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Some physico-chemical and functional attributes of six indigenous apricot genotypes from Gilgit-Baltistan, Pakistan

Sartaj Ali[1*], Tariq Masud[2], Kashif S. Abbasi[3], Talat Mahmood[4], Amjad Ali[1]

[1]*Department of Agriculture and Food Technology, Karakoram International University, Gilgit-Baltistan, Gilgit, 15100, Pakistan*

[2]*Department of Food Technology, Pir Mehr Ali Shah, Arid Agriculture University, Rawalpindi, 45000, Pakistan*

[3]*Department of Agriculture, University of Haripur, Khyber Pakhtunkhawa, Pakistan*

[4]*Quality Enhancement Cell, University of Haripur, Khyber Pakhawa, Pakistan*

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Abstract

The current study was conducted to investigate some physico-chemical and functional attributes of six apricot genotypes (i.e. Halman, Jahangir, Marghulam, Shakanda, Shirini and Yagoo) indigenous to the agro-climate of Gilgit-Baltistan. Proximate composition (dry matter, protein, fat, fiber, sugars and ash), biochemical characteristics (TSS, pH, acidity, ascorbic acid, total phenolics, carotenoids and antioxidant activity), mineral contents and technological traits were evaluated. The data revealed a rich nutritional and functional composition in terms of sugars (38.63-68.59%), fiber (7.06-10.36%), ascorbic acid (57.50-75.02 mg/100g), total phenolics (4376-7123 mg GAE/100g**)**, carotenoids (19.61-50.12 mg ß-carotene/100g) and a significant antioxidant potential in the tested cultivars on dry weight basis. Mineral composition showed potassium, calcium, phosphorus, magnesium, sodium and iron as the major, while zinc, manganese, nickel and copper as the minor elements in apricot. Some pomological properties of fruit were also determined to be vital traits of consumer acceptance and industrial significance. The varietal comparison revealed Halman and Shakanda as the most promising varieties for functional and compositional attributes.

* **Corresponding Author:** Sartaj Ali ✉ sartaj_kiu@yahoo.com

Introduction

Apricot (*Prunus armeniaca L.*) belongs to the genus *Prunus* of the Rosaceae family and grown in climates having well-differentiated seasons (Ahmadi *et al.*, 2008). The fruit is considered to be native to China with a long history of cultivation from where it was later on introduced into Europe and America (Herbst, 2001; Faust *et al.*, 1996). Turkey, Iran and Pakistan are the major apricot producing countries in the world (FAO, 2010). In Pakistan, the apricot is grown in the Baluchistan, Khyber Pakhtunkhawa and Northern Areas (Gilgit-Baltistan) (Jasra and Rafi, 2007). It is the most popular and common fruit of Gilgit-Baltistan and hence Baltistan is also known as Little Tibet of Apricots by historians and travelers. Favorable agro-climatic conditions render this region ideal for apricot growing (MFC, 2005; Jan, 2006). It stands 1st in volume among the major fruits with an annual production of 114286 tons from 60 varieties (DOA, 2009). The economic significance is obvious from the fact that 20 percent of farm earnings come from apricot. Currently, there is a growing interest in phytochemicals due to their significant roles in alleviating chronic diseases and maintaining good health. Consumer awareness regarding healthy foods has further attracted the attention of researchers towards the investigation and characterization of these compounds (Kaur and Kapoor, 2001; Boyer and Liu, 2004). Fruits are of special interest for their diverse composition such as polyphenols, carotenoids and antioxidant vitamins (A, C, E), hence considered as functional foods (Ackurt, 1999; Kim *et al.*, 2003; Garcia-Alonso *et al.*, 2004). Apricot is a good source of sugars, organic acids, vitamins (A, C and B complex), minerals, phytochemicals (phenolic compounds and carotenoids) and aroma compounds (Haciseferogullari *et al.*, 2007). The composition of fruits is affected by certain factors like genotype, regional and environmental variations and cultural practices (Akin *et al.*, 2008; Munzuroglu *et al.*, 2003). Thus it becomes crucial to investigate the composition of fruits grown in different agro-ecological zones to establish their nutritional and functional potentials. Apricot fruit has although been thoroughly investigated for its composition by many researchers around the globe (Sass-Kiss *et al.*, 2005 17), however, limited work has been carried out to explore the nutritional potential of apricot from this region. Being the neighbor to apricot birth place, Gilgit-Baltistan is rich in indigenous apricot germplasm and has a great genotypic diversity. In the light of the above facts, this study was planned to investigate local apricot varieties to assist different stakeholders to utilize the fruit potential for food and economic benefits.

Materials and methods

Collection of fruits

Fresh and ripe fruits of six apricot genotypes (i.e. Halman, Jahangir, Marghulam, Shakanda, Shirini and Yagoo) were harvested at the ripe stage from the Zakir Fruit Farm Jalalabad, Gilgit on 15th June, 2011. The fruits were immediately shifted in corrugated cartons to the Department of Food Technology, PMAS Arid Agriculture University, Rawalpindi for further studies.

Chemicals and reagents

All the chemicals and reagents used in the experiments were of analytical grade.

Proximate composition of apricot

Proximate composition of apricot fruit was evaluated following the standard procedures of (AOAC, 2005). The moisture content and dry matter were estimated through the oven drying method by placing shredded sample in a hot air oven at 75^{o}C for 48 hrs till constant weight. Ash and crude fiber contents were assessed according method No. 920.86, 940.26. Protein content was estimated through Kjeldhal distillation apparatus by measuring total nitrogen and then converting to protein by using the conversion factor (Nx6.25) method No. 920.10, crude fat by solvent extraction in Soxhlet apparatus and measuring weight differences. Reducing, non-reducing and total sugars were estimated by Lane and Eynon method and expressed as gram per 100g on dry weight basis.

Physico-chemical and functional properties

Total soluble solid (TSS) expressed as °Brix was determined in the pulp of randomly selected 10 fruits from each variety, using a digital refractometer PL-3 (ATAGO™, Japan) at 29±1°C and pH was recorded by using a pH-meter (Inolab™ WTW Series, Germany). Acidity was measured by titration of apricot juice with 0.1 N NaOH and expressed as percentage of Malic acid, while ascorbic acid was estimated using 2, 6-dichlorophenolindophenol titration method (mg/100g) and the results were presented on dry matter basis (AOAC, 2005).

Measurement of total phenolic compounds

Total phenolic compounds (TPC) were assessed by using the Folin-Ciocalteu,s assay (Sponas and Wrolstad, 1990). After crushing and homogenization, five grams of sample were taken and diluted to 30 ml with 80% methanol. The sample was centrifuged for 15 min at 10,000g and then filtered with a 0.45 mm membrane filter. After filtration, 0.5 ml sample was taken in volumetric flask and then 5 ml of 2 N Folin-Ciocalteu reagent and 4 ml of 7.5% sodium carbonate solution were added and volume was made up to 25 ml with 80% methanol. The contents kept at 50°C for 8-10 min and the absorbance was measured at 765 nm using Spectrophotometer (CE-2021, CECIL Instruments® Cambridge, England). TPC were quantified from a calibration curve using Gallic acid as standard and expressed as milligram of Gallic acid equivalents (mg GAE/100g) on dry weight basis.

Measurement of total carotenoids

Total carotenoids (TC) were evaluated according to the method described by Rodriguez-Amaya (1999). The extract was prepared by adding five grams of homogenized sample with 100 ml of methanol and petroleum ether 1:9 v/v and then the mixture was transferred to a separating funnel. Petroleum ether was filtered through sodium sulfate and transferred to a volumetric flask; final volume was made up to 100 ml with petroleum ether. TC was measured at 450 nm by using a spectrophotometer (CE-2021, 2000 series CECIL Instruments® Cambridge, England). The results were expressed as β-carotene equivalents per 100g dry weight basis.

Free radical scavenging activity

Antioxidant potential (%) was measured in terms of free radical scavenging activity by using a modified version of 2, 2-diphenyl-l-picrylhydrazyl (DPPH) as described by Brand-Williams *et al.* (1995). Five grams of homogenized sample were extracted with 10 ml methanol for 2 hours. 0.1 ml sample from methanolic extract was added in test tube having 3.9 ml of DPPH solution (6×10^{-5} mol/L) and incubated at room temperature for 30 min. Absorbance was measured at 517 nm after incubation. Radical scavenging activity was calculated as percent inhibition of DPPH radical by the following formula:

$$\% \text{ Inhibition} = (A_{blank} - A_{sample}/A_{blank}) \times 100$$

Mineral Contents

Mineral contents were estimated by the ashing method (AOAC, 2005). The obtained ash was digested with 5 ml 6 M HCl in water bath. Calcium, Iron, Zinc, Manganese, Copper, Nickel and Magnesium of apricot were determined in an Atomic Absorption Spectrophotometer (GBC-932 Australia), whereas Sodium and Potassium by Flame Photometer (Model PFP 7 Jenway™ England) and Phosphorus, colorimetrically by using UV-Spectrophotometer (UNICO 2100™ Series Japan) (Watanabe and Olsen, 1965).

Technological traits

The fruit linear dimensions i.e. length (L), width (W), thickness (T) of fruits was measured by a Digital Vernier Caliper (China) with an accuracy of 0.01 mm and fruit volume (V) by liquid displacement method (Mazumdar and Majumder, 2003). The geometric mean diameter (D_g) and surface area (S) was calculated by using the following formulae according to Mohsenin (1970) and Baryeh (2001).

$$D_g = (LWT)^{0.333}$$

Where, L is length, W is width and T is the thickness of the fruit.

$$S = \pi D_g^2$$

Where, D_g is the Geometric mean diameter of the fruit.

Sphericity of the fruit was determined according to Ahmadi *et al.* (2008):

$\Phi = (D_g / L) \times 100$

Physical properties (fruit weight, pulp weight, pit weight and pulp/pit ratio) were recorded by weight difference according to using 40 randomly selected fruits from each variety (AOAC, 2005).

Statistical Analysis

The results were subjected to statistical analysis by considering the varieties as variation source, using one-way ANOVA. Statistical differences at $p < 0.05$ were considered significant and means were compared with Duncan Multiple Range Test (DMRT) according to Steel *et al.* (1997) through MSTAT-C Software (Michigan State University, 1991).

Results

The data regarding proximate composition revealed a significant difference ($p < 0.05$) among the tested varieties for dry matter, ash, crude fiber, fat and protein except sugars which were partly different (Table 1). Dry matter was found in the range of 14.00±0.55 to 21.81±0.54 g/100g of fresh weight. The highest dry matter was found in Jahangir followed by Halman, Shakanda, Marghulam, Shirini and Yagoo. Ash content in the tested apricot varieties ranged between 5.80±0.037 to 8.14±0.049 g/100g. The values obtained were significant ($p < 0.05$) among the varieties. The highest value was found in Jahangir followed by Halman, Marghulam, Shakanda, Shirini and Yagoo. Crude fiber range was found between 6.91±0.024 to 10.36±0.013 g/100g and the results significantly differed ($p < 0.05$) among the investigated cultivars. The Shakanda was found to be dominating in crude fiber followed by Marghulam, Jahangir, Halman, Shirini and Yagoo. The values for crude fat and protein were established as 1.54±0.020 to 4.56±0.036 g/100g and 3.85±0.033 to 7.11±0.045 g/100g respectively. Similarly, the values for reducing, non-reducing and total sugars were found between 11.07±0.32 to 19.98±0.37, 26.53±0.54 to 48.53±0.42 and 38.63±0.68 to 68.59±0.79 g/100g respectively, which were partially significant among the six genotypes. Highest total sugars were recorded in Shakanda followed by Shirini, Yagoo and Halman, Marghulam and Jahangir.

Table 1. Proximate composition of apricot from Northern Areas (Gilgit-Baltistan) Pakistan.

Parameters	Varieties					
	Halman	Jahangir	Marghulam	Shakanda	Shirini	Yagoo
	------------------------------------- g/100g dw--					
Dry matter	18.00± 0.29b	21.81±0.54a	16.00±0.73d	16.90±0.37c	15.00±0.34e	14.00±0.55f
Ash	8.03±0.036b	8.14±0.049a	6.96±0.024d	7.06±0.015c	6.48±0.028e	5.80±0.037f
Crude fiber	8.41±0.013c	6.91±0.024f	9.97±0.021b	10.36±0.013a	7.98±0.012d	7.06±0.016e
Crude fat	2.41±0.016c	1.54±0.020e	2.41±0.024c	4.56±0.036a	3.05±0.024b	2.02±0.019d
Crude protein	5.00±0.020c	3.85±0.033f	5.25±0.024b	7.11±0.045a	4.69±0.012d	4.17±0.037e
Reducing sugars	13.01±0.21d	12.10±0.14e	11.07 ±0.32f	19.98±0.37a	16.74±0.16b	13.75±0.25c
Non-Red. sugars	39.77±0.66b	26.53±0.54d	39.75±0.50b	48.53±0.42a	37.03±0.43c	39.54±0.54b
Total sugars	52.78±0.87b	38.63±0.68d	50.82±0.82c	68.59± 0.79a	53.65±0.59b	53.29±0.79b

Means of three replications + standard deviation (SD) on dry weight basis.

Means within the same line followed by the same letters are not statistically significant ($p < 0.05$).

Data pertaining to chemical and functional properties is presented in Table 2. TSS range was found between 14.03±0.45 to 23.00±0.73 °Brix. Shakanda had the maximum TSS followed by Halman, Shirini, Jahangir, Yagoo and Marghulam. Titratable acidity was found in the range between 1.86±0.001 to 3.88±0.006% malic acid. Marghulam had the highest TA on dry matter basis followed by Yagoo, Shirini, Jahangir, Halman and Shakanda respectively. The values for both the parameters were significant among all the varieties. Ascorbic acid content was established in the range of 57.50±0.32 to 75.02±0.40 mg/100g on dry weight basis and differed significantly ($p < 0.05$) among the genotypes.

Marghulam was rich in ascorbic acid followed by Halman, Yagoo, Shakanda, Jahangir and Shirini.

Table 2. Physico-chemical and antioxidant composition of apricot.

Parameters	Varieties					
	Halman	Jahangir	Marghulam	Shakanda	Shirini	Yagoo
TSS (°Brix)	22.00±0.61b	17.30±0.12d	14.03±0.45f	23.00±0.73a	18.20±0.37c	16.20±0.24e
Titratable Acidity (%)	1.95±0.001e	2.41±0.003d	3.88±0.006a	1.86±0.001f	2.83±0.002c	3.37±0.003c
Ascorbic Acid (mg/100 g)	62.65±0.27b	58.95±0.53e	75.02±0.40a	60.49±0.25d	57.50±0.32f	61.27±0.30c
Total Phenolics (mg GAE/100 g)	7123±40.00a	5211±40.00c	4376±30.00d	5722±30.00b	5115±54.00c	4612±30.00d
Total Carotenoids (mg/100g ß-carotene)	50.12±1.00a	40.54±0.78c	19.61±0.50f	46.07±0.88b	39.45±0.740d	36.41±0.700e
Free Radical Scavenging Activity (%)	79.43±3.40a	61.02±1.80c	32.44±0.90e	66.76±2.80b	60.85±3.20c	39.71±2.10d

All the values are means of three replications + standard deviation (SD).

Titratable acidity, ascorbic acid, total phenolics as Gallic acid equivalent and total carotenoids as ß-carotene equivalent have been presented on dry weight basis.

Means within the same line followed by the same letters are not statistically significant ($p < 0.05$).

The varieties investigated for total phenolic contents were found to be rich and the values were statistically ($p < 0.05$) different among the genotypes (Table 2). The TPC ranged from 4376±30.00 to 7123±40.00 mg GAE/100g on dry weight basis among the varieties. The highest concentration was found in Halman (7123±40.00) followed by Shakanda (5722±30.00), Jahangir (5211±40.00), Shirini (5115±54.00), Yagoo (4612±30.00) and Marghulam (4376±30.00). Similarly, total carotenoid contents were found in the range of 19.61±0.50 to 50.12 mg/100g ß-carotene on dry weight basis in the varieties under investigation (Table 2). Amongst, Halman was leading in TC (50.12±1.00) followed by Shakanda, Jahangir, Shirini, Yagoo and Marghulam (46.07±0.88, 40.54±0.78, 39.45±0.740, 36.41±0.700, 19.61±0.50 mg/100g ß-carotene) respectively.

Table 3. Mineral content of apricot from Northern Areas (Gilgit-Baltistan) Pakistan.

Parameters	Varieties					
	Halman	Jahangir	Marghulam	Shakanda	Shirini	Yagoo
			mg/100g dw			
Na	18.71±0.60b	21.05±1.30a	15.89±0.23c	16.44±0.38c	14.30±0.60d	12.50±0.14e
K	1967±29.67	2055±38.00a	1250±20.00f	1666±30.00c	1420±25.00d	1323±15.00e
Ca	100.50±2.30c	114.30±3.20a	66.88± 0.72e	106.20±2.60b	97.48±0.89c	78.76±0.74d
P	256.80±7.24a	252.90±5.30a	180.10± 2.70d	212.40±3.48b	166.70±2.20e	190.60±3.10c
Mg	147.90±6.20a	149.40±7.10a	118.90±4.30d	137.70±3.50b	125.20±1.60cd	133.10±2.00bc
Fe	11.96±0.50a	8.34±0.41b	4.04±0.31e	7.50±0.38c	3.90±0.24e	6.38±0.45d
Zn	3.38±0.21a	2.80±0.18b	1.08±0.11e	2.40±0.24c	1.43±0.16d	0.96±0.12e
Mn	0.92±0.33b	1.19±0.44a	0.47±0.11e	0.88±0.32c	1.01±0.52a	0.67±0.25d
Ni	0.29±0.07cd	0.62±0.09a	0.38±0.04bc	0.44±0.04b	0.33±0.03cd	0.27±0.02d
Cu	0.43±0.05b	0.64±0.05a	0.11±0.02e	0.34±0.04c	0.27±0.02d	0.16±0.02e

All the values are means of three replications + standard deviation (SD).

Means within the same line followed by the same letters are not statistically significant ($p < 0.05$).

Results pertaining to antioxidant activity (% DPPH free radical scavenging capacity) have been presented in Table 2. The values were ranging from 32.44±0.90 to 79.43±3.40% and the differences were significant among the varieties ($p < 0.05$). The highest activity was found in Halman (79.43±3.40) followed by Shakanda (66.76±2.80), Jahangir (61.0261.02±1.80), Shirini (60.8560.85±3.20), Yagoo (39.7139.71±2.10) and Marghulam (32.44±0.90) respectively.

Table 4. Geometric and dimensional properties of apricot from Northern Areas (Gilgit-Baltistan) Pakistan.

Parameters	Varieties					
	Halman	Jahangir	Marghulam	Shakanda	Shirini	Yagoo
Moisture (%)	82.00±0.24e	78.15±0.44f	84.00±0.73c	83.10±0.37d	86.00±0.44a	85.00±0.45b
Fruit length (mm)	36.44±0.23b	39.18±0.09a	28.14±0.12d	39.69±0.10a	36.18±0.10b	33.00±0.88c
Fruit width (mm)	38.10±0.08a	37.40±0.20b	30.41±0.11f	36.39±0.12c	36.12±0.06d	30.74±0.20e
Fruit thickness (mm)	40.10±0.10a	35.30±0.16b	29.34±0.17e	28.50±0.06f	33.77±0.25c	31.25±0.12d
Geo. mean Diameter (mm)	38.20±0.19a	37.10±0.18b	29.27±0.07f	34.60±0.18d	35.13± 0.13c	32.00±0.17e
Fruit volume (cm^3)	26.68±0.24a	25.00±0.22b	23.33±0.15c	19.33±0.13e	20.00±0.12d	23.33±0.11c
Surface area (cm^2)	4582±45.58a	4322±21.00b	2690±12.86f	3759±39.50d	3875±28.86c	3215±30.00e
Sphericity (%)	97.09±0.03b	104.80±0.03a	104.01±0.03a	87.17±0.01d	97.71±0.01b	96.96±0.01c
Fruit weight (g)	31.74±0.10a	28.90±1.00b	15.23±0.10e	24.00±0.13c	23.37±0.20c	17.38±1.00d
Pulp weight (g)	28.48±0.08a	26.43±0.09b	13.38±0.07f	21.03±0.10d	21.57±0.12c	16.36±0.10e
Pit weight (g)	2.50±0.20b	2.47±0.07b	1.82±0.08c	3.00±0.40a	2.04± 0.04c	1.22±0.04d
Pulp/ pit ratio	11.39±0.69b	10.81±0.38b	7.36±0.37c	7.00±1.00c	10.52±0.09b	13.00±1.00a

All the values are means of three replications + standard deviation (SD) on fresh weight basis.
Means within the same line followed by the same letters are not statistically significant ($p < 0.05$).

Mineral contents (mg/100g dry weight) have been presented in Table 3. The results showed significant variations ($p < 0.05$) among the varieties. Regarding macro elements K was the highest (1250±20.00-2055±38.00) in all samples followed by P (166.70±2.20-256.80±7.24), Mg (118.90±4.30-149.40±7.10), Ca (66.88±0.72-114.30±3.20) and Na (12.50±0.14-21.05±1.30) respectively. Jahangir has the maximum values for most of the macro and micro elements followed by Halman, Shakanda, Shirini, Yagoo and Marghulam; however P was high in Halman. Among the micro elements, Fe (3.90±0.24-11.96±0.50) was high followed by Zn (0.96±0.12-3.38±0.21), Mn (0.47±0.11-1.19±0.44), Ni (0.27±0.02-0.62±0.09) and Cu (0.11±0.02-0.64±0.05).

Some selected geometrical traits i.e. fruit length, fruit width, fruit thickness, geometric mean diameter, fruit volume, surface area and sphericity were determined (Table 4). These characteristics were assessed on fresh weight basis at moisture levels 78.15±0.44 to 86.00±0.44%. Significant differences ($p < 0.05$) exist among all the traits except sphericity (Table 4). The results regarding weight dimensions were established between 15.23±0.10 to 31.74±0.10 g for fruit weight, 13.38±0.07 to 28.48±0.08 g for pulp weight, 1.22±0.04 to 3.00±0.40 g/100g fresh weight for pit weight and 7.00±1.00 to 13.00±1.00 for pulp and pit ratio. At the given moisture content the results were statistically significant ($p < 0.05$).

Discussion

Nutritional and health promoting components of fruits and vegetables have attracted the consumers towards their increased use as natural foods. This trend has necessitated the investigation of fruits from different agro-ecological regions of the world for their compositional data to facilitate the choice of processors and consumers. Proximate composition of apricot was assessed on dry weight basis, since moisture influence the overall composition of nutrient components of a fresh commodity (Ali *et al.*, 2011). Similarly, dry matter is instrumental in selecting apricots for dried products or fresh consumption. Varieties with high dry matter are preferred for drying, while low dry matter varieties are consumed fresh. Previously (Haciseferogullari *et al.*, 2007) and (Akin *et al.*, 2008) have reported high dry matter contents of apricots and observed variation in contents among the fruits of different regions. The ash content is the indicator of minerals present in the commodity and according to the results, Jahangir was found best. Crude fiber is also an important component of fruits although has no significance in terms of energy, however vital in maintaining health through improving bowl movement and absorbing extra fat from the blood. Likewise, crude fat and protein provide energy and building material for sustaining body structure and functions. All the tested varieties showed varying amounts of the above components. Sugars show energy potential of a fruit and also indicators of maturity. The present findings regarding sugar content of different genotypes were partially significant. Our results agree with the findings (Haciseferogullari *et al.*, 2007) and (Akin *et al.*, 2008) on Turkish apricot. The compositional difference may be due to their genotypes, geography and agricultural practices [Ali *et al.*, 2011; Scalzo *et al.*, 2005; Munzuroglu *et al.*, 2003).

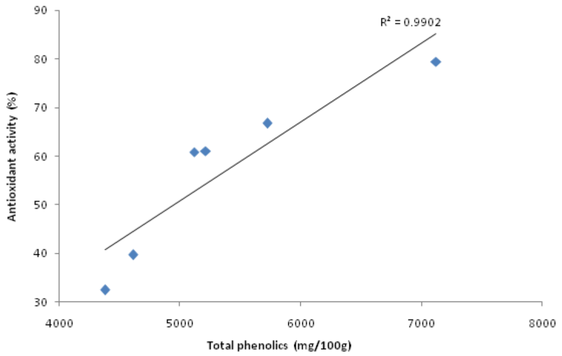

Fig. 1. Correlation between total phenolic content and antioxidant activity in apricot.

The TSS content of fruits is an indicator of the ripening process and used as a tool in determining the harvesting time (Ali *et al.*, 2011). It also represents the sugar content and hence considered as a quality parameter. In case of our study Halman was dominating in TSS content and significant ($p < 0.05$) differences were found for all genotypes. Titratable acidity represents organic acid composition of a commodity. Malic acid is the predominant organic acid in apricot followed by citric acid beside minute amounts of tartaric, oxalic, succinic and fumaric acid (Gurrieri *et al.*, 2001; Hasib *et al.*, 2002). Acid composition is also an important attribute in determining the taste of the commodity. A balanced composition of organic acids, sugars and volatile compounds is responsible for exceptional flavor of the fruit (Baldwin *et al.*, 2000). Furthermore organic acids are required in minute quantities and play their role in acid base balance in the body fluids (Ali *et al.*, 2011). The values for titratable acidity in the present study showed significant differences ($p < 0.05$) among the varieties except Shirini and Yagoo.

Ascorbic acid is the most important water-soluble vitamin due to its high bioavailability and as an efficient free radical scavenger (Myne, 1996). The varieties under investigation were found rich in ascorbic acid composition and the overall results were partially significant ($p < 0.05$). Studies have shown that apricot possesses appreciable amount of ascorbic acid (Akin *et al.*, 2008; Ali *et al.*, 2011; Haciseferogullari *et al.*, 2007). It has also been furnished that compositional differences exist due to genotype, growing practices and agro-climatic conditions (Ali *et al.*, 2011; Scalzo *et al.*, 2005; Munzuroglu *et al.*, 2003).

Phenolic compounds and carotenoids have gained very much importance due to their antioxidant potential and possible role in prevention of cancer and cardiovascular diseases (Boyer and Liu 2004). Thus the phytochemical composition determines the nutraceutical significance of fruits and considered as a vital quality factor. The findings of the current study were in accordance with the previous work by (Akin *et al.*, 2008) and (Ruiz *et al.*, 2005) on Maltaya and Spanish apricots. All the evaluated varieties demonstrated high amounts of phenolic compounds and carotenoids. Both the phenolic content and carotenoids were high in Halman followed by Shakanda. A partially significant trend was found for phenolic contents, while the differences for carotenoids were highly significant among the varieties. The variation in composition among the varieties is in line with previous reports of Dragovic-Uzelac *et al.* (2007) and attributed to genotype, agro-climate and agronomic practices (Ali *et al.*, 2011; Haciseferogullari *et al.*, 2007).

Apricot is rich in phytochemicals (phenolic compounds and carotenoids), which are considered as potential antioxidants (Leccese *et al.*, 2007). The high antioxidant potential is attributed to a wide variety of phytochemicals that occur in all parts of plants (Akinci *et al.*, 2004). In case of the present study a strong correlation (R^2 = 0.9902) was found among phenolic compounds and free radical scavenging capacity (Fig. 1). It shows the potential of phenolics in quenching free radicals that cause degenerative diseases. Bioactive compounds like phenolics and carotenoids are considered as nutraceuticals and are becoming quality index parameters of fruit and vegetable species (Leccese *et al.*, 2010). These components besides their high biological value enhance sensory attributes through adding color and aroma to the produce. These results were comparable with the previous investigations on apricot by (Akin *et al.*, 2008) and (Boyer and Liu, 2004).

Mineral composition indicated that apricot genotypes contain appreciable amounts of essential minerals (Table 3). The results showed Jahangir as the prominent variety regarding mineral composition followed by Halman and Shakanda. Among different mineral elements, potassium, phosphorus, magnesium and calcium were abundant followed by sodium and iron. Similarly, the contents of zinc, manganese and nickel were also good. These findings were in line with previous studies on Turkish Apricots (Haciseferogullari *et al.*, 2007). However, variations in available data might be due to the genotype, geographical origin, climate and agronomic practices (Ali *et al.*, 2011; Scalzo *et al.*, 2005; Munzuroglu *et al.*, 2003). Mineral elements serve as structural components of the body and also play their role as part of amino acids and enzyme systems in different biological processes (Brody, 1994).

Technological properties (size, shape and weight dimensions) have significant impact on the sensory attributes of fruits and in attracting the consumer. These traits are important in designing packaging material, process development and mechanization of the horticultural industry (Ahmadi *et al.*, 2008). Halman was found excellent in technological attributes and next to it was Jahangir among the tested varieties.

Conclusions

The results of the present study revealed that the apricot varieties were rich in functional and compositional attributes. Shakanda and Halman were prominent genotypes in proximate composition and functional attributes i.e. total phenolics, carotenoids and antioxidant activity among the indigenous varieties. The mineral composition showed potassium, phosphorus, magnesium and calcium followed by sodium as the major elements and Jahangir was rich in mineral components among all the varieties. The present results demonstrated that apricot growing in this region possesses a rich nutritional profile with significant levels of bioactive compounds and mineral elements. This study suggests the exploitation of apricot fruit for a variety of health food for the economic uplift of the marginalized mountain communities.

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