactive phytochemicals and vitamins like A, C, thiamine, riboflavin, niacin and pantothenic acid (Leccese et al., 2007). Among the phytochemicals, phenolics, carotenoids and antioxidants are important for their biological value (Lichou et al., 2003).

During the ripening of fruits a series of complex biochemical reactions take place which leads to production of phenolic compounds, carotenoids and the formation of volatile compounds. Among these natural compounds, carotenoids are the prevalent group of pigments in nature, and present in all photosynthetic organisms, which are responsible for most of yellow to red colors of fruits and flowers.

In the recent years, there is an increasing interest in polyphenols and carotenoids for their antioxidant properties and ability to fight against chronic diseases (Dragovic-Uzelac et al., 2007). It has been shown that dietary antioxidants may provide effective protection from oxidative damage in living systems (Lila, 2004). Apart from its nutritional characteristics, apricot fruit also has some pharmacological significance due to having high amounts of antioxidant. It is used as cleansing agent and mild laxative, antipyretic, antiseptic, emetic and ophthalmic properties. A recent study by Enomoto

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et al. (2010), has suggested that daily consumption of 3 Japanese apricots has an inhibitory effect on mucosal inflammation of the stomach and chronic atrophic gastritis (CAG) progressions in individuals with *Helicobactor pylori* infection. This study stresses the need to assess the apricot fruit for its potential health benefits. The seed of apricot is also considered as analgesic, anti-asthamic, antispasmodic, pectoral sedative and used in the production of oils, benzaldehyde, cosmetics, active carbon and aroma compounds (Southon and Faulks, 2002).

Although, different apricot varieties have been investigated for their composition by many researchers in the world (Sass-Kiss et al., 2005), however, according to our knowledge, this is the ever first study carried out on the composition of apricots from Northern Areas of Pakistan. Therefore the aim of this study was to explore physico-chemical characters and functional properties of commonly grown apricot varieties, so as to produce a convenient data suitable for the researchers, apricot marketing and processing entrepreneurs.

2. Material and methods

2.1. Materials

Fresh ripe apricots of the cultivars (Alman, Habi, Khakhas, Mirmalik, Neeli and Shai) were harvested from Zakir Fruit Nursery Jalalabad Distt. Gilgit, Northern Areas of Pakistan during June 2008. The fruits were immediately shifted to the Department of Food Technology, Pir Mehr Ali Shah, Arid Agriculture University Rawalpindi for further studies. The fruit were cleaned, sorted and graded to remove dust, dirt, immature and damaged fruits.

2.2. Proximate composition

Moisture content and dry matter were determined by oven drying method till constant weight, while crude fat by Soxhlet apparatus through solvent extraction then evaporation and measuring weight difference according to AOAC (1990) method No. 983.23, Crude protein by measuring total nitrogen through Kjeldhal method (920.10) and converted into protein using conversion factor ($N \times 6.25$), similarly crude fiber and ash content were analyzed according to AOAC (1990) method Nos. 920.86 and 940.26 respectively. Soluble solid content (expressed as °Brix) was determined in the pulp of each sample using a digital refractometer PL-3 (ATAGO, Japan) at 29 ± 1 °C and temperature correction was made accordingly as per AOAC (1990), method No. 920.151. Similarly, reducing, and total sugars were determined by Lane and Eynon method (925.35 and 925.36).

2.3. Chemical and functional properties

Chemical and functional properties of apricot varieties were evaluated as under. The pH values were measured by using a pH-meter (Inolab. WTW Series, Germany) and titratable acidity was determined by titrating 5 ml of juice with 0.1 N NaOH and results were expressed as percentage of Malic acid on fresh weight basis (AOAC, 1990) method No. 981.12. Ascorbic acid was estimated using 2,6-dichlorophenolindophenol titration according to AOAC (1990) method No. 967.21 and data were presented on dry weight basis.

2.3.1. Measurement of total phenolic compounds

Total phenolics were measured by using the Folin–Ciocalteu assay as described by Sponas and Wrolstad (1990) with some modifications. Ten fruits randomly selected from each variety were crushed and homogenized in a homogenizer. Five grams of fruit puree was taken from the homogenate and diluted to 30 ml with 80% methanol and clarified by centrifugation at $10{,}000 \times g$ for 15 min. The extract was filtered through a 0.45 mm membrane filter. Now from this filtrate, 0.5 ml was taken in a 25 ml volumetric flask, to which 5 ml 2 N Folin–Ciocalteu reagent and 4 ml of 7.5% sodium carbonate solution were added and volume was made with 80% methanol. The contents were allowed to stand for 5–8 min at 50 °C and the absorbance was measured at 765 nm using a CE-2021, Spectrophotometer (CECIL Instruments Cambridge, England). Total phenolics were estimated by calibration curve obtained from measuring the absorbance of a known concentration of Gallic acid standard. The concentrations were expressed as milligrams of Gallic acid equivalents (GAE) per 100 g of dry weight.

2.3.2. Measurement of total carotenoids

Total carotenoids were extracted according to the method of Rodriguez-Amaya (1999) with some modifications. Briefly, 5 g of sample was homogenized with 100 ml of methanol: petroleum ether (1:9, v/v) and the mixture were transferred to a separating funnel. Petroleum ether layer was filtered through sodium sulphate, transferred to a volumetric flask and total volume was made up to 100 ml with petroleum ether. Finally, the total carotenoid content was measured by a spectrophotometer (CE-2021, 2000 series CECIL Instruments Cambridge, England) at wave length of 450 nm and the results were expressed as β-carotene equivalents (mg/100 g of dry weight).

2.3.3. Antioxidant activity

Radical scavenging activity was measured using a modified version of the method described by Brand-Williams et al. (1995) that involves the use of the free radical 2,2-diphenyl-l-picrylhydrazyl (DPPH). 5 g of ground frozen tissue was taken in triplicate, homogenized and extracted with 10 ml methanol for 2 h. 0.1 ml from the above extract was taken in test tube and 3.9 ml of DPPH solution (6×10^{-5} mol/L) was added and incubated at room temperature for 30 min. After incubation absorbance was measured at 517 nm. The DPPH solution was freshly prepared daily, stored in a flask covered with aluminum foil and kept in the dark at 4 °C between measurements. Blank sample was prepared containing the same amount of methanol and DPPH solution and measured daily. Radical scavenging activity was calculated as % inhibition of DPPH radical by the following formula:

$$\%\text{Inhibition} = \frac{A_{\text{blank}} - A_{\text{sample}}}{A_{\text{blank}}} \times 100$$

2.4. Mineral analysis

The mineral contents of apricot were determined according to AOAC (1990). The samples (0.8–1 g) were ashed in a muffle furnace at a temperature of 550 ± 10 °C for 6 h and the ash obtained was digested with 5 ml 6 M HCl on a water bath. After drying 7 ml 0.1 M HNO_3 was added and contents were diluted to 100 ml with double deionized water as described by Nielsen (1994). Calcium (Ca), Iron (Fe), Zinc (Zn), Manganese (Mn), Copper (Cu), Nickel (Ni) and Magnesium (Mg) were determined in an Atomic Absorption Spectrophotometer (GBC-932 Australlia) whereas Sodium (Na) and Potassium (K) by Flame Photometer (Model PFP 7 Jenway, England) and Phosphorus (P) by using a Spectrophotometer (CE-2021, 2000 series CECIL Instruments Cambridge, England).

2.5. Geometrical and physical characteristics

Physical characteristics (fruit weight, pulp weight, pit weight and pulp/pit ratio) of apricots were determined by a digital electronic balance (Inolab. WTW Series, Germany), with 0.001 g sensitivity, using 40 randomly selected fruits from each variety.