Table S1. Rotated factor loadings, eigenvalues and variances explained of the three first principal components

Variables	PC1	PC2	PC3	Variables	PC1	PC2	PC3
β-Sesquiphellandrene	**0.985**	-0.034	0.093	Heptadecanoic acid	-0.115	-0.082	**0.909**
Pyran aldehyde	**0.985**	-0.034	0.095	α-Muurolene	0.014	0.369	**0.908**
α-Bergamotene	**0.981**	-0.035	0.090	Hydroxtyrosol	-0.420	0.165	**0.889**
(E)-3-Hexen-1-ol acetate	**0.976**	-0.007	0.129	Decanoic acid	-0.326	0.293	**0.858**
Octanoic acid	**0.971**	-0.032	0.098	Heneicosanoic acid	-0.449	0.135	**0.855**
Hexyl acetate	**0.918**	-0.291	0.067	Vanilic acid	-0.032	0.076	**0.851**
Trans-ferrulic acid	**0.916**	-0.182	-0.183	Cyclosativene	0.092	0.262	**0.828**
1-Hexanol	**0.891**	0.325	-0.009	a-Copaene	-0.453	0.309	**0.821**
Caffeic acid	**0.872**	0.014	-0.250	Stearic acid	-0.356	-0.369	**0.765**
Tyrosol	**0.864**	-0.411	-0.201	10-Heptadecanoic acid	0.398	0.370	**0.667**
Benzaldehyde	**0.792**	0.239	-0.243	Total phenolic content	**-0.898**	0.095	-0.269
Free fatty acid	**0.788**	0.229	0.496	(E)-2-Hexenal	**-0.867**	0.437	-0.114
Pinoresinol	**0.772**	-0.287	-0.216	Tricosanoic acid	**-0.540**	-0.648	-0.132
Chlorophyll	**0.761**	0.165	-0.039	3-Ethyl-1,5-octadiene	**-0.521**	0.023	0.188
Luteolin	**0.753**	0.173	-0.415	Ethanol	**-0.506**	-0.129	-0.742
4-Hexanedienal	**0.747**	0.394	-0.172	(E)-2-Decenal	-0.290	**-0.907**	-0.071
Phenylethanol	**0.743**	0.277	-0.265	Oleic acid	-0.148	**-0.840**	0.022
(Z)-3-Hexen-1-ol	**0.738**	0.195	0.599	3-Hexenal	-0.445	**-0.833**	0.263
α-Curcumene	**0.736**	-0.216	0.401	MUFAs	-0.145	**-0.831**	-0.029
Carotenoids	**0.704**	0.138	-0.102	(E)-4,8-Dimethyl-1,3,7-nonatriene	-0.494	**-0.829**	-0.073
Palmitic acid	**0.595**	-0.051	-0.752	1-Penten-3-ol	-0.185	**-0.820**	-0.453
11-Eicosenoic acid	**0.589**	0.183	0.244	(Z)-2-Penten-1-ol	0.314	**-0.779**	-0.386
p-Qumaric acid	**0.507**	0.336	-0.717	Docosanoic acid	0.388	**-0.734**	0.387
PUFAs	0.049	**0.935**	0.109	1-Pentanol	0.032	**-0.716**	-0.262
Linoleic Acid	0.086	**0.931**	0.116	Eicosanoic acid	0.251	**-0.695**	0.153
Catechin	-0.193	**0.879**	-0.308	Apigenin	-0.157	**-0.539**	-0.632
K_{270}	0.016	**0.813**	0.272	SFAs	0.352	**-0.527**	-0.306
Linolenic acid	-0.548	**0.789**	-0.026	9-Hexadecenoic acid	-0.124	0.007	**-0.940**
(Z)- β-Ocimene	-0.512	**0.761**	0.006	Pyridine	-0.264	0.488	**-0.576**
K_{232}	0.311	**0.737**	-0.276	(E)-2-Heptenal	-0.264	0.489	**-0.575**
Oleuropin	-0.496	**0.717**	-0.127	Phenylmethanol	-0.256	0.484	**-0.557**
Nonanal	0.212	**0.579**	0.557	2-Ethylhexanol	0.365	0.443	-0.489
Pentadecanoic acid	0.198	**0.559**	0.434	1,2-Dimethyl benzene	-0.184	0.132	-0.408
(E)-2-Hexen-1-ol	-0.461	**0.544**	0.609	(E)-2-Pentenal	0.496	-0.289	-0.406
Hexanal	0.027	**0.515**	0.312	Pentanal	-0.085	0.181	-0.335
5-Ethyl-2(5H)-furanone	0.385	**0.506**	-0.067	Methylbenzene	-0.086	0.181	-0.335
Total antioxidant capacity	-0.289	0.250	**0.918**	Peroxide value	0.254	-0.427	0.141

	PC1	PC2	PC3
Variance explained of total varince	29.80%	23.89%	21.81%
Sum of variance		75.50%	
Eigenvalues	22.43	18.82	14.63

Table S2. Morphological and quality characteristics of the olive plant/fruit variety used in the study [62]

Phenolic compound	Edincik	Ayvalık	Domat	Uslu	Gemlik
Flower bud					
Length	short	Medium	medium	medium	short
Number of flowers	small	medium	small	small	small
Leaf					
Shape	long-elliptical	long-elliptical	long-elliptical	long-elliptical	long-elliptical
Length	long	medium	medium	medium	medium
Width	medium	medium	medium	medium	medium
Fruit					
Weight	medium	medium	extra-large	medium	medium
Shape	oval	oval	elliptical	oval	oval
Symmetry	symmetrical	symmetrical	symmetrical	slight-symmetrical	slight-symmetrical
Widest point	towards tip	central	central	central	central
Fruit tip	round	round	round	pointed	round
Stem part	cut	round	round	round	cut
Stone					
Weight	medium	medium	large	large	medium
Shape	elliptical	oval	long	elliptical	oval
Symmetry	symmetrical	symmetrical	symmetrical	asymmetric	slight-symmetrical
Widest point	towards tip	near-end	central	central	towards tip
Stone tip	pointed	pointed	pointed	pointed	round
Stem part	pointed	cut	pointed	pointed	round
Surface	rough	rough	rough	rough	rough
Tip point	pinpoint	pinpoint	pinpoint	pinpoint	pinpoint
Quality features					
Number of fruits (kg)	311	291	140	260	273
Pulp ratio (%)	89	89	88	88	86
Stone ratio (%)	11	11	12	12	14
Oil ratio (%)	low (<18%)	high (>22%)	low (<18%)	low (<18%)	high (>22%)

Edincik

Ayvalık
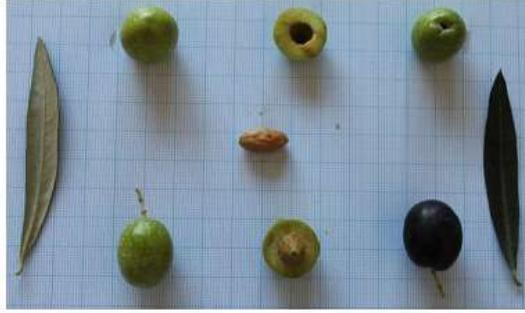
Domat

Uslu

Gemlik

Figure S1. Fruits, leaves and seeds of olive varieties used [63]

Materials and Methods

Phenolic compounds (PC) analysis

The analysis of phenolic fractions in samples was carried out using a Water Alliance e2695 HPLC (Waters, Milford, MA, USA) system, consisting of a photodiode array detector (PDA) (Waters 2996, Milford, MA, USA) and an inertSustain C18 (5μm, 4.6 x 250 mm, GL Sciences, Tokyo, Japan). The phenolic extract was filtered through a 0.45 μm polyvinylidine fluoride (PVDF) syringe filter before the injection into the system. The operational procedures of the HPLC were performed as described by Veneziani et al. (2018) [8], with some modifications. The mobile phases were ultrapure water acidified to pH 2.10 with phosphoric acid (A) and methanol: acetonitrile (90:10, v/v) mixture (B). The flow rate was 1.0 mL/min and the total run time was 73 min. The elution gradient was as follows: 95% A and 5% B for 2 min, 75% A and 25% B in 8 min, 60% A and 40% B in 10 min, 50% A and 50% B in 16 min, 0% A and 100% B in 14 min. This last composition was sustained for 10 min and then returned to the initial composition within 13 min. The quantification PC was performed with calibration curve for each available commercial standard. The phenolic alcohols (hydroxytyrosol, tyrosol), oleuropein, phenolic acids (*p*-qumaric, *t*-ferrulic, caffeic and vanilic acids), catechin and pinoresinol were detected at 280 nm, while apigenin and luteolin were detected at 335 nm. Results were expressed as mg.kg^{-1}.

Volatile compounds (VC) analysis

A 2 g of oil sample was weighed in a 20 mL SPME vial (Supelco) and 10 μL of isobutyl acetate (500 mg.L^{-1}) solution was added as an internal standard (IS). The vial was closed with a screw cap with a silicone septum and placed into the tray of the autosampler. The rest of SPME operations were applied on the autosampler. The sample vial was maintained in the heating block at 40 C° for 30 min under an agitation at 220 rpm. Then, a divinlybenzene/carboxen/polydimethylsiloxane (DVB/CAR/PDMS) fiber (2 cm, 50/30 μm, Supelco) was inserted to the vial and exposed to the headspace of the vial at the same conditions for 25 min.

After extraction, the VC were desorbed thermally from the fiber in the injection port of the GC at 250 C° for 5 min, with a splitless mode. The separation was achieved with a DB-HeavyWax column (0.25 μm, 60 m x 0.25 mm) (Agilent Technologies). Hydrogen was used as the carrier gas at a flow rate 1.05 ml.min-1. The oven temperature was first kept at 40 C° for 2 min, then increased to 80 C° at a rate of 3 C°.min-1 and held at this temperature for 1 min. and then was programmed to 240 C ° at a rate of 5 C°.min-1 and held at this temperature for 6 min. The temperatures of ion source and the interface of MS were 201 C° and 250 C°, respectively. Electron ionizing (EI mode) energy was recorded at at 70 eV. Mass scanning range was m/z 20-450.

The identification of VC was performed by comparing their mass spectra with those of NIST11 and Wiley9 mass spectral libraries and literature. Additionally, the many identifications were confirmed by comparing VC retention indices (Kovats Index) with those available in the literature. The quantifications of VC were calculated by matching the peak area of each compound to the calibration curves of IS, and expressed as mg per kg of sample.