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Kernel Sugar Components of Turkish and Foreign Apricot (*Prunus armeniaca* L.) Varieties

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This study involves in determining kernel sugar contents of Turkish apricot varieties (Kabaasi, Sakit, Alyanak, Tokaloglu, Salak, Hasanbey, Hacihaliloglu and Sekerpare) and foreign apricot varieties (Paviot, Colomer and Thyrinte) grown in Van (eastern Anatolia, Turkey). The sugar contents of kernels were detected by HPLC. The main sugar was sucrose in the majority of apricot varieties. Kernels of Turkish varieties contained 2.20-5.30 g/100 g sucrose, 0.40-3.40 g/100 g maltose, 0.90-3.64 g/100g glucose and 0.57-5.58 g/100 g fructose. Sugar contents of seeds belonging to foreign varieties were 3.30-4.67 g/100 g sucrose, 1.50-2.52 g/100 g maltose, 3.38-3.72 g/100 g glucose and 1.86-2.93 g/100 g fructose. Sugar contents significantly, differed by varieties. In addition, positive correlation coefficients were computed among kernel sugars.

Key Words: Apricot, Kernel, Free sugars, Relationship, Van, HPLC.

INTRODUCTION

In the near East of Central Asia, Turkey is rich in genetic resources of apricot[1]. In Turkey, local apricot selections are included in the Irano-Caucasian group[2]. Turkey is the leading exporter country of dried apricot around the world and meets about 20 % of world apricot production[3]. Although apricots are cultivated almost in all parts except Black Sea region, they are commercially grown for dried production in Malatya located in the eastern Turkey. In Malatya, the leader city of Turkey's apricot production, a large part of the crop is dried for export. Recently, apricot growing also develops in the Mediterranean and Aegean coastal regions using low chilling domestic and foreign cultivars and develops for table production with precocity cultivars and early ripening selections[4,5]. In apricot culture areas of Turkey, there is a large number of genotypes other than standard cultivars[3,6-9]. Therefore, the maintenance of apricot genetic resources that are being increasingly lost and their identification in terms of genetic variability are very important for future breeding efforts.

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In Turkey, apricot sweet kernels are used for appetizer purposes like almond kernels. Therefore, their identification in nutritional value as a genetic material based on variety, selection, genotype and different ecology will reveal new knowledge in this field. A large amount of fruit seeds is currently discarded yearly at processing stage, although they have a large industrial potential for many purposes as a valuable resource[10]. Apricot kernels are mainly used for cosmetics, medicinal purposes[10] and scents and pits are utilized as fuel[11]. In addition, more information on varieties and composition is needed for the most effective utilization of apricot seeds[10].

In the fruits, sucrose, glucose and fructose are considered as the main sugars[12]. Their amount and composition can vary to fruit species, varieties, ecological conditions, technical and cultural practices since they influence the fruit taste[13]. Regarding effects on fruit taste, fructose is sweeter than sucrose and sucrose is sweeter than glucose[12]. Apricot fruit contain 17.45% fructose, 32.26 % glucose and 22.89 % sucrose as % dry basis[14]. Other than protein, oil and other components, sugar contents of apricot kernel affects its usage areas in the industry. In apricots, kernel quality is closely associated with kernel flavour. There exist a limited information on sugar contents of apricot kernels.

Now-days, the improvement of fruit quality is very important among apricot breeding objectives[2,15]. Since sugar content and composition highly influence the fruit flavour quality, their biochemical characterization is considered as a part of an efficient breeding strategy[16]. Similarly, biochemical characterization of apricot seeds are also important for human health and diets as well. Van city has a microclimatic structure located in the eastern Anatolia region of Turkey. In Van, apricots are grown at about 1700 m attitudes. This study aimed at determining sugar contents of seeds in apricot varieties grown in Van and defining their sugar composition in nutritional value.

EXPERIMENTAL

The material of this study consisted of kernels of Turkish apricot (*Prunus armeniaca* L.) varieties (Kabaasi, Sakit, Alyanak, Tokaloglu, Salak, Hasanbey, Hacihaliloglu and Sekerpare) and foreign apricot varieties (Paviot, Colomer and Thyrinte) grown under Van (eastern Anatolia, Turkey) ecological conditions. Apricot fruits belonging to different varieties were collected at their harvest times. Kernels were removed from their fruits. Within the 50 fruits of each variety, many kernels were randomly chosen for analyses and they were dried in a vacuum oven at 60 ºC for 3 d.

In analyzing sugar composition, HPLC is powerful technique than gas-chromatography method[17]. Although compositional analyses of sugars were

performed by gas-chromatography method. Sugar contents (fructose, sucrose, glucose and maltose) were analyzed by using the modified methods[18,19]. 2 g of kernel sample for each variety was ground into powder in liquid nitrogen and 40 mL methanol was added. After the mixture was incubated on a magnetic stirrer at 65 ºC for 0.5 h, it was centrifuged at 4 ºC, 1300 rpm for 40 min. Then, the supernatant was transferred in clean tube and made up to 50 mL with methanol. Methanol was removed by rotary evaporator and the residue was dissolved in 25 mL double distilled water. Following passing of the extract through Sep-Pak C_{18} cartridge, 2.5 mL of filtrate was mixed with 7.5 mL acetonitrile. It was filtrated by 0.45 μm membrane filter and injected into HPLC. The calibration of column was done by fructose, sucrose, glucose and maltose standards. Sugar components were expressed as g/100 g.

With three replications, a completely randomized design was used for statistical analysis of data belonging to sugar components. The means were separated by Duncan's multiple range test. Significant differences were found at $p < 0.01$. Statistical package program Minitab was used for the analysis of variance. The LSD values were computed for multiple comparisons of the means. In addition, the analyses of correlation and regression were made to reveal relationships among sugar components of apricot kernel, by using Excel package program.

RESULTS AND DISCUSSION

As sugar components, contents of fructose, glucose, sucrose and maltose contents of kernels significantly. differed by varieties. The main sugar was sucrose in the majority of apricot varieties. Kernels of Turkish varieties contained 2.20-5.30 g/100 g sucrose, 0.40-3.40 g/100 g maltose, 0.90-3.64 g/100 g glucose and 0.57-5.58 g/100 g fructose. Sugar contents of seeds belonging to foreign varieties were 3.30-4.67 g/100 g sucrose, 1.50-2.52 g/100 g maltose, 3.38-3.72 g/100 g glucose and 1.86-2.93 g/100 g fructose (Table-1).

Kernels of salak had the highest fructose content (5.58 g/100 g), followed by hasanbey (4.10 g/100 g), alyanak (3.00 g/100 g), paviot (2.93 g/100 g) and colomer (2.40 g/100 g) respectively. Glucose content (3.72 g/100 g) of colomer kernels was detected in the highest amount, followed by thyrinte (3.71 g/100 g), hasanbey (3.64 g/100 g), Sakit (3.60 g/100 g) and paviot (3.38 g/100 g), respectively. Sucrose content (6.36 g/100 g) of colomer kernels was determined at the highest level, followed by kabaasi (5.30 g/100 g), paviot (4.67 g/100 g), salak (4.09 g/100 g) and tokaloglu (4.09 g/100 g), respectively. With respect to maltose content, alyanak and sekerpare varieties had the lowest contents of maltose. Salak and colomer varieties had the highest levels of maltose with 3.40 and 2.52 g/100 g (Table-1).

TABLE-1
SUCROSE, MALTOSE, GLUCOSE AND FRUCTOSE CONTENTS (g/100 g IN DRY WEIGHT) IN THE KERNELS OF FOREIGN AND TURKISH APRICOT VARIETIES GROWN IN VAN (EASTERN TURKEY)

Apricot varieties		Fructose (g/100 g)	Glucose (g/100 g)	Sucrose (g/100 g)	Maltose (g/100 g)
Foreign varieties	Paviot	2.93	3.38	4.67	1.50
	Colomer	2.40	3.72	6.36	2.52
	Thyrinte	1.86	3.71	3.30	1.50
Turkish varieties	Kabaaşı	1.70	2.55	5.30	1.30
	Alyanak	3.00	1.87	2.20	0.40
	Tokaloğlu	1.87	1.20	4.09	1.33
	Sakit	1.50	3.60	3.30	1.30
	Şalak	5.58	3.02	4.20	3.40
	Hasanbey	4.10	3.64	5.10	0.70
	Hacihaliloğlu	1.38	2.20	3.68	0.90
	Şekerpare	0.57	0.90	3.10	0.60
	Zerdali	2.27	1.60	3.20	1.10
Significance		***	***	***	***
LSD (0.01)		1.34	1.13	1.57	1.53

On the other hand, relationships among kernel sugar contents were also computed. The correlation coefficients were r = 0.480 between sucrose and maltose, r = 0.490 between sucrose and glucose (Fig. 2), r = 0.227 between sucrose and fructose, r = 0.431 between maltose and glucose, r = 0.546 between maltose and fructose (Fig. 1) and r = 0.390 between glucose and fructose, respectively. Therefore, positive correlation coefficients were computed among kernel sugar contents (Table-2).

TABLE-2
RELATIONSHIPS AMONG SUGAR CONTENTS IN APRICOT KERNELS EXAMINED

Correlation coefficients (r)	Maltose	Glucose	Fructose
Sucrose	0.480	0.490	0.227
Maltose	–	0.431	0.546
Glucose	–	–	0.390

There exist a limited knowledge regarding sugar contents of apricot kernels although they are consumed for appetizer and medicinal purposes. It has been reported that apricot kernels contain high levels of carbohydrates, their carbohydrate contents range from 17.3 to 25.5 %[20-22].

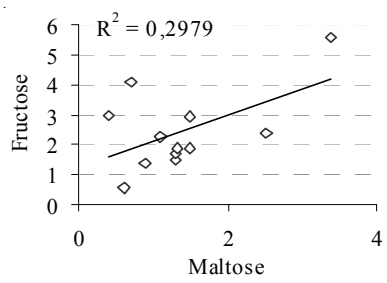

Fig. 1. Relationship of maltose and fructose in kernels of apricot varieties

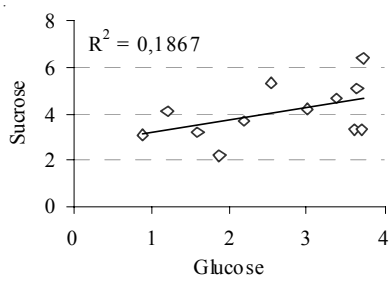

Fig. 2. Relationship of sucrose and glucose in kernels of apricot varieties

In addition, apricot seeds contain 4.10-7.76 % the total sugar[23] and 5.86 % invert sugar[24]. The major sugar component of apricot fruit is sucrose[25]. Pala *et al.*[26] reported that kernels of Turkish apricot varieties contain 0.28-1.03 % glucose, 0.12-2.40 % fructose and 0.26-3.01 % sucrose. Gurrieri *et al.*[16] determined 0.7-6.1 g/100 g reducing sugar and 2.7-12.9 g/100 g sucrose for the ripe fruits of 51 apricot genotypes originated from France, Spain, Italy, Greece and USA.

Sugar compositional data reveal that kernels of some apricot varieties grown in Van contain higher glucose (two or three times), fructose (about two times) and sucrose (about two times) than those reported by Pala *et al.*[26]. These findings indicate that kernel sugar composition was highly affected by different ecological conditions will also contribute to nutritional improvement efforts of apricot kernels.

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