

VOLATILE COMPOSITIONS AND SOME FRUIT CHARACTERISTICS OF TABLE APRICOT VARIETIES FROM TURKEY

E. Kafkas,¹ L. Son,² M. Kurkcuoglu,³ and K. H. C. Baser³

UDC 547.913

In the last few decades the world apricot production has been supplied mainly by Mediterranean countries, i.e., Turkey, Spain, Italy, France, and Greece [1]. Mut was the earliest fresh apricot growing in the center of the world. The first fresh fruits came to the market from this area and were sold at high prices [2].

The first significant studies on apricot flavor were previously performed by utilizing direct extraction, vacuum steam distillation, and charcoal adsorption to isolate the volatiles [3, 4]. Several other authors used various techniques for these determinations and made correlations between sensory and instrumental data or the odor unit concept [5–8]. SPME is a simple, solvent-free method for the isolation and concentration of volatile compounds present in the headspace without modifications of these compounds due to temperature or the solvent effect [9, 10]. Guillot [11] reported the chemical characterization of several apricot cultivars (Iranian, Orangered, Goldrich, Hargrand, Rouge de Roussillon, and A4025) as analyzed by HS-SPME-GC/MS. In the six cultivars, 23 volatile compounds were identified by HS-SPME-GC/MS. Studies on the odor threshold [7] demonstrated that the major contributors to the aroma of blended apricot included β -ionone, linalool, γ -decalactone, β -cyclocitral, phenylacetaldehyde, and γ -octalactone. The authors assume that β -ionone and linalool may be responsible for the floral character, and lactones for the fruity, peach, and coconut background aroma [6, 7]. Other compounds such as carbonyl compounds also contribute to the apricot aroma [5].

Gomez and Ledbetter [12] reported that the volatile compounds behaved differently during the fruit maturation period, alcohols being the most important group, quantitatively during the three developmental stages in apricot fruit.

Guichard and Souty [13] compared the relative concentrations of various volatiles in six different apricot cultivars and showed that the C6 lipid degradation products, lactones, terpenes, and ketones, are the most abundant constituents.

Several studies concerning the volatile fraction of apricot showing a great variability concerning the nature and concentration of the aromatic compounds isolated from different cultivars are available [7, 14]. However, studies devoted to volatile compounds involved in apricot flavor are scarce [5–8]. This study focuses on some pomological characteristics and identification of volatile constituents of the main commercial (Precoce de Tyrinthe, Tokaloglu, Bebeco, and Sekerpare) apricot varieties.

The fruit characteristics of four apricot cultivars are given in Table 1. The differences among the genotypes on fruit weights were found to be significant. Fruit weights ranged from 35.4 g (Sekerpare) to 47.4g (Precoce de Tyrinthe). Precoce de Tyrinthe and Bebeco were found to be firmer than the others. The largest kernel was obtained from Precoce de Tyrinthe and it was followed by Tokaloglu, Bebeco, and Sekerpare. These results are similar to the results of Son and Kuden [15], and the same authors had indicated that Tokaloglu was found to be 45.8 g. The highest titratable acidity was obtained from Tokaloglu and Precoce de Tyrinthe apricots, followed by Bebeco. Sekerpare had the lowest acidity. This results were found to be parallel to [5].

As regards the TSS, the highest TSS was found to be in Sekerpare, followed by Bebeco, Tokaloglu, and Precoce de Tyrinthe, similar to the results of [5].

In another study, Son and Kuden [15] reported some fruit quality characteristics of apricot cultivars grown in the Mut region. The authors had reported the following fruit characteristics for Precoce de Tyrinthe apricot: weight 48.8 g; TSS value 11.8%; and acidity 1.56%. Similar results were obtained in the present study (Table 1).

1) University of Cukurova, Subtropical Fruits Research and Application Center, 01330, Balcali, Adana; 2) University of Mersin, High School Proficiency Department of Horticulture, 33600 Mut, Mersin; 3) University of Anadolu, Faculty of Pharmacy, Department of Pharmacognosy, Eskisehir. Published in *Khimiya Prirodnikh Soedinenii*, No. 3, pp. 285-286, May-June, 2007. Original article submitted May 10, 2006.

TABLE 1. Some Pomological Characteristics of Table Apricot Cultivars Grown in the Mut Region

Cultivars	Fruit weight, g	Flesh firmness	Kernel weight, g	Titrateable acidity, %	TSS, %
Tokaloglu	47.15 a	Medium	2.75 b	1.55 a	12.90 b
Sekerpare	35.37 c	Medium	2.43 c	0.43 c	18.30 a
Pre. de Tyrinthe	47.42 a	Firm	2.90 a	1.54 a	12.10 c
Bebeco	45.10 b	Firm	2.72 b	1.47 b	13.05 b
D%5	0.95	-	0.06	0.04	0.23

TABLE 2. Volatiles Identified in Four Apricot Cultivars by HS-SPME and GC/MS

Compounds	Cultivars			
	Tokaloglu	Sekerpare	Bebeco	P. de Tyrinthe
Furfural	Tr.	Tr.	Tr.	Tr.
(<i>E</i>)-2-Hexenal	Tr.	-	-	-
Maltol	15.7	-	Tr.	7.3
2,3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one	20.3	29.5	22.1	16.0
5-Hydroxymethyl furfural	62.7	70.5	77.9	74.1
γ -Decalactone	Tr.	-	Tr.	0.7
δ -Decalactone	Tr.	-	-	0.2
Total, %	98.7	100	100	98.3

The volatile composition of four apricot cultivars is given in Table 2. Eight compounds were identified. Among the detected compounds 5-hydroxymethyl furfural and 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one were detected as the major components. Furfural was detected in trace amount in all the experimental cultivars. Maltol was detected in cultivars Tokaloglu and P. de Tyrinthe at low relative percentages (15.7% and 7.3%) and trace amount in the cultivar Bebeco, whereas in Sekerpare this compound was not detected. Lactones, especially γ -decalactone and δ -decalactone, were also detected in all the cultivars except for Sekerpare.

Our results were found to be close to Gomez and Ledbetter [12]. Maltol was detected in three cultivars in different percentages, whereas it was not detected in the other two.

As a result, cultivar Sekerpare is found to be the sweetest one and having excellent edible quality. 5-hydroxymethyl furfural and 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one were found to be the major compounds characteristic of the aroma of apricots, and these compounds were found to be the most abundant in Bebeco and Sekerpare cultivars.

The fruits of four table apricot cultivars (Tokaloglu, Sekerpare, P. de Tyrinthe, and Bebeco) from the Mut region of Icel province of Turkey were used. A randomised block design was used with six replications.

Fruit Quality Characteristics. Fruit weight, flesh firmness, kernel weight, titrateable acidity, and TSS contents of four apricot cultivars were measured. TSS contents were determined using a hand refractometer. Titrateable acidity (malic acid) was calculated by titrating fruit juice with 0.1 N NaOH. The data obtained were analyzed with Tukey's test using Castat software [16].

Head Space-Solid Phase Micro Extraction (HS-SPME). The SPME fiber was inserted into a 20 mL glass vial containing 5 g apricot homogenate. A fused-silica fiber coated with 100 μ m polydimethylsiloxane (Supelco) was used for adsorbing the volatile compounds. The homogenized apricot samples were stirred with a magnetic stirrer for 30 min at 30°C with the fiber hanging in the headspace. After equilibration, the fiber was removed and the analytes were thermally desorbed in the injector port of the gas chromatograph. Thermal desorption was performed in the injector glass liner at 250°C for 2 min.

GC-MS Analysis. The adsorbed flavor compounds of apricots were analyzed using a Shimadzu GC-MS QP 5050 A. A CPSil5CB column (25 m \times 0.25 mm i.d., 0.4 μ m thickness) was used, with helium as the carrier gas. The GC oven temperature was kept at 60°C and programmed to 260°C at a rate of 5°C/min, and then kept constant at 260°C for 40 min. Split flow was adjusted to 50 mL/min. The injector temperature was at 250°C. The MS was taken at 70 eV. The mass range was m/z

30–400. Library search was carried out using the commercial Wiley GC-MS Library and MassFinder Library as well as the in-house-Baser Library of Essential Oil Constituents. The mass spectra were also compared with those of reference compounds and confirmed with the aid of retention indices from published sources. Relative percentage amounts of the separated compounds were calculated from total ion chromatograms through the computerized integrator.

REFERENCES

1. S. Perda and S. Tondini, *Rivista di Frutticoltura*, **7**, 59 (1997).
2. H. Ayanoglu and N. Kaska, *Acta Hort.*, **384**, 147 (1995).
3. C. Tang and W. Jennings, *J. Agric. Food Chem.*, **15**, 24 (1967).
4. C. Tang and W. Jennings, *J. Agric. Food Chem.*, **16**, 252 (1968).
5. G. Chariote, F. Rodriguez, and J. Crouzet, *J. Food Sci.*, **46**, 1898 (1981).
6. E. Guichard, P. Schlick, and S. Issanchou, *J. Food Sci.*, **55**, 735 (1990).
7. G. R. Takeoka, R. A. Flath, R. M. Thomas, R. Teranishi, and M. Guentert, *J. Agric. Food Chem.*, **38**, 471 (1990).
8. M. Toth-Marcus, M. Boross, F. Plazso, and M. Kerek, *Die Nahrung*, **33**, 433 (1989).
9. A. D. Harmon, *Techniques for Analyzing Food Aroma*, 81 (1997).
10. J. Pawliszyn, *Headspace Analysis of Food and Flavours: Theory and Practice*, 73 (2001).
11. S. Guillot, L. Peytavi, S. Bureau, B. Renaud, R. Boulanger, J. P. Lepoutre, J. Crouzet, and S. S. Garindo, *Food Chem.*, **96**, 147 (2006).
12. E. Gomez and C. A. Ledbetter, *J. Sci. Food Agric.*, **74**, 541 (1997).
13. J. Crouzet, P. Etievant, and C. Bayoneve, *Food flavours. Part C. The Flavour of Fruits*, Amsterdam: Elsevier, (1990)
14. L. Son and A. Kuden, *C. U. Z. F. Dergisi*, **16** (1), 93 (2001).
15. L. Son and A. Kuden, *Turk J. Agric. For.*, **27**, 261 (2003).
16. A. Duzgunes, *Istatistik prensipleri ve metotlari. E. U. Matbaasi, Izmir*, 378 (1963).