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POMOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF LOCAL APPLE GENOTYPES GROWN IN UŞAK - TURKEY

AYŞEN MELDA ÇOLAK* AND AHMET ÖZOĞUL

Department of Horticulture, Faculty of Agriculture and Natural Sciences, Uşak University, 64200 Uşak, Turkey
**Correspondingauthor'semail: aysen_melda@yahoo.com*

Abstract

Apple is grown more than other fruits in the world. Recently, raising awareness in the community about consuming food rich in antioxidants is crucial for human health. This study was carried out to state the physical and biochemical properties of some local apple genotypes grown in Uşak district, Turkey. This region has a lot of apple genotypes with significant genetic variability. As a result of the field study conducted at Uşak district, thirteen different apple genotypes were collected for analysis. In the current Uşak local apple genotypes, oxalic acid, malic acid and ascorbic acid values were found between 2.89 and 561 ppm and 1725, 12159 ppm and 29 and 203 ppm, respectively. Citric acid was found at the trace level and no acetic acid and gallic acid were detected. Results further revealed that based on pomological and biochemical features of the genotypes, the apple genotypes UO1, UH, PB, EK1, and EK2 seem to be the promising ones in terms of their fruit weight, width, and height.

Key words: Apple genotypes, Pomological and biochemical features, Phenolic compounds, Selection.

Introduction

Apple is a species of the genus Malus belonging to the family Rosaceae (Unal, 2011). Apple has been cultivated since ancient times in Asia and European continents. Today, apple cultivation culture has spread to almost all the regions of Northern and Southern hemispheres with a temperate climate (Özçağran *et al.*, 2004).

Apple decreases the risks of cancer, heart disease, asthma and diabetes with its rich chemical content. Past studies revealed ed in laboratory experiments that apple fruits have very strong antioxidant activity, which prevents cancer cell proliferation, lowers the fat oxidation and cholesterol (Boyer & Liu, 2004; Gundoğdu *et al.*, 2018; Okatan *et al.*, 2018). Apple is second place to blueberries, which have the highest content in terms of total phenolic substances. It also takes third place after blueberry and lemon in the activity of preventing lung cancer cell increase (Sun *et al*., 2002).

The development of fruit characters is a major aim in all apple breeding programs. Soluble sugars and organic acids are significant components of fruit, and they exert a strong effect on all organoleptic quality of fruits (Borsani *et al.*, 2009). Soluble sugars in fruits are mainly composed of sucrose, fructose, and glucose, while malic, citric, and tartaric acids are the primary organic acids. Different organic acids or sugar components vary in sweetness or acidity (Doty, 1976).

Past studies on pomological and phenological aspects have been carried out in different apple varieties in order to determine the most suitable variety for their region around the world (Karadeniz *et al.*, 2005; Kırkaya, 2013; Karşı, 2016). They determined the compatibility and durability of the apple genotypes against important conditions i.e., taste, appearance, yield, disease resistance, preservation, and environmental factors and quality criteria (Akçay *et al.*, 2009).

The aim of our investigations was to determine the pomological, chemical and biochemical features of local apple varieties in Uşak District, Turkey.

Materials and Methods

Plant material: The current study was conducted during 2017-2018. Thirteen apples genotypes have been found by field search in contact with growers in Uşak District, Turkey. The material consists of the fruits of the apple trees belonging to different apple genotypes naturally grown from seeds. Information were collected especially from elders community and based on this information, the trees of the different apple genotypes were used for sampling and were determined. Apple genotypes were named as UO1, UO2, UO3, UH, UM, UG, BGED, BN, PB, KÇ, UÇ, EK1, and EK2. The climate data of the region were shown in Table 1. The sampling and measurements were performed three times (replicates) in each local apple genotype. Twenty fruits were separated in each replicate and a total of 60 fruits were separated for measurement of the physical and chemical characteristics of each apple genotype. In order to determine the pomological features, the measurements were carried out on the fruits themselves. The biochemical features were determined through analysis of juices of the fruits collected in tubes after the fruits were processed with a juicer and filtered with special filters.

Pomological features: Measurements were performed on 60(threeduplicates) fruits randomly selected from each genotype and fruit width (mm), fruit height (mm), fruit weight (g), fruit hardness, fruit stem length (mm), fruit shell thickness (mm), seed number, seed height (mm), and seed weight (g) were measured.

Bio-chemical features

Chemical contents: Soluble solid content (SSC) were determined by Model HI-96801 Hanna, German (digital refractometer) having a sensitivity of 0.2 Brix, at room temperature. The pH value was determined by using a pH meter (Hanna-HI 98103, German) and its calibration was done using pH 4.0 and pH 7.0 tampons (Anon., 1995).

Table 1. Climate data of the region.

UŞAK	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Average temperature °C	2.3	3.3	6.1	10.9	15.6	19.9	23.4	23.4	19.1	13.6	8.2	4.1	12.5
Average highest temperature °C	6.8	8.2	11.7	16.8	21.8	26.5	30.3	30.5	26.2	20.2	14.0	8.7	18.5
Average lowest temperature °C	-1.3	-0.6	1.3	5.2	9.2	12.6	15.4	15.6	11.9	7.9	3.8	0.6	6.8
Average of total monthly rainfall amount (mm)	74.3	65.0	58.5	50.1	49.0	27.8	14.9	10.6	16.7	40.7	58.4	81.3	547.3
Highest temperature °C	18.3	23.6	27.0	30.0	32.1	36.6	40.2	38.2	36.5	32.6	26.0	21.8	40.2
Lowest temperature °C	-19.9	-15.0	-12.5	-6.2	-1.0	2.9	7.4	6.8	2.0	-4.8	-11.8	-18.9	-19.9

(Source: MGM, www.mgm.gov.tr)

Table 2. Pomological features of the apple genotypes.

Genotypes	Fruit weight (g)	Fruit height (mm)	Fruit width (mm)	Fruit stem length (mm)	Fruit shell thickness (mm)	Fruit hardness (kg/cm^2)	Seed weight (g)	Seed height (mm)	Seed numbers
UO1	130,14	61,78	67,08	21,44	0,13	2,44	0,054	6,892	5,6
UO2	41,24	44,88	45,38	22,91	0,15	4,58	0,046	8,73	10,6
UO3	67,22	44,91	55,47	11,89	0,13	4,14	0,048	10,11	7,2
UH	126,58	53,34	70,73	13,08	0,14	2,78	0,042	8,118	2,4
UM	69,81	49,70	54,00	22,21	0,14	3,54	0,036	7,37	4,8
UG	41,24	41,25	47,34	13,85	0,15	3,76	0,042	7,254	10,6
BGED	46,77	43,48	46,15	23,97	0,13	5,38	0,048	8,824	6,2
BN	76,12	52,97	56,19	13,48	0,15	4,54	0,042	8,486	3,2
PB	119,68	46,70	64,67	16,07	0,15	2,58	0,05	8,164	6,4
KÇ	70,51	48,04	54,67	24,18	0,13	4,1	0,038	6,948	6,4
UÇ	43,51	39,10	46,71	23,58	0,12	2,98	0,026	6,29	4
EK1	86,55	52,61	59,93	9,10	0,13	3,30	0,046	7,474	5
EK2	142,42	58,86	65,47	12,34	0,16	4,92	0,058	9,322	4

Determination of the total phenolic substance: Total phenol content (TPC) were determined using the Folin-Ciocalteu test. The 0.2 mL of the extract and 0.5mL of Foline-Ciocalteu reagent (diluted 10 times with water) was added to the test tubes. The solution was then kept in the dark for five minutes and then 1 ml of sodium carbonate (7.5% w/v) was added. The tubes were covered with parafilm and kept in the dark for one hour. The absorbance at 765 nm was measured by UV-Vis spectrophotometer (Jasco V-530). By comparing with the gallic acid calibration curve, the investiations were expressed as gallic acid/g dry sample. Each experiment was carried out in three replicates (Kahkönen *et al.,* 1999).

Total flavonoid content: The total flavonoid content in the crude extract were determined with the aluminum chloride colorimetric method. The 50 µl extract (1 mg/ml ethanol) was diluted to 1 ml with methanol, mixed with 4 ml of purified water and then with 0.3 ml of 5% $NaNO_2$ solution. After incubation, 5 ml 0.3 ml 10% $AlCl_3$ solution was added and the mixture was kept still for 6 minutes. Then, 2 ml 1 mol/L NaOH solution was added and the final volume of the mixture was brought to 10 ml with distilled water and the mixture was kept still for 15 minutes and the absorbance was measured at 510 nm. Total flavonoid content was calculated from the quercetin calibration curve and the results were expressed as mg quercetin equivalent per dry weight (Chang *et al.,* 2002).

Determination of organic acid: The organic acid compositions of the samples were determined by Agilent brand 1260 model HPLC by first filtering the fruit juices with white tape filter paper and then 25-micron injector tip filter. For this purpose, ACE 5 C18 column (5 µm, 250 mm x 4.6 mm) and UV detector were used. In the analysis carried out in isocratic flow, orthophosphoric acid with 2% KH_2PO_4 solution adjusted to pH 2.3 was used as the mobile phase. The organic acids were determined at a wavelength of 214 nm in the analysis performed at a flow rate of 0.9 µl/min at 30 °C and a volume of 10 µlinjection. The analysis time was 20 minutes. The amounts of organic acid components in the samples were calculated based on standard organic acid analysis results (Fadavi *et al.,* 2005).

Statistical analysis

Ward's method, one of the hierarchical clustering methods, was used in the classification process of the varieties by their pomological, biochemical, organic acid contents. In the clustering analysis, the data were further subjected to z standardization and squared Euclidean distance measurement.

Results and Discussion

The characteristics of the apple genotypes under investigation were determined as the arithmetic average of 20 fruits for each variable. The results obtained in relation to some pomological and biochemical features of the apple genotypes are presented below.

Pomological features: Results revealed that the highest fruit weight was obtained in genotype EK2 (142.42 g) while lowest in UG (41.36 g) (Table 2). In apple genotypes, the fruit height and width ranged from 39.09 mm (UÇ) to 61.77 (UO1) and 45.38 (UO2) to 70.73 (UH), respectively. The highest stem length was found to be 24.18 mm (KÇ) while the lowest stem length was found to be 9.1 mm (EK1). The highest fruit shell

thickness was measured to be 0.16 mm (EK2) while the smallest shell thickness was found to be 0.12 mm (UÇ). The largest fruit hardness was found to be 5.38 kg/cm^2 (BGED) while the lowest fruit hardness was found to be 2.44 kg/cm^2 (UO1) in the current study. The seed height values were calculated between 10.11 (UO3) and 6.29 mm (UÇ). The seed weight values were determined between 0.058 (EK2) and 0.026 g (UÇ). The highest seed number was found to be 10.6 (UG) while the lowest seed number was found to be 2.4 (UH).

In a study by Özrenk *et al.,* (2011), the weight of the fruits was found to be ranging from 139.3 to 20.9 g. In a study by Coşkun & Aşkın (2016), the fruit weight was found to be ranging between 96.99 and 184.25 g. Şenyurt *et al.,* (2015), found that it was ranging from 80.70 to 195.61 g. Öztürk and Öztürk (2016), found that fruits weights vary between 112.3 (Jersey Mac) and 173.9 g (Starkrimson Delicious). The fruit weights found in the current study for the city of Uşak are similar to the ones reported in other studies and they are even superior in weight to some foreign and improved varieties.

Özmen & Çekiç (2018) found that fruit heights are between 47.93 and 67.23 mm. In a study by Öztürk & Öztürk (2016), the fruit heights were found to be ranging from 54.55 (Jersey Mac) to 63.74 mm (RedChief). Özongun *et al.,* (2014), found fruit height between 59.95 mm and 73.97 mm in apple varieties. Uzun (2015), measured the fruit heights in the range of 46.81 mm-65.57 mm. Özmen & Çekiç (2018), found the width of apple fruits as varying between 57.67 and 85.50 mm. Öztürk & Öztürk (2016), found it to be varying between 64.83 (Golden Delicious) and 74.27 mm (Granny Smith). Özongun *et al.,* (2016), was determined fruit width was found between 66.09 mm and 82.71 mm in apple varieties. Uzun (2015), found that the widths of the fruits vary between 60.61 mm and 78.60 mm. When the height and width values measured for the fruits belonging to the local genotypes of this study are compared to the heights and width of other studies that it is seen that our results are superior in some varieties while inferior in some others in our study.

In a study by Kırkaya (2013), the stem length was found to be ranging from 8.31 mm to 27.26 mm. Karşı (2016), found that the fruit stem length varies between 1.19 cm (Hüryemez) and 2.45 cm (Granny Smith). The stem length values measured in the current study were found to be parallel to the stem length values found in other studies for both local and foreign varieties.

In a study by Kırkaya (2013), the stem length was found to be ranging from 8.31 mm to 27.26 mm. Karşı (2016), found that the values of fruit stem length between 11.90 mm (Hüryemez) and 24.50mm (Granny Smith). Kırkaya (2013), found that the fruit shell thickness varies between 0.22 mm and 0.32 mm. Öztürk and Öztürk (2016), found shell thickness values ranging from 0.11 to 0.24 mm. Uzun (2015), found that the shell thickness is between 0.27 mm (Van-III) and 0.46 mm (Pamuk-V). Şenyurt *et al.,* (2015), found fruit flesh hardness values between 6.27 kg/cm^2 and 9.39 kg/cm^2. Güleryüz & Ercişli (1995), on the other hand, found the fruit flesh hardness values varying between 2.85 kg/cm^2 and 2.05 kg/cm^2 in apple genotypes. Arıkan *et al.,* (2015), measured fruit flesh hardness values between 4.53 kg/cm^2 and 5.92 kg/cm^2 in some apple varieties. Uzun (2015), found fruit flesh hardness values ranging from 6.45 kg/cm^2 to 11.72 kg/cm^2 in apple genotypes. Thus, it is seen that the fruit stem length, shell thickness, and fruit flesh hardness values found for the local genotypes of the city of Uşak are higher for some varieties while smaller for others than the values reported in other studies. Stem length, shell thickness, and fruit flesh hardness can be affected by climatic and environmental conditions, fruit waiting time, maturity level and shell thickness.

In a study, the seed lengths in all the genotypes were measured to be ranging from 6.62mm to 10.59 mm (Gürel&Yarılgaç, 2010). Çulha (2010), found that the number of seeds in the fruits varies between 6.66 (Fuji) and 8.66 (RedChief, Starking Delicious). Researchers found the number of seeds between 1.10 and 8.10, and seed length between 5.42 mm and 12.9 mm, seed weight between 0.29 g and 5.5 g (Uzun & Balta, 2015). Şenyurt *et al.,* (2015), found the number of seeds between 3.85 mm and 8.70 mm, and seed weight between 0.04 g and 0.07 g in all the varieties. Thus, it can be argued that there are some similarities and differences between the genotypes in the city of Uşak and other genotypes investigated in other studies in terms of seed number, weight, and height.

The classification of the genotypes by their pomological features is given in Figure 1. According to clustering analysis in terms of pomological characteristics, UO1, UH, EK1, PB BN, EK2 formed one group while UO2, UG, UO3, BGED, UM, KÇ, UÇ formed another group. In terms of these features, UO1, UH, EK1, PB, BN and EK2 varieties were included in one group and became varieties similar to each other. The varieties in this group have higher values in terms of pomological features than the varieties in the other group. Particularly the EK2 variety was found to have higher values than the other varieties in the same group.

Bio-chemical Features

Total phenolic, total flavanoid, pH and SSC contents: Total Phenolic PPM/GAE, Total Flovanoid PPM/QE, pH (%) and SSC (%) values are presented in Table 3. As a result of the analyses conducted, it was found that the highest phenolic values were determined between 1068 ppm (UO2) and 128 ppm (UO3). The flavonols were the major group of polyphenolic compounds found in the apple cultivars (Đorđević *et al.,* 2019). The highest flavonoid content was found to be 5320 ppm (UO2) and the lowest flavonoid content was found to be 280 (UO3). The pH values were found between 5.34 (UÇ) and 4.49 (EK2). When the soluble solid content (SSC) was found between 17.9% (UM) and 9.8% (PB).

Uzun (2015), measured the fruit juice pH as varying between 3.01 and 4.53. Karşı (2016) found that fruit pH values between 2.9 (Royal Gala) and 3.9 (Amasya). Gürel & Yarılgaç (2010), found that fruit pH varies between 3.60 and 4.82 in apple genotypes. Ülgen (2010), reported pH values of apple genotypes ranging from 2.8 to 4.6. Özmen and Çekiç (2018), found pH values ranging from 2.88 to

5.30. Kırkaya (2013), found that the soluble solids content value between 9.01% and 13.75% in apple genotypes. Karşı (2016), found that SSC values between 7.73 % (Hüryemez) and 14.60% (Golden Delicious). Çulha (2010), measured the highest soluble solids content value in Golden Delicious between 14.03 % and 14.83 % in local apple genotypes 2010. Özmen & Çekiç (2018), found the soluble solids content value of apple genotypes as varying between 9.9% and 16.8%. Abacı & Sevindik (2014), reported that in terms of the total phenolic substance content the highest content is found in the shell of the red Uruset (578.7 mg/100 g) and in its fruit flesh (112.2 mg/100 g) while the lowest content is found in the shell of the Kanevoz variety (209.7 mg/100 g) and its fruit flesh (46.9 mg/100 g). Moreover, as can be seen in this study, the total phenolic substance content is higher in the fruit shell than its flesh. Bouayed *et al.*, (2011), found that the total phenolic content varies between 120 and 180 mg/100g. Karadeniz & Ekşi (2001), conducted a study on the distribution of phenolic substance in apple juice and investigated the phenolic substance compositions and found that following: Chlorogenic acid concentration between 62.3 and 342.6 mg/I; epicatechin between 5.3 and 240.1 mg/l; phloretin glycoside between 5.5 and 60.0 mg/l), phloridzin between 6.9 and 29.7 mg/1 and p-coumaric acid between 1.1 and 16.0 mg/l. Lachman *et al.*, (2006), conducted a study on the amount of polyphenol substance in different apple varieties and found the greatest amount in the melrose variety with 1.343.06 mg/kg and the lowest amount in the Rosana variety with 760.03 mg/kg and in the apple juice, the highest amount was found in the Melodie variety with 697.41 mg/l and the lowest amount in the Selena variety with 331.11 mg/l. Wolf *et al.*, (2003), found the following amounts of polyphenol substance in different varieties of apple: in the flesh of the Idared variety 120.1 mg/100 g; in its shell 588.9 mg GAE/100 g; in the fruit of the Rome Beauty variety 159.0±15.1 mg/100 g; in its shell 500.2±13.7 mg GAE (gallic acid equivalents) /100 g. Bouayed *et al.*, (2011), found that the total flavonoid content varies between 20 and 80 mg/100g. Wolf *et al.*, (2003), found the flavonoid content in the flesh and shell as follows; for the Rome Beauty variety as 77.1 mg/100g, for the Golden Delicious variety as 61.0 mg/100g, for the Idared variety as 55.8 mg/100g and for the Cortland variety as 50.0 mg/100g. In light of these values reported in the literature, it can be argued that our values in the apple varieties in our study are relatively higher. This difference is thought to be related to harvest season, different apple varieties, naturally grown from the seed, climatic and environmental conditions, soil and rain conditions.

According to the clustering analysis, the biochemical features were divided into two main groups. While the first group included the UO1, UM, BN, KÇ, UÇ, UO2, UG, BGED, EK1, EK2 genotypes, the second group included the UO3, PB and UH genotypes. In the first group, the UO1, UM, BN, KÇ, UÇ genotypes exhibited features similar to each other and the UO2, UG, BGED, EK1, EK2 genotypes exhibited features similar to each other (Fig. 2).

Among the apple genotypes investigated in the current study, the oxalic acid amounts were found to be 267 ppm (PB) and 561 ppm (UÇ); the highest malic acid amounts were found between 1725 ppm (UG) and 12159 ppm (UO3). The highest ascorbic acid amount was found to be 203 ppm (BGED) and the lowest ascorbic acid amount was found to be 29 ppm (PB); in all the genotypes the citric acid was found to exist in trace amount while no acetic acid or gallic acid was found (Table 4).

Mordoğan & Ergun (2001) measured amounts of malic acid between 2.71 mg/g and 40.10 mg/g in apple varieties. In the same study, researchers found citric acid values between 2.29 and 51.56 mg/g in apple varieties. Coşkun & Aşkın (2016) found that malic acid values between 18.83 mg/g and 71.07 mg/g; oxalic acid values between 47 mg/g and 79.50 mg/g; citric acid between 241mg/g and 555.5 mg/g; tartaric acid between 840 mg/g and 3825.5 mg/g. Chen *et al*., (2012), found that the percentage of gallic acid in the whole apple varieties are higher than the peel. They reported the gallic acid value of apple cultivars in followed order: Red Delicious>Royal Gala>Golden Delicious. In a study of red and white-fleshed apple genotypes, researchers reported that gallic and syringic content changed among genotypes. Gallic acid was found as 4.0 mg/kg in red-fleshed Hongxun and as 1.5 mg/kg in white flesh Golden Delicious. Also, syringic acid values between 13.8 and 48.1 mg/kg (Wang *et al.*, 2015). Karadeniz *et al.*, (2005), reported phenolic compound differences in apple genotypes.

The organic acid, phenolic, and flavonoid amount in the genotypes from the city of Uşak vary among the apple genotypes grown in this region and are generally higher than the amount reported in the literature for other genotypes from different regions yet there are also some similarities. The reasons behind this difference can be all the ecological factors, differences in the soil structure and genotype variety.

The genotypes were divided into two main groups on the basis of their organic acid content and each group was divided into two sub-groups. The first main group included the UO1, PB, UO3, UH, EK2 genotypes. In this main group, UO1 and PB were found to have values close to each other and UH and EK2 were found to have values close to each other. The second main group included the UO2, BN, UM, EK1, UG, UÇ, BGED, KÇ genotypes. The UO2, BN, UM, EK1, UG, UÇ genotypes constituted a sub-group while the BGED, KÇ constituted the second sub-group. Within the sub-group, the genotypes exhibiting features more similar to each other are UO2-BN, UM-EK1, BGED-KÇ (Fig. 3).

Clustering analysis show that the genotypes are divided into two groups in general. Then each main group is divided into two sub-groups. The first main group is consisted of UO1, UH, PB, UO3, EK2 genotypes. The UO1, UH, PB genotypes make up the first sub-group and the UH-PB genotypes have features closer to each other. The second sub-group includes the UO3-EK2 genotypes. The second main group involves the UO2, UG, BGED, UM, UÇ, KÇ, BN, and EK1 genotypes. The first sub-group of the second main group includes the UO2, UG, BGED genotypes while the second sub-group contains the UM, UÇ, KÇ, BN and EK1 genotypes. In terms of all their features, the UO2-UG, UM-KÇ, and BN-EK1 genotypes have features closer to each other (Fig. 4).

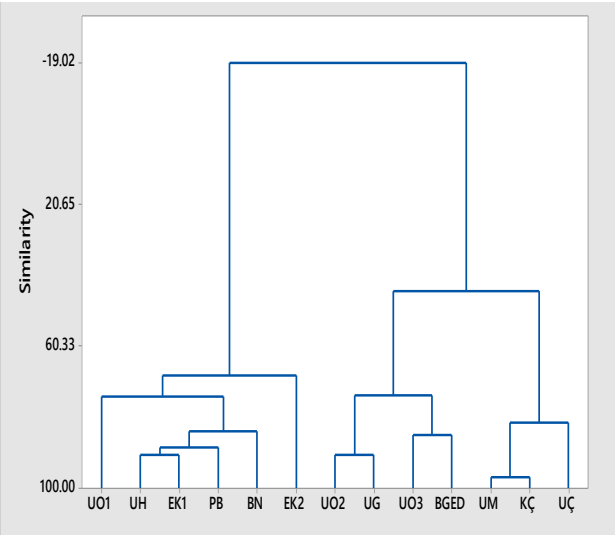

Fig. 1. Classification of genotypes in terms of their pomological features.

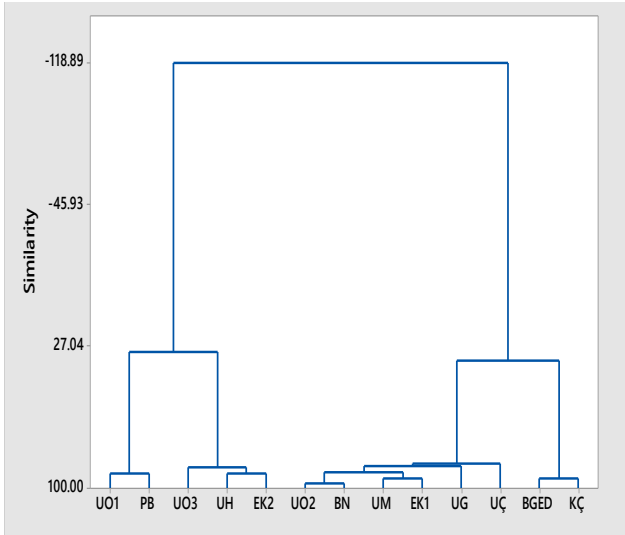

Fig. 3. Classification of the genotypes by their acidic features.

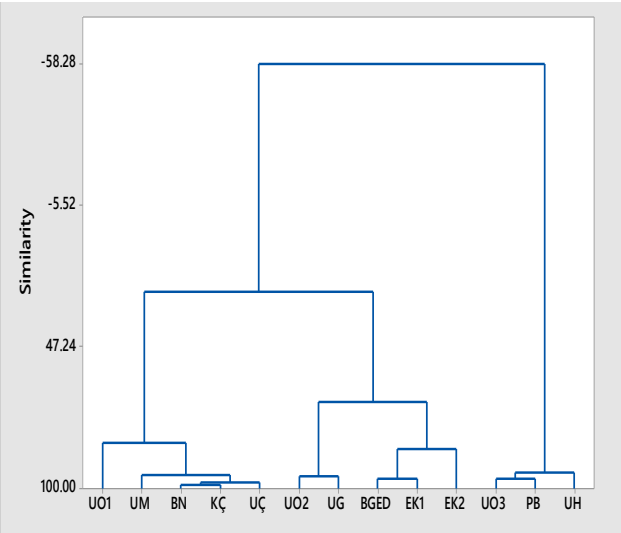

Fig. 2. Classification of genotypes by their biochemical features.

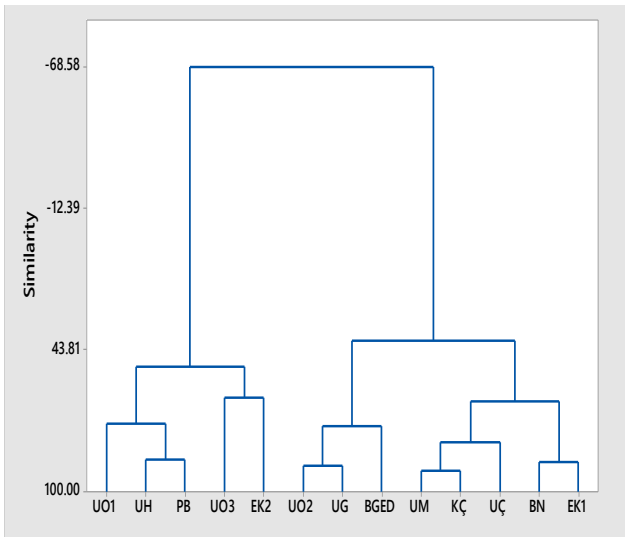

Fig. 4. Clustering analysis in terms of all the features investigated.

Table 3. Total phenolic, flavonoid substance contents, pH and SSC values of the applegenotypes.

Genotypes	Total Phenolic PPM/GAE	Total flavanoid PPM/QE	pH (%)	SSC (%)
UO1	293	660	5,32	12,9
UO2	1068	5320	5,32	16,4
UO3	128	280	4,58	12,4
UH	375	1380	4,54	10,08
UM	366	1420	5,23	17,9
UG	929	5020	5,15	14
BGED	803	3480	5,02	17,1
BN	609	2340	5,15	16,6
PB	145	300	4,68	9,8
KÇ	514	1840	5,08	15,6
UÇ	548	1780	5,34	16,3
EK1	812	3260	4,98	14,3
EK2	666	2600	4,49	16,7

Table 4. Organic acid contents of the apple genotypes.

Genotypes	Oxalic Acid (ppm)	Malic acid (ppm)	Ascorbic acid (ppm)	Citric Acid (ppm)	Acetic Acid (ppm)	Gallic Acid (ppm)
UO1	354	3065	45	Trace Amount	Undetected	Undetected
UO2	474	4298	127	Trace Amount	Undetected	Undetected
UO3	295	12159	82	Trace Amount	Undetected	Undetected
UH	352	9030	67	Trace Amount	Undetected	Undetected
UM	514	6468	91	Trace Amount	Undetected	Undetected
UG	439	1725	84	Trace Amount	Undetected	Undetected
BGED	474	5415	203	Trace Amount	Undetected	Undetected
BN	508	3574	103	Trace Amount	Undetected	Undetected
PB	267	4592	29	Trace Amount	Undetected	Undetected
KÇ	452	3360	169	Trace Amount	Undetected	Undetected
UÇ	561	3371	61	Trace Amount	Undetected	Undetected
EK1	468	4473	67	Trace Amount	Undetected	Undetected
EK2	383	11830	31	Trace Amount	Undetected	Undetected

Conclusion

As a result of the analysis of some pomological and biochemical features of the genotypes we obtained in the city of Uşak, the UO1, UH, PB, EK1, EK2 genotypes seem to be promising in terms of their fruit weight, width, and height. In this study, some genotypes are found superior and some inferior, when compared to the genotypes, analyzed in other studies. The natural growth of the genotypes on their own in their natural habitats has led to natural adaptation of the fruits to the ecological conditions of the region and though they have superior features in terms of organic acid, phenolic content and taste and as they are not subject to commercial activities, their attraction seems to be weak in terms of some features such as fruit weight, width, and height. As a result, the local producers do not include local genotypes in their production and thus our local genotypes face the threat of extinction, although they have superior features such as ecological adaptation, suitability for climate conditions and resilience against transportation conditions, storage difficulties, disease possibility, and pest invasion. Therefore, our local genotypes should be identified and should be improved so that local communities can be provided with another source of income and some contributions can be made to the economy of the country.

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