JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

J. Agric. Food Chem. **2005,** *53,* 5003−5009 **5003**

Determination of the Phytoalexin Resveratrol (3,5,4′-Trihydroxystilbene) in Peanuts and Pistachios by High-Performance Liquid Chromatographic Diode Array (HPLC-DAD) and Gas Chromatography−Mass Spectrometry (GC-MS)

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The phytoalexin resveratrol (3,5,4′-trihydroxystilbene) in edible peanut (*Arachis hypogaea* L.) and pistachio (*Pistacia vera* L.) varieties grown in Turkey was analyzed by high-performance liquid chromatographic diode array and gas chromatography−mass spectrometric detection. *trans*-Resveratrol in six peanut varieties, five pistachio varieties, and four market samples ranged between 0.03 and 1.92 μg/g. The Çerezlik 5025 peanut (1.92 ± 0.01 μg/g) and Ohadi pistachio genotype (1.67 ± 0.01 μg/g) had significantly higher *trans*-resveratrol contents. Peanuts contained 0.03−1.92 μg/g (av = 0.84 μg/g) of *trans*-resveratrol, whereas pistachio contained 0.09−1.67 μg/g (av = 1.15 μg/g). With exposure to UV light for 1 min, *trans*-resveratrol concentrations of samples ranged from 0.02 to 1.47 μg/g and those of *cis*-resveratrol from 0.008 to 0.32 μg/g. The occurrence of resveratrol in peanut and pistachio was confirmed by total ion chromatograms (TIC) of bis[trimethylsilyl]-trifluoroacetamide derivatives of resveratrol isomers and comparison of the mass spectral fragmentation data with those of a resveratrol standard. Formation of the *cis*-isomer in pistachios was higher than in peanuts.

KEYWORDS: Resveratrol; *trans*-resveratrol; *cis*-resveratrol; peanut; pistachio; HPLC-DAD; GC-MS

INTRODUCTION

Epidemiological and clinical investigations have shown that the polyphenolic phytoalexin resveratrol (3,5,4′-trihydroxystilbene) has been associated with reduced cardiovascular disease and reduced cancer risk. Resveratrol has been shown to possess cancer chemopreventive activity in mice and to act as an antimutagen and antioxidant (*1*, *2*), and it has been confirmed that *trans*-resveratrol is a chemopreventive agent against human breast cancer (*3*).

Resveratrol has been reported in a number of plant species including grapes (*Vitis vinifera*) and wines (*4*−*7*) and was observed to occur there as a response to fungal infection or injury. It also occurs in polygonaceous plants, such as *Polygonum cuspidatum*, used as herbal folk remedies in China (*8*), and in peanut hypocotyls (*9*) and seed (*10*). Recently, this major phytoalexin compound was found in edible peanuts and peanut cultivars (*11*, *12*). Resveratrol (*trans*-resveratrol, *trans*-3,5,4′-trihydroxystilbene) is one of the major stilbene phytoalexin phenolics produced by different parts of the peanut plant (*Arachis hypogaea* L.) containing the peanut kernel. Stilbene compounds are produced after biotic or abiotic stress by the peanut plant as a defense response to some exogenous stimuli, especially a fungal infection such as *Botrytis cinerea* Pers. (*9*, *10*). Arora and Strange (*13*) reported the accumulation of resveratrol and other phytoalexins in imbibed peanuts after wounding (slicing and incubation) (*13*). Sobolev and Cole (*14*), who earlier reported no resveratrol in uninfected tissue (*10*), published a study concerning the concentrations of resveratrol in several commercial peanut butters and peanut product in the United States (*14*).

Resveratrol occurs in the *trans*- and *cis*-isomeric forms **(Figure 1)**. In Vitaceae fungal infection or UV light stimulates the production of stilbene synthase and catalyzes the reaction of 4-hydroxycinnamoyl-CoA and malonyl-CoA to produce *trans*-resveratrol (*15*). *cis*-Resveratrol has not been reported in *Vitis vinifera*, and it has been shown to be present in wines (*16*). The *trans*-isomers are transformed to the *cis*-forms under UV light (*17*).

Quantitative amounts of *trans*-resveratrol were determined as 0.03−7.17 ppm in grapes, grape vine, and red wines (*7*); they range from 0.01 to 1.79 μg/g of peanuts (*10*−*12*, *15*) by HPLC- and GC-MS-based chromatographic methods.

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10.1021/jf050496+ CCC: $30.25
Published on Web 05/14/2005

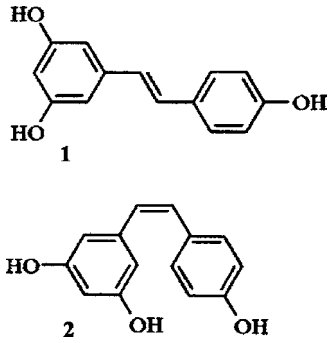

Figure 1. Resveratrol isomers: **1**, *trans*-resveratrol; **2**, *cis*-resveratrol.

Peanuts (*A. hypogaea* L.) and pistachios (*Pistacia vera* L.) are economically important commercial crops in Turkey. Peanut and pistachio cultivars of high quality are grown in Turkey. In 2001, Turkey's annual peanut production was 72 000 tons and pistachio production was 30 000 tons, whereas in the first half of 2002, these amounts were 70 000 and 55 000 tons, respectively (*18*). Turkey is third in pistachio production area in the world, followed by the United States and Iran. No study could be found regarding resveratrol levels of pistachios, which are a valuable commodity for various food industries.

Peanut is mainly utilized as an oilseed, as a snack food, and as a gourmet oil; it is also used in the peanut butter industry, in biscuit and confectionery making, in the canned fish industry, in soap manufacturing, and in the byproduct industry in Turkey (*12*). Due to the hard-shell fruit and crack-shell form, pistachio is a unique nut and is not destroyed through processing such as roasting, salting, and packaging. Pistachio is mainly used as a snack food in the shell, as a confectionery and desert ingredient (particularly in *baklava*, a sweet pastry made of sheets of pastry, nuts, and sugar), and in ice-cream manufacturing in Turkey. It is utilized as an aroma additive in fermented meat (sausage, salami), as a food additive in the bread and baking industry, and as a food additive in pudding. It is consumed as a salad sauce and in dip foods (*12*, *19*).

The objectives of this research were to identify *trans*-resveratrol in six peanut cultivars, five pistachio cultivars, and four local market samples and to determine the *cis*-resveratrol contents in the above-mentioned peanuts and pistachios after exposure to UV light by using high-performance liquid chromatographic diode array (HPLC-DAD) and gas chromatography−mass spectrometric (GC-MS) detection.

MATERIALS AND METHODS

Chemicals and Materials. *trans*-Resveratrol standard was purchased from Sigma-Aldrich Corp. (St. Louis, MO). Aluminum oxide (Al_2O_3) for neutral column chromatography was obtained from Acros (Geel, Belgium). Absolute ethanol (HPLC grade) was obtained from J. T. Baker via the distributor Ekin Chemistry Co. (Istanbul, Turkey), and acetonitrile (HPLC grade) was obtained from Labscan Ltd. (Dublin, Ireland). Silica gel 60 C_{18} and 2,2,2-trifluoroacetamide were obtained from Merck Co. (Darmstadt, Germany). Bis[trimethylsilyl]trifluoroacetamide (BSTFA) was purchased from Alltech Associates, Inc. (Deerfield, IL).

Research Samples. Peanut genotype cultivars used for analysis were as follows: six peanut cultivars, NC-7, Çom, Gazipaşa, Florispan (yağlık), Çerezlik 5025, and Çerezlik PI-355276, were obtained from Akdeniz Agricultural Research Institute (Antalya, Turkey) (harvested in 2002); five pistachio cultivars, Uzun, Kırmızı, Halebi, Ohadi, and Siirt, were obtained from Gaziantep Pistachionut Research Institute (Gaziantep, Turkey) (harvested in 2002). Four peanut and pistachio samples were obtained from local markets in the cities of İzmir and Manisa.

Sampling Procedure. Research materials were held in cold storage (−28 °C) with N_2 atmosphere until analysis. Prior to analysis, seed coats of samples were removed by hand and were placed into polyethylene bags.

***trans*-Resveratrol to *cis*-Resveratrol Conversion in Samples.** The conversion of *trans*-resveratrol to the *cis*-form in samples was accomplished via exposing samples to a model UVL-S6 UV lamp (UVP, Inc., San Gabriel, CA) at 366 nm for 1 min (*17*). Similarly, 10 μL of standard *trans*-resveratrol in a vial was converted to the *cis*-form to obtain a trans + cis standard mixture.

Extraction. The sample extraction procedure was modified according to the method described by Sanders et al. (*11*). Research materials were ground in a hand coffee mill apparatus. Finely ground material was extracted with 20 mL of 80% (v/v) ethanol solution/10 g of sample in an ice bath (4 °C) for 5 min by a Tefal homogenizer at high speed. The residue was extracted with the same procedure three more times. The residue was removed and the supernatant obtained. Combined supernatant was protected from light by covering with aluminum foil in a screw-cap vial. Two milliliters of the supernatant was passed through a column containing 1 mL of a 1:1 w/w mixture of silica gel 60 R_{18} and Al_2O_3 for quantitative analysis. The column was washed with 2 mL of 80% ethanol. This column was washed with ethanol two more times, and the combined eluates were dried under N_2 atmosphere at room temperature (25 °C). The dried eluates were suspended in 300 μL of 10% ethanol. Final extracts of samples were protected from light in amber vials. The data obtained were the mean of six extractions with duplicate analyses of each extraction ($n = 6$) ($p < 0.01$).

HPLC Analysis. The injection amount of final extracts was 10 μL, and reversed-phase HPLC conditions for *trans*- and *cis*-resveratrol determination in peanut and pistachio samples are shown below. The isocratic reversed-phase HPLC-DAD method was used for *trans*- and *cis*-resveratrol quantitative determination. HPLC equipment was supplied by Hewlett-Packard (HP 1100 ChemStation software) consisting of a 250 × 4.6 mm i.d., 5-μm Hypersil-ODS column (Phenomenex, Torrance, CA). The mobile phase mixture was acetonitrile/bidistilled water (40:60, v/v) plus 0.1% TFA (v/v). The DAD was set at 308 nm (UV detection). Sensitivity was 0.05 AUFS, and the flow rate was 1.0 mL/min. The column oven was set at 30 °C, the injection amount was 10 μL, and the total elution time was 15 min. Each was injected three times ($n = 3$) ($p < 0.01$).

Calibration of Standard *trans*-Resveratrol. *trans*-Resveratrol standard was diluted using chloroform over the range of 0.01−6.0 mg/L (0.01, 0.1, 0.5, 3.0, and 6.0 mg/L) and had linear calibration curves through the origin.

The linearity plotting at 308 nm was ($y = 205.286x + 26.354$) ($R^2 = 0.9997$) for working solutions, where x is resveratrol concentration as ng/μL and y is peak area.

Recovery Analysis and Analytical Precision. Peak identity was confirmed via the retention times of the sample peaks compared to the retention times of the pure standards by using the Hypersil-ODS column. Recovery studies were performed from 0.01 to 6.0 mg/L (0.01, 0.1, 0.5, 3.0, and 6.0 mg/L) of standard, and recoveries were determined in triplicate in pistachio Ohadi by spiking pure standard in the range of 5−25 μL to the extraction solutions prior to sample analysis ($R^2 = 0.9999$) with the same HPLC procedure.

GC-MS Analysis. Final extracts were silylated with BSTFA. One milliliter of extract was dried in a vacuum, and then it was dissolved with 0.2 mL of BSTFA. The dissolved extract was heated at 60 °C for 30 min. A 2 μL derivatized sample was injected into the GC-MS. Both 20 μg of *trans*-resveratrol standard and 20 μg of (*trans* + *cis*) standard mixture were dissolved with 100 μL of BSTFA, and dissolved extracts were heated at 60 °C for 30 min. Working standard solutions were prepared from these stock solutions, and the derivatized standard was injected as 2 μL samples. GC-MS conditions for *trans*- and *cis*-resveratrol detection in peanut and pistachios are shown below.

A HP 5400 model gas chromatograph using a 30 m × 0.25 mm i.d., 0.25 μm DB-5MS capillary column (J&W Scientific, Folsom, CA) was utilized for analyses. Initially, the column temperature was 150 °C for 1 min; then the column was heated to 300 °C at 10 °C/min and kept at this temperature for 20 min. The flow rate of carrier gas (He) was 1.0 mL/min, the split ratio was 50:1, and the scan mode was 25−

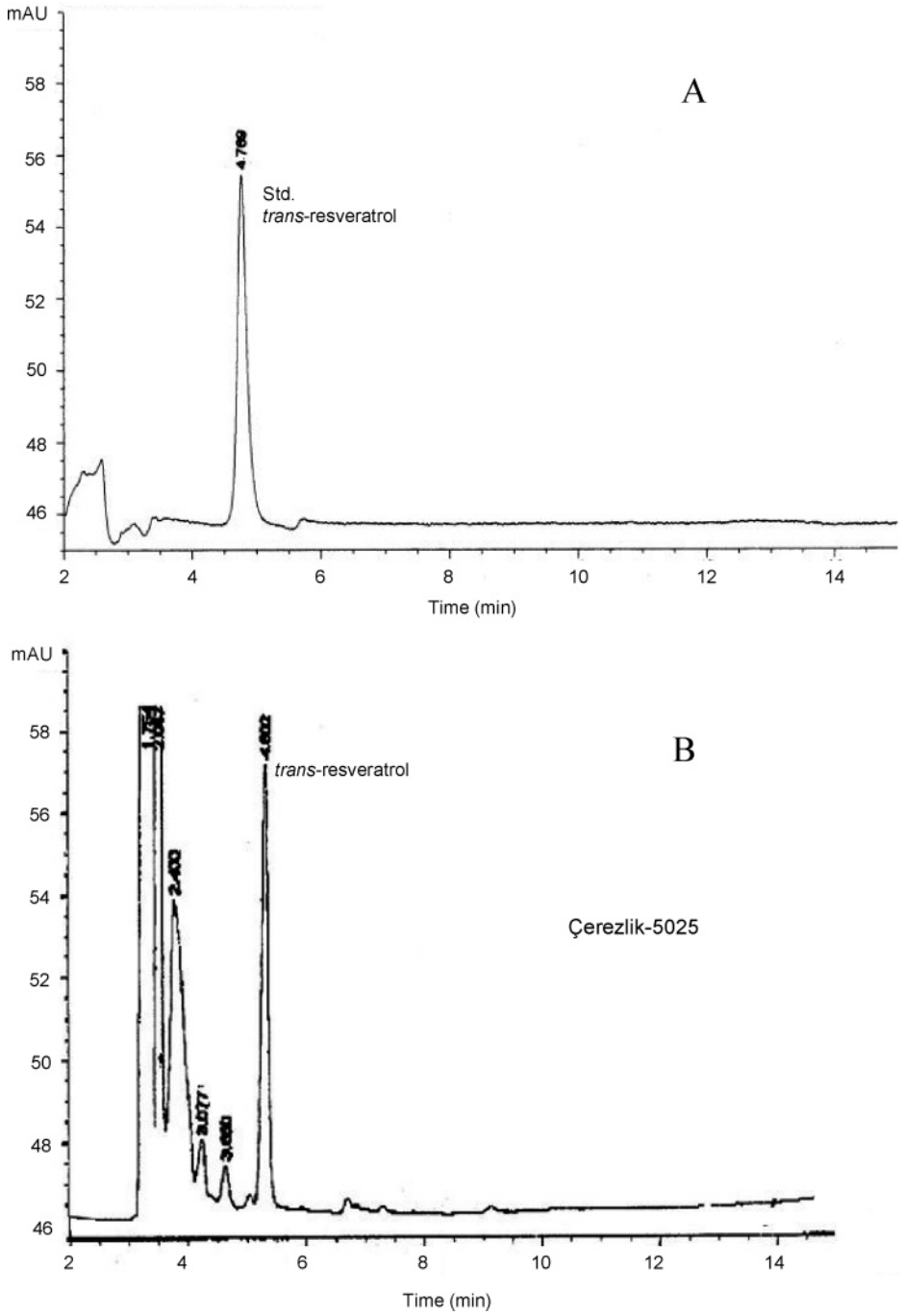

Figure 2. HPLC-DAD chromatograms of (**A**) standard *trans*-resveratrol and (**B**) *trans*-resveratrol in peanut genotype Çerezlik 5025.

250 amu. The elution time for all of the detections was 40 min. Trimethylsilyl (TMS) derivatives of *trans*- and *cis*-resveratrol in peanuts and pistachios were confirmed by comparison to the TMS derivative of the standard mixture.

Statistical Analysis. The data obtained were analyzed with Statistica for Windows (ver. 6.0) (*20*) by one-way analysis of variance (Kruskal−Wallis ANOVA) with *trans*- and *cis*-resveratrol contents of peanut and pistachios as the source of variance. Multiple regression analyses were also performed between *trans*- and *cis*-resveratrol contents of samples.

RESULTS AND DISCUSSION

***trans*-Resveratrol in Genotype Cultures and Market Samples.** *trans*-Resveratrol was perfectly separated with the chromatographic conditions used (**Figure 2**), and this HPLC-DAD procedure provided the baseline separation of *trans*-resveratrol.

In **Figure 2**, the retention times of standard *trans*-resveratrol (4.77 min) and *trans*-resveratrol in peanut Çerezlik 5025 (4.80 min) were rather similar. As shown in **Figure 2**, the *trans*-resveratrol peak in our procedure was found to have a shorter retention time than values found in recent studies, which were longer than 8 min (*11*, *14*). The Hypersil-ODS column may provide an advantage in faster elution.

Table 1 shows the *trans*-resveratrol content in 15 samples, consisting of 6 peanut genotypes, 5 pistachio varieties, and 4 market samples. In our research, utilizing the optimized HPLC method, for peanut and pistachio samples, *trans*-resveratrol concentration ranged from 0.03 to 1.92 μg/g ($n = 12$). *trans*-Resveratrol concentration of peanut variety Çerezlik 5025 (*A. hypogaea* L.) (1.92 μg/g) and that of pistachio variety Ohadi (*P. vera* L.) (1.67 μg/g) were significantly higher ($p < 0.01$)

Figure 3. Size differences of peanut and pistachio varieties.

Table 1. *trans*-Resveratrol Content of Peanut and Pistachio Samples[a]

genotype culture and market sample	Latin name	*trans*-resveratrol ± SD (μg/g)
NC-7	*A. hypogaea* L.	0.15 ± 0.01
Çom	*A. hypogaea* L.	0.03 ± 0.02
Gazipaşa	*A. hypogaea* L.	1.08 ± 0.01
Florispan (Yağlık)	*A. hypogaea* L.	0.05 ± 0.00
Çerezlik 5025	*A. hypogaea* L.	1.92 ± 0.01
Çerezlik PI-355276	*A. hypogaea* L.	1.80 ± 0.00
Uzun	*P. vera* L.	0.09 ± 0.02
Kırmızı	*P. vera* L.	1.04 ± 0.01
Halebi	*P. vera* L.	1.43 ± 0.00
Ohadi	*P. vera* L.	1.67 ± 0.01
Siirt	*P. vera* L.	1.53 ± 0.00
İzmir market 1a	*A. hypogaea* L.	1.54 ± 0.00
İzmir market 1b	*P. vera* L.	1.09 ± 0.01
Manisa market 1a	*A. hypogaea* L.	1.65 ± 0.02
Manisa market 1b	*P. vera* L.	1.35 ± 0.01
av value		1.09 ± 0.01

[a] $p < 0.01$.

(**Table 1**). Çom and Florispan genotypes had little resveratrol, with 0.03 and 0.05 μg/g, respectively.

trans-Resveratrol in peanut varieties was in the order Çerezlik 5025 > Çerezlik PI-355276 > Gazipaşa > NC-7 > Florispan > Çom, whereas in pistachio varieties it was Ohadi > Siirt > Halebi > Kırmızı > Uzun. Market sample peanuts İzmir 1a and Manisa 1a contained 1.54 and 1.65 μg of *trans*-resveratrol/g, respectively. Pistachio from İzmir and Manisa markets (1b) had 1.09 and 1.35 μg of *trans*-resveratrol/g, respectively (**Table 1**).

Sanders et al. (*11*) reported that various peanut cultivars contained 1.6−3.7 μg of *trans*-resveratrol/g, and they also identified 0.03−0.14 μg of *trans*-resveratrol/g in cultivated peanuts in different areas (as Spanish, Runner, and Virginia varieties) by HPLC; their data were confirmed by GC-MS (*11*). *trans*-Resveratrol concentration was detected as 0.02−1.79 μg/g in different U.S. genotypes (Florunner, SunOleic 95R, NC-9, and Starr varieties) (*11*). Lee and co-workers reported 0.25−0.41 μg of *trans*-resveratrol/g in peanut varieties consumed in Korea (*21*).

We detected 0.03−1.92 μg/g (av = 0.84 μg/g) *trans*-resveratrol in our peanut genotypes, whereas 0.09−1.67 μg of *trans*-resveratrol/g (av = 1.15 μg/g) was found in our pistachio varieties. The *trans*-resveratrol contents of cultivated peanut and pistachio varieties in Turkey in our research were in accordance with the studies described by Sanders et al. (*11*) and Lee et al. (*21*). According to our data, the *trans*-resveratrol amount in pistachio varieties (0.09−1.67 μg/g) was higher than that of peanut varieties (0.03−1.92 μg/g) ($p < 0.01$) (**Table 1**). No previous studies have described the determination of resveratrol concentrations in pistachios.

According to Sanders et al. (*22*), peanut maturity has been related to changes in many compositional and quality characteristics of peanut varieties (*22*). Peanuts of three different commercial sizes, extra large kernels (ELK), medium, and no. 1 (determined by seed thickness), were examined in the NC-9 cultivar (*11*). On the basis of their findings, the no. 1 size is composed of small seeds and represents a generally less mature lot of peanuts than the ELK or medium Virginia size (*11*). Sanders and co-workers (*11*) determined that although the various sizes had different mean concentrations, the differences were less than those found among subsamples of the same type and size. Sobolev and Cole (*14*) showed an inverse relationship between size and resveratrol concentration in a single lot of Florunner peanuts (*14*). It was reported that resveratrol concentrations increased in unacceptable peanuts such as color-sorted rejects from variously sized grades (*14*). Donner et al. (*23*) reported that immature (small) seeds had greater capacity for phytoalexin production than mature (larger) seeds (*23*).

Figure 3 shows size differences of peanut and pistachio varieties that are studied in this research. Among our peanut research samples, the Florispan (Yağlık) peanut cultivar has the smallest size and has a much lower resveratrol concentration

Table 2. *trans*- and *cis*-Resveratrol Contents in Peanuts and Pistachio Nuts after Exposure to UV Light for 1 min[a]

genotype culture and market sample	Latin name	*trans*-resveratrol ± SD (μg/g)	*cis*-resveratrol ± SD (μg/g)	total resveratrol ± SD (μg/g)
NC-7	*A. hypogaea* L.	0.10 ± 0.01	0.04 ± 0.01	0.15 ± 0. 02
Çom	*A. hypogaea* L.	0.02 ± 0.00	0.00 ± 0.01	0.03 ± 0.02
Gazipaşa	*A. hypogaea* L.	0.79 ± 0.01	0.29 ± 0.02	1.08 ± 0.03
Florispan (Yağlık)	*A. hypogaea* L.	0.03 ± 0.01	0.01 ± 0.01	0.05 ± 0.02
Çerezlik 5025	*A. hypogaea* L.	1.42 ± 0.02	0.50 ± 0.00	1.92 ± 0.03
Çerezlik PI-355276	*A. hypogaea* L.	1.47 ± 0.01	0.32 ± 0.01	1.80 ± 0.02
Uzun	*P. vera* L.	0.07 ± 0.00	0.02 ± 0.01	0.09 ± 0.01
Kırmızı	*P. vera* L.	0.79 ± 0.01	0.25 ± 0.02	1.04 ± 0.03
Halebi	*P. vera* L.	1.05 ± 0.00	0.38 ± 0.01	1.43 ± 0.02
Ohadi	*P. vera* L.	1.24 ± 0.00	0.43 ± 0.01	1.67 ± 0.01
Siirt	*P. vera* L.	1.18 ± 0.01	0.34 ± 0.00	1.53 ± 0.01
İzmir market 1a	*A. hypogaea* L.	1.09 ± 0.01	0.44 ± 0.00	1.54 ± 0.02
İzmir market 1b	*P. vera* L.	0.81 ± 0.02	0.27 ± 0.01	1.09 ± 0.03
Manisa market 1a	*A. hypogaea* L.	1.22 ± 0.00	0.42 ± 0.01	1.65 ± 0.02
Manisa market 1b	*P. vera* L.	1.00 ± 0.00	0.35 ± 0.01	1.35 ± 0.01
av value		0.82 ± 0.01	0.27 ± 0.01	1.09 ± 0.02

[a] $p < 0.01$.

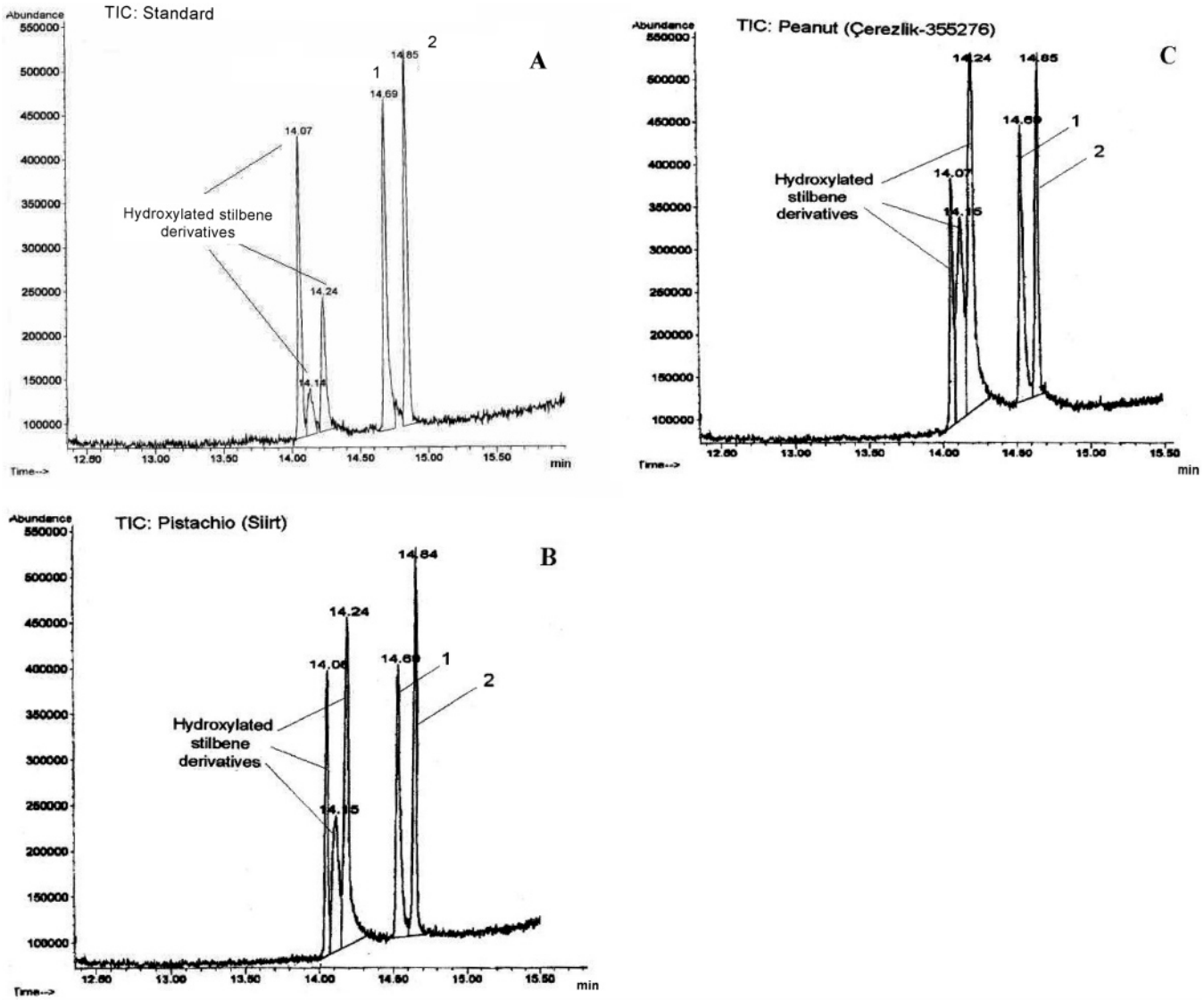

Figure 4. GC-MS total ion chromatograms (TIC) of BSTFA derivative of (**A**) standard resveratrol, (**B**) pistachio (Siirt), and (**C**) peanut (Çerezlik-355276): (1) *trans*-resveratrol; (2) *cis*-resveratrol.

(0.05 μg/g). Although the Çom genotype has a larger size than the Florispan (Yağlık) genotype, its resveratrol concentration is lower than that of Florispan (0.03 μg/g) (**Table 1**), and there is no statistically significant difference between the resveratrol contents of the two genotypes. Our findings are in agreement with the above-mentioned study reported by Sobolev and Cole

(*14*) and confirmed the inverse relationship between size and resveratrol concentration.

However, the NC-7 genotype, with a medium size, has 0.15 μg/g of *trans*-resveratrol, whereas Çerezlik PI-355276, Çerezlik 5025, and Gazipaşa genotypes, with large sizes, have 1.80, 1.92, and 1.08 μg of *trans*-resveratrol/g, respectively. According to our findings, because Çerezlik PI-355276 and Çerezlik 5025 have high levels of *trans*-resveratrol, it is supposed that there is more resveratrol accumulation in more mature genotypes ($n = 12$) ($p < 0.01$). Genotype differences and synergistic effects are also important factors.

Recently, resveratrol has been also observed in peanut kernel (*24*) and in roots (*25*, *26*). Lee et al. (*27*) reported 0.09−0.30 μg of *trans*-resveratrol/g in edible peanuts, whereas Chung et al. (*28*) determined 0.05−0.06 μg/g of fresh weight of *trans*-resveratrol in developing seeds and seed coats of field-grown peanuts. Our results are also in accordance with these studies and significantly higher than these described studies (**Table 1**). Stilbene contents in field-grown fruits may also be affected by a wide range of environmental effects including temperature, soil, light levels, the nutritional condition of the plant, and pathogen attack (*12*). Fungal infection such as *B. cinerea* occurs on the tree and is known as gray spoilt factor in the plant; *Botrytis* infection may develop at −1 °C (*29*).

***trans*- and *cis*-Resveratrol in Genotype Cultures and Market Samples.** Research samples were exposed to UV light at 366 nm for 1 min according to the method reported by Siemann and Creasy (*17*), and *trans*-resveratrol conversion to the *cis*-form in samples was performed. Ten microliters of standard *trans*-resveratrol in a screw-capped vial was converted to the *cis*-form and a (*trans* + *cis*) standard mixture obtained on the basis of a similar procedure. It was found that the *cis* isomer average retention time was 5.29 min in samples and 5.30 min in the standard. In 11 genotypes and 4 market samples, the *trans*-resveratrol concentration of peanut and pistachio samples ranged from 0.03 to 1.48 μg/g and *cis*-resveratrol content from 0.01 to 0.33 μg/g ($n = 12$) ($p < 0.01$) (**Table 2**).

***trans*- and *cis*-Resveratrol Identification in Samples by GC-MS.** Confirmation of the occurrence of resveratrol in Turkish peanut and pistachio varieties was obtained by GC-MS with flame ionization detection (FID). **Figure 4A** shows the total ion chromatogram (TIC) of the BSTFA derivative of resveratrol standard. Panels **B** and **C** of **Figure** exhibit TIC of BSTFA derivatives of pistachio (Siirt) and peanut (Çerezlik 355276) varieties, respectively. With HPLC data and TIC provided by GC-MS, resveratrol compounds from the extract had retention times identical to that of the standard. *trans*- and *cis*-resveratrol and hydroxylated stilbene derivatives of samples had fragmentation patterns similar to that of the resveratrol standard. Thus, the occurrence of resveratrol in peanuts and pistachios has been confirmed.

In TIC of TMS derivatives of resveratrol standard and samples based on molecular ion and *m*/*z* mass spectrometric data, *trans*-resveratrol and *cis*-resveratrol and hydroxylated stilbene derivative peaks were also identified **(Figure 4A−C)**. Peak retention times of derivatized *trans*-resveratrol standard, pistachio Siirt extract, and peanut Çerezlik 355276 extract were similar and were 14.69, 14.69, and 14.70 min, respectively. Also, MS ions and abundance were similar and fragmentation patterns were identical. The retention times of derivatized *cis*-resveratrol standard, pistachio Siirt extract, and peanut Çerezlik 355276 extract were also similar and were 14.85, 14.84, and 14.84 min, respectively. Their characteristic MS (*m*/*z*) data and fragmentation patterns were also similar.

No detailed study could be found regarding the *cis*-isomer occurring in peanut and pistachio spreads by UV light exposure. Qualitative *cis*-isomer identification in peanuts has been reported, but no quantitative analysis of samples (*11*). If the transformation from *trans*-resveratrol to *cis*-isomer is reported as percent between peanut genotypes, the order is Çerezlik PI-355276 > Çerezlik 5025 > Gazipaşa > Çom >Florispan > NC-7. The *trans*-resveratrol in Çerezlik PI-355276 is changed to the *cis*-isomer as the highest ratio (**Table 2**).

It is reported that peanut and pistachio varieties grown in Turkey are excellent potential sources of phytoalexin resveratrol compounds for human nutrition due to their nutraceutical effects, and our detection method is reproducible for the objective identification of resveratrol. In this context, especially, resveratrol contents of pistachios are a step toward further utilization of pistachios in the food industry. Data such as those reported in this study could have a significant economic impact for the pistachio industry. A study concerning processing effects such as roasting and storage conditions of peanuts is also in progress.

ACKNOWLEDGMENT

We thank Akdeniz Agricultural Research Institute, Antalya and Gaziantep Pistachio Research Institute, Gaziantep, for material support.

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Received for review March 6, 2005. Revised manuscript received April 10, 2005. Accepted April 11, 2005. We thank Ege University Research Fund Project (No. 2000-022) for financial support.

JF050496+