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DETERMINATION OF MACRO-MICRO NUTRIENT CONTENTS IN DRIED FRUIT AND LEAVES AND SOME POMOLOGICAL CHARACTERISTICS OF SELECTED FEIJOA GENOTYPES (*Feijoa sellowiana* Berg.) FROM SAKARYA PROVINCES IN TURKEY

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ABSTRACT

This study was conducted to determine some pomological characteristics and macro- micro nutrient contents of both leaves and fruits of 11 Feijoa genotypes (*Feijoa sellowiana* Berg.) selected from Sakarya Province in Turkey. For these genotypes, fruit weight, fruit length, fruit width, soluble solid content and fruit acidity values ranged between 18.57 – 40.00 g, 27.74 -59.95 mm, and 23.42-39.43 mm, 8.30-14.20%, and 3.33-4.50, respectively. The analysis results showed that N, P, K, Ca, Mg, Fe, Mn, Zn, and Cu contents in dried fruits of these selected genotypes were 0.72-1.47%, 0.091-0.104%, 0.53-0.94%, 0.33-0.75%, 0.070-0.103%, 38-200 ppm, 2.10-6.30 ppm, 2.90-7.30 ppm, and 1.71- 6.95 ppm. On the other hand, N, P, K, Ca, Mg, Fe, Mn, Zn, and Cu contents of leaves for those contents were 1.42-2.31%,0.092-0.134%, 0.32-0.66%, 1.70-3.40%, 0.19-0.32%, 70-148 ppm,18-63 ppm, 6.70-11.10 ppm, and 1.32- 2.88 ppm. Significant differences among these genotypes were found for chemical composition ($P<0.05$). As all the trees were in similar environment and agronomical practices, it could be suggested that these differences due to genotypic differences.

Key words: Feijoa, *Acca sellowiana*, Selection, Chemical content.

INTRODUCTION

Feijoa (*Feijoa sellowiona* Berg. or syn. *Acca sellowiana* L.*)* belongs to the Myrtaceae family native to Southern of South America, where it is widely distributed. The feijoa, also known as pineapple guava or guavasteen, is an evergreen shrub or small tree which produces small, tasty fruit in late summer and early fall (Weston, 2010; Gutierrez *et al.,* 2008; Ruberto and Tringali 2004; Cangahuala *et al.,* 2009; Gilman and Watson 1993). The feijoa, originated from the highland of southern Brazil, parts of Colombia, Uruguay and Northern Argentina. It is believed that the plant was first grown in Europe in about 1900. (Gutierrez *et al.*, 2008; Cangahuala *et al.,* 2009). It was introduced to Turkey by Yalova Ataturk Horticultural Research Center in 1988. Since then, studies on adaptation have been started in several regions of Turkey and these studies have been conducted together with selection studies (Kahraman *et al.,* 2007; Samanci 1995).

Feijoa's fruit, maturing in autumn, is green, ellipsoid, and about the size of a chicken egg. Feijoa fruit like the guava is a good source of Vitamin C with low in calories and a rich source of minerals and fiber (Basile *et al.,* 1997; Weston 2010). Particularly in South America and Australia, Feijoa fruits are used in the form of jam, paste syrup, liqueur, crystallized fruits, jelly, conserved relish sauce or sparkling wine and ice cream. It also employed flavouring for ice cream or soft drinks (Morthon 1987; Gutierrez *et al.,* 2008). Furthermore, Feijoa is widely used like food and in folk medicine around the world. Many pharmacological studies have demonstrated the ability of feijoa plant to exhibit, antioxidant, hepatoprotection, antiallergy, antimicrobial, antidiabetic, anticough, antiinflamatory supporting its traditional uses (Vuotto *et al.,* 2000; Teixeira *et al.,* 2003; Ojewole 2005; Gutierrez *et al.,* 2008). Its leaves are medically used to treat digestive suffering associated with severe diarrhoea, gastrointestional and respiratory disturbances, dysentary, ulcers and for sheumatic pains. Feijoa leaf extract is used to reduce blood glucose level in diabetics as a hot tea. (Rodriguez *et al.,* 1994; Convay 2002; Teixeira *et al.,* 2003; Ojewole 2005; Oh *et al.,* 2005; Gutierrez *et al.,* 2008; Beyhan *et al.,* 2010). Because of these benefits for human health, Feijoa is suggested to be one of the most important fruit types recently. (Binder and Flath 1989; Dicesare *et al.,*1995; Heinrich *et al.,* 1998; Gutierrez *et al.,* 2008). In recent years, it has, therefore, been a growing concern about studies on chemical contents of Feijoa plant (Ekholm *et al.*, 2007).

Feijoa a new fruit variety for Turkey, and is cultivated in different regions including Marmara region in the North West of Turkey. However, trees grown in this region have no standard traits due to their propagations from seed. Hence selection studies are still continuing in the region. The present study was aimed to select and cultivate promising genotypes having superior traits. Knowledge about pomological and chemical traits of these promising genotypes will be used to obtain new cultivars for breeding purposes.

MATERIALS AND METHODS

This study was carried out in Sakarya province in Marmara Region in Turkey during 2008-2009. Promising 11 feijoa genotypes were selected from wild feijoa population according to some fruit characteristics (fruit weights, fruit length, fruit width, soluble solid content and fruit pH value at harvesting time). Twenty fruits were used from each variety to describe fruit traits. Fruit and leaf samples were collected from each aspect of trees during first half of October. The fruits were harvested after ripening for mineral analysis. Fruit and leaf samples were dried at 68º C for 72 hours and then were kept under shade. Nitrogen value was determined by Kjheldahl method, Phosphorous was determined by Iodo-phenol blue method, Potassium (K), Calcium (Ca), Magnesium (Mg), iron (Fe), Manganese (Mn), Zinc (Zn) and Copper (Cu) contents were determined with atomic absorption spectrophotometer. (Kacar 1984; Jones *et al.,* 1991; Erdal 2005; Biricik and Basoglu 2006; Kazankaya *et al.,* 2008). All trees from the selected genotypes were in the same orchard. Soil analysis is presented in Table 1 (Bozkurt *et al.,* 2001; Yarılgac *et al.,* 2003).

Statistical analyses were performed using the SAS software. The obtained data were analyzed using One-way ANOVA. Significant differences were determined by Duncan's Multiple Range tests (Orhan *et al.,* 2004).

Table 1. Some physical and chemical soil properties of research orchard.

Soil properties	Values	Evaluation
Texture	Loamy	Middle
Organic matter (%)	4.2	High
PH (1:2.5)	8.66	Alkaly
Lime (%)	18.0	High
EC (mS cm^{-1})	0.234	Unsalted
Available P (ppm)	35	High
Variable K(ppm)	183	Enough
Variable Ca (ppm)	2087	Enough
Variable Mg (ppm)	417	Enough
DTPA-Fe (ppm)	50	High
DTPA-Mn (ppm)	65	High
DTPA-Zn (ppm)	2.84	High
DTPA-Cu (ppm)	3.41	High

RESULTS AND DISCUSSION

Pomological and Phenological Characteristics: Some pomological and phenological characteristics of the selected 11 genotypes are presented in Table 2. First harvesting for all genotypes started in first week of November except one genotype (Mestan-1), fruits were harvested in second week of November. Soluble solid content of fruits in eating maturity was observed to be between 8.30 and 14.20 percent, while pH value of fruit pulp ranged between 3.33 and 4.50. The characteristics of these genotypes grown in other countries were almost similar to the characteristics of genotypes cultivated in Turkey. For the genotypes harvested during first half of November, fruit weight was ranged 23.28-69.20 g, fruit length, 40.91-66.22 mm. and shape index, 0.60-0.90 were reported by Kahraman *et al.* (2007). The results of the present study are quite similar to the earlier reports in other regions of the world (Samancı, 1995, Kahraman *et al.*, 2007). Vuotto *et al.* (2000) found that fruit length and fruit weight ranged 50 to 80 mm and 20 to 30 g, respectively. However, Gillman and Watson, (1993) reported fruit height ranging 25- 75 mm. Morthon (1987) reported soluble solid contents in fruits as 7 - 20 percent.

Macro and Micro Element Contents in Dried Fruits: Mineral contents of fruits in the examined genotypes are depicted in Table 3. Results revealed that N, P, K, Ca, Mg, Fe, Mn, Zn, and Cu contents of the dried fruits ranged 0.72-1.47%, 0.091-0.104%, 0.53-0.94%, 0.33-0.75%, 0.070-0.103%, 38.00-200 ppm, 2.10-6.30 ppm, 2.90-7.30 ppm and 1.71-6.95 ppm., respectively. While the differences between the genotypes for macro and micro element contents were significant ($P<0.05$) however, there was a non significant difference for P contents. As all the trees under study were reared under same conditions, It could be suggested that the differences between the content values resulted from genotypic differences. In has been reported that the differences between chemical contents of fruits of feijoa and other fruit types could be due to genetic differences. (Ozdemir and Topuz 1997; Ozdemir *et al.,* 2004; Erdal 2005; Biricik and Basoglu 2006; Ekholm *et al.*, 2007; Gutierrez *et al.,* 2008; Kazankaya *et al.,* 2008; Eksi and Ozhamamci 2009).The results of the present study also confirmed the results of the previous studies. Morthan (1997) stated that K, Na, Ca, Mg, P, and Fe contents of feijoa fruit were 0.166%, 0.50%, 0.40%, % 0.80, 0.10%, 50 ppm, respectively. Gutierrez *et al.,* (2008), found that Ca, P, and Fe contents of the fruit ranged between 9.1-17.0 mg/100 g, 17.8-30.0 mg/100 g, and 0.30-0.70 mg/100 g, respectively. These authors observed that the differences were significant among varieties.

Macro and Micro Element Contents in Leaves: The results of leaf analysis in the studied genotypes are summarized in Table 4. Statistically significant differences for macro-micro element contents in the leaves were observed in the present study. As reported by many authors, chemical contents of plant leaves were influenced by many factors such as genetic, environment, climatic conditions, irrigation, fertilizing and soil conditions (Chetri *et al.,*1999; Bozkurt *et al.,* 2001; Asiey *et al.,* 2007). Moreover, mineral contents in leaves also change seasonally (Marschner, 1995).

Table 2. Some Pomological and phenological characteristics of the selected promising feijoa genotypes.

Genotypes	Fruit Weight (g)	Fruit Length (mm)	Fruit Height (mm)	S.S.C. (%)	Acidity (PH)	First Harvesting
Mestan-1	20.91	40.42	30.59	10.50	4.25	11.10.2009
Mestan-3	27.98	27.74	23.42	10.20	4.50	11.02.2009
Mestan-4	22.00	41.28	31.35	8.30	3.33	11.02.2009
Mestan-5	29.23	49.27	35.32	10.00	3.73	11.02.2009
Mestan-6	18.57	43.31	29.05	10.20	3.51	11.02.2009
Mestan-12	19.00	37.81	30.88	14.20	3.47	11.02.2009
Mestan-15	37.14	48.68	35.98	11.60	4.13	11.02.2009
Mestan-22	23.85	43.21	31.71	12.00	3.40	11.02.2009
Mestan-26	40.00	46.61	39.43	14.00	2.84	11.02.2009
Mestan-27	21.66	58.96	32.14	13.00	3.50	11.02.2009
Mestan-28	32.66	59.95	30.63	14.00	3.45	11.02.2009

Table 3.Results of chemical analyses in dried fruits of the selected genotypes and Duncan's test *

Genotypes	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
Mestan 01	1.34^{ba}	0.095^{a}	0.53^{e}	0.43^{b}	0.077^{b}	49.00^{c}	3.70^{d}	4.20^{e}	1.71^{f}
Mestan 03	1.47^{a}	0.099^{a}	0.75^{bcd}	0.43^{b}	0.081^{b}	91.00^{b}	4.90^{bc}	6.60^{ab}	5.60^{ab}
Mestan 04	1.06^{c}	0.104^{a}	0.76^{bcd}	0.45^{b}	0.076^{b}	93.00^{b}	4.90^{bc}	5.20^{cd}	6.95^{a}
Mestan 05	1.08^{c}	0.101^{a}	0.80^{bc}	0.75^{a}	0.094^{a}	105.00^{b}	5.50^{b}	7.30^{a}	5.37^{ab}
Mestan 06	1.31^{b}	0.099^{a}	0.65^{de}	0.35^{b}	0.077^{b}	86.00^{b}	6.30^{a}	6.70^{ab}	4.46^{bcd}
Mestan 12	1.10^{c}	0.091^{a}	0.94^{a}	0.70^{a}	0.103^{a}	94.00^{b}	5.00^{cb}	6.10^{bc}	5.20^{bc}
Mestan 15	0.91^{d}	0.094^{a}	0.83^{abc}	0.45^{b}	0.076^{b}	84.00^{b}	4.50^{c}	4.50^{de}	2.99^{def}
Mestan 22	0.74^{e}	0.093^{a}	0.71^{dc}	0.46^{b}	0.070^{cb}	106.00^{b}	3.30^{d}	4.00^{e}	2.61^{ef}
Mestan 26	0.72^{e}	0.101^{a}	0.86^{ba}	0.33^{b}	0.061^{c}	94.00^{b}	2.10^{e}	3.00^{f}	2.10^{ef}
Mestan 27	0.96^{cd}	0.096^{a}	0.79^{bcd}	0.37^{b}	0.079^{b}	38.00^{c}	3.40^{d}	2.90^{f}	1.75^{f}
Mestan 28	0.96^{cd}	0.095^{a}	0.72^{bcd}	0.37^{b}	0.078^{b}	200.00^{a}	3.60^{d}	4.90^{de}	3.60^{cde}

*Means with different letter in same column are significantly different at level ($P<0.05$)

Table 4.Results of chemical analyses in leaves of the selected genotypes and Duncan's test*

Genotypes	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)	Zn (ppm)	Cu (ppm)
Mestan 01	1.95^{c}	0.099^{c}	0.48^{cb}	1.70^{h}	0.27^{cb}	70.00^{f}	18.00^{g}	6.70^{e}	1.32^{e}
Mestan 03	1.42^{e}	0.086^{e}	0.48^{cb}	2.83^{b}	0.28^{b}	104.00^{cb}	30.00^{de}	8.10^{c}	2.16^{bcd}
Mestan 04	1.53^{e}	0.092^{def}	0.43^{cde}	2.38^{def}	0.26^{bcd}	63.00^{f}	26.00^{ef}	7.10^{de}	1.88^{cde}
Mestan 05	1.70^{d}	0.105^{b}	0.41^{def}	2.77^{bc}	0.23^{cde}	116.00^{b}	63.00^{a}	7.60^{cd}	1.49^{e}
Mestan 06	2.22^{ab}	0.101^{bc}	0.32^{g}	2.34^{ef}	0.23^{de}	148.00^{a}	37.00^{b}	7.50^{cd}	1.50^{e}
Mestan 12	1.93^{c}	0.091^{de}	0.38^{fg}	2.13^{gf}	0.19^{f}	87.00^{de}	34.00^{cb}	6.70^{e}	2.49^{ab}
Mestan 15	1.71^{d}	0.092^{d}	0.39^{efg}	2.69^{bcd}	0.26^{bcd}	101.00^{bcd}	32.00^{cd}	7.50^{cd}	1.87^{cde}
Mestan 22	1.48^{e}	0.102^{bc}	0.35^{fg}	3.40^{a}	0.32^{a}	97.00^{cd}	34.00^{cb}	10.20^{b}	1.45^{e}
Mestan 26	1.58^{de}	0.134^{a}	0.66^{a}	2.63^{cde}	0.27^{cb}	88.00^{cde}	24.00^{f}	11.10^{a}	2.32bc
Mestan 27	2.31^{a}	0.105^{b}	0.50^{b}	2.03^{g}	0.20^{ef}	73.00^{ef}	37.00^{b}	6.60^{e}	1.76^{de}
Mestan 28	2.15^{b}	0.106^{b}	0.46^{bcd}	2.47^{cde}	0.28^{b}	100.00^{bcd}	19.00^{g}	10.40^{b}	2.88^{a}

*Means with different letter in same column are significantly different at level ($P<0.05$).

If it is presumed that characteristics such the soil, environment, climate factors and cultural application in the garden where all the trees were planted are homogenous, as reported earlier, these differences may be due to the genetic characteristics of genotypes (Kacar 1984; Erdal *et al.,* 2005; Ekholm *et al.*, 2007; Kazankaya *et al.,* 2008). Results from the present study were in conformity to those reported in earlier studies.

In a study conducted in India, N, P, K, Ca, Mg contents of feijoa leaves were reported between 1.51-2.08%, 0.07-0.19%, 0.38-0.81%, 0.21-0.83% and 0.32-0.56 %, respectively (Chetri *et al.,* 1999). Gutierrez *et al.,* (2008)

reported that feijoa leaves contains 0.30-1.00% Ca, 0.06-0.30% Mg, 0.10-0.38% P, 0.21-0.39% K , 0.03-0.20 Na 0.02-0.14 ppm Cu, 2.86-5.14 ppm Fe, 0.31-0.57 ppm Zn and 0.00-0.26 ppm Mn. The results obtained in the present study were consistent with those of these studies.

Conclusion: The Feijoa genotypes analysis showed that there were significant differences in macro and micro element contents between varieties for both leaf and dried fruit samples suggesting that these differences may be due to differences in genetic composition of different varieties. It is therefore, recommended that in future selection programs for Feijoa, these features should be taken into consideration.

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