

Supplementary Information for

Chemical and Sensory Characteristics of Different Red Grapes Grown in Xinjiang, China: Insights into Wines Composition

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Supplementary Figures

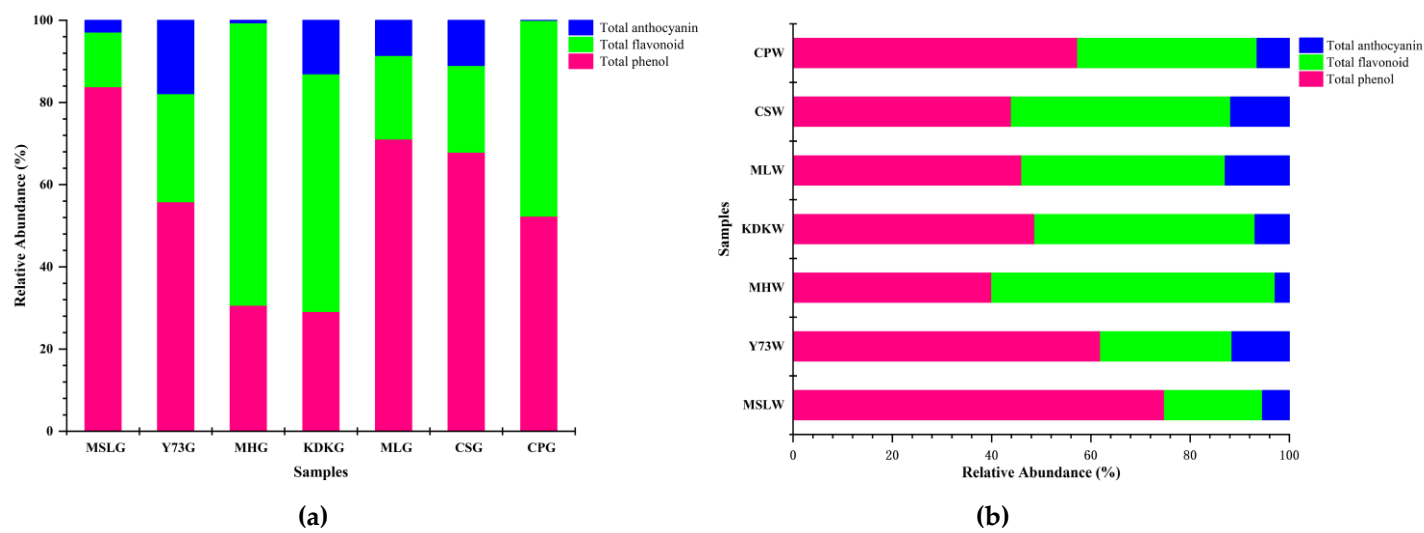


Figure S1. The relative abundance of total anthocyanin, total flavonoid, total phenol in seven grape cultivars (a) and corresponding wines (b). Samples' full names are as follows: MSL (Marselan), Y73 (Yan 73), MH (Muscat Hamburg), KDK (Kadarka), ML (Merlot), CS (Cabernet Sauvignon) and CP (Crimpose). Furthermore, G represents "grape" and W represents "wine".

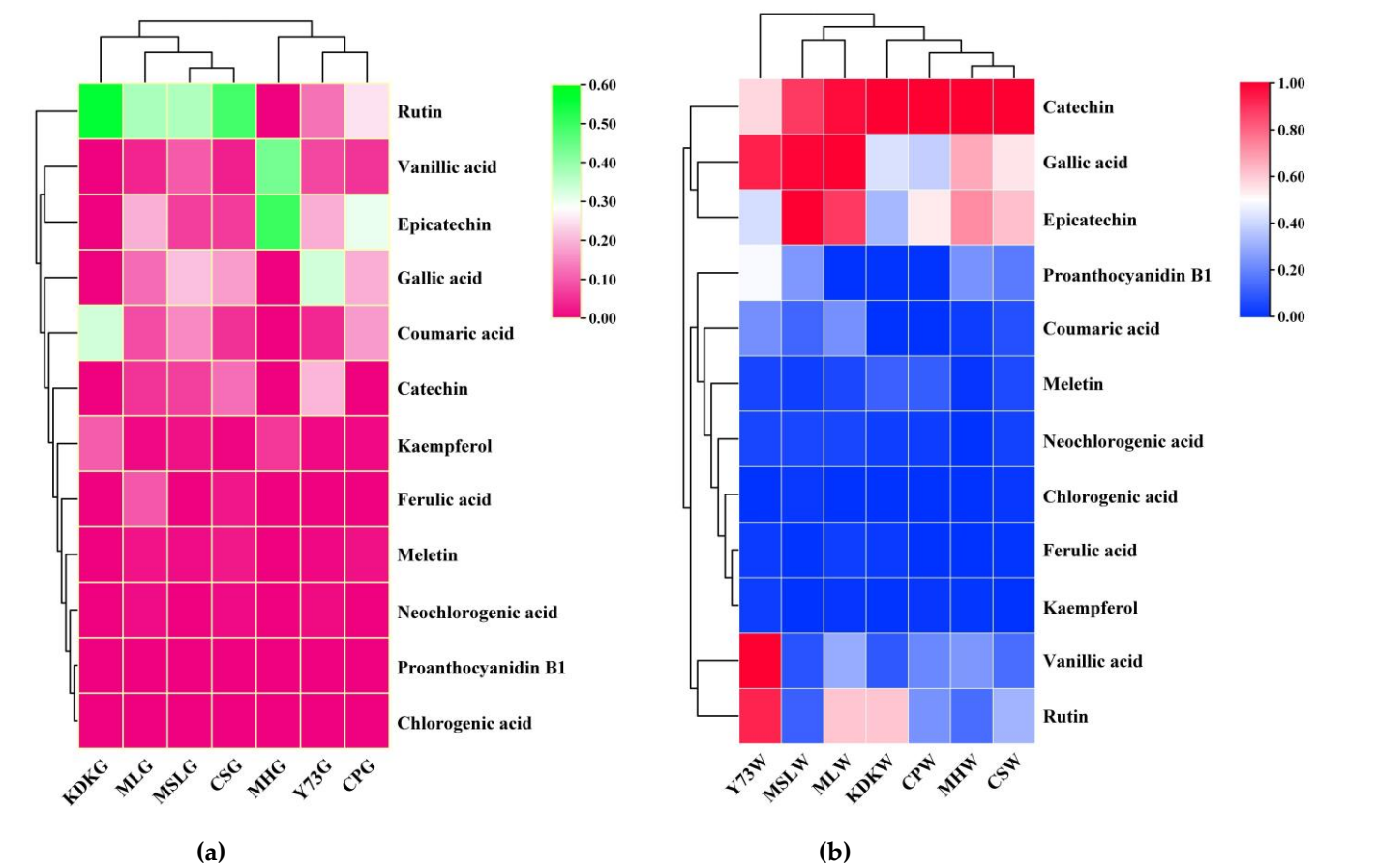


Figure S2. The clustering analysis of twelve phenolic compounds in seven grape cultivars (a) and corresponding wines (b). Samples' full names are as follows: MSL (Marselan), Y73 (Yan 73), MH (Muscat Hamburg), KDK (Kadarka), ML (Merlot), CS (Cabernet Sauvignon) and CP (Crimpose). Furthermore, G represents "grape" and W represents "wine".

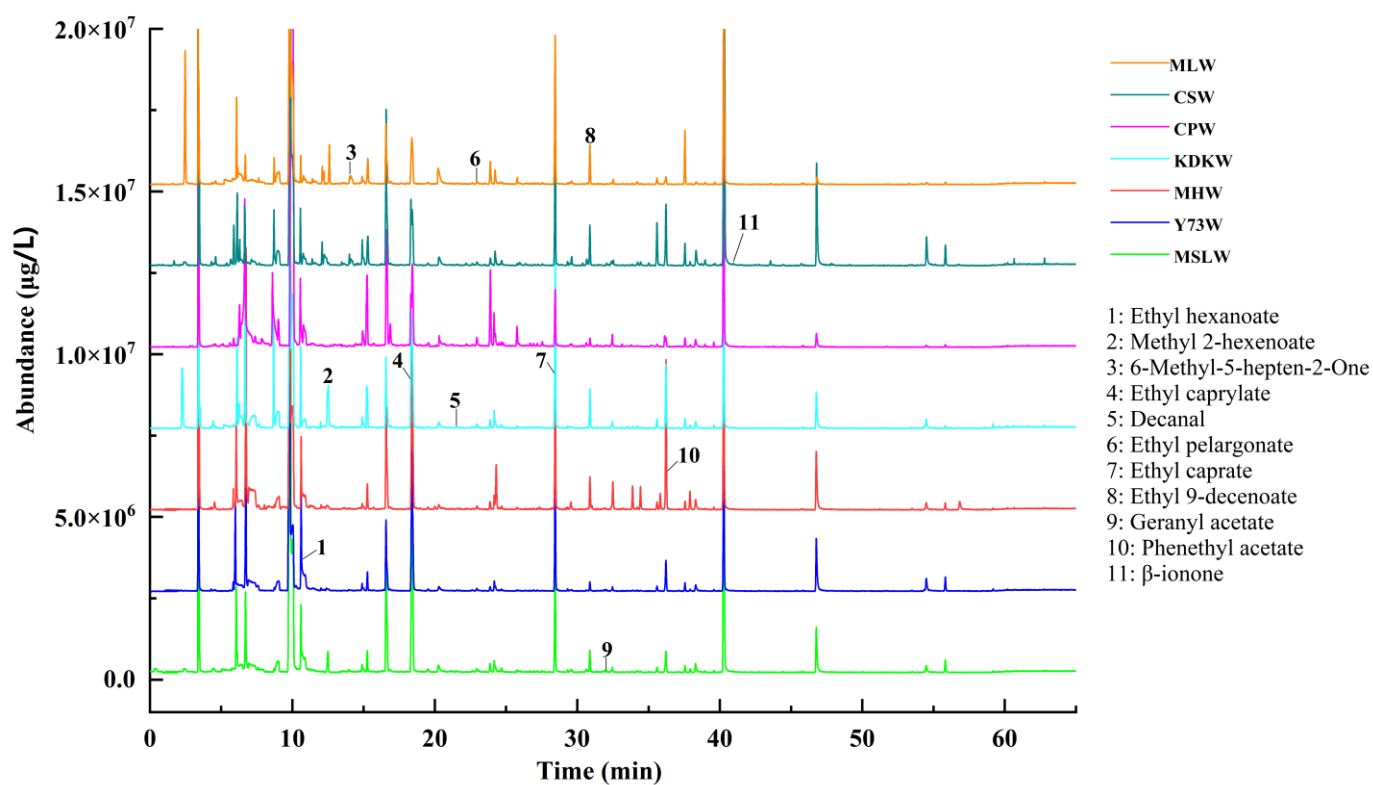


Figure S3. Overlay of the main ion chromatograms of seven varieties of wine. Samples' full names are as follows: MSL (Marselan), Y73 (Yan 73), MH (Muscat Hamburg), KDK (Kadarka), ML (Merlot), CS (Cabernet Sauvignon) and CP (Crimpose). Furthermore, W represents "wine".

Supplementary Tables

Table S1. Antioxidant activity (mmol TE/L) in seven varieties of wine.

Variety	Radical scavenging capacity		Reducing capacity	
	ABTS ⁺	DPPH	FRAP	CUPRAC
MSLW	20.29 ± 7.39bc	13.81 ± 0.63b	65.4 ± 0.48b	18.17 ± 0.85b
Y73W	24.85 ± 1.75a	17.81 ± 0.56a	102.68 ± 4.05a	21.97 ± 0.56a
MHW	12.81 ± 8.05d	9.12 ± 0.49d	35.44 ± 2.34d	12.82 ± 0.52c
KDKW	8.29 ± 4.76e	9.31 ± 0.45d	20.86 ± 0.78f	6.74 ± 0.37e
MLW	18.61 ± 1.07c	9.96 ± 0.28d	34.26 ± 1.33d	11.47 ± 0.18d
CSW	22.01 ± 7.31b	12.31 ± 0.77c	25.98 ± 0.36e	10.72 ± 0.72d
CPW	20.95 ± 0.83b	12.16 ± 0.56c	56.34 ± 0.85c	18.04 ± 0.64b

1. Samples' full names are as follows: MSL (Marselan), Y73 (Yan 73), MH (Muscat Hamburg), KDK (Kadarka), ML (Merlot), CS (Cabernet Sauvignon), and CP (Crimpose). Furthermore, G represents "grape" and W represents "wine". 2. Mean values and standard deviations followed by different letters in a column indicate that the samples were significantly different ($p < 0.05$, Tukey's HSD test).

Table S2. Selected volatile compounds found in seven varieties of grapes (µg/kg).

Compounds	RI	MSLG	Y73G	MHG	KDKG	MLG	CSG	CPG	¹ Odor threshold (µg/L)	² OAV	³ Odors
Alcohols											
3-methyl-2-pentanol	1173	5.59 ± 0.34b	1.41 ± 0.01cd	ND	ND	2.06 ± 0.08c	36.43 ± 2.32a	0.59 ± 0.23cd	50000	<0.1	nf
2-hexanol	1184	ND	0.32 ± 0.09b	ND	ND	ND	5.05 ± 1.24a	ND	14000	<0.1	Resinous, flowery, born green
Eucalyptol	1204	ND	ND	ND	ND	ND	0.52 ± 0.05a	ND	nf	<0.1	nf
Isoamyl alcohol	1206	4.38 ± 0.60b	ND	2.81 ± 0.03c	ND	2.33 ± 0.29d	2.13 ± 0.17d	6.52 ± 0.17a	5000	0.1-1	Whiskey, malt
1-Hexanol	1355	11.10 ± 0.37cd	6.92 ± 0.20d	ND	ND	15.20 ± 0.18c	95.78 ± 9.79a	25.50 ± 0.32b	150	0.1-1	Green, herb
(Z)-2-Hexen-1-ol	1415	ND	5.97 ± 0.11c	ND	ND	2.61 ± 1.02d	39.65 ± 1.25a	8.06 ± 1.25b	nf	— —	Fruity, unripe banana
1-Heptanol	1457	ND	ND	ND	ND	ND	0.82 ± 0.02a	ND	1000	<0.1	Fruity, waxy flavor, born green
2,3-Butanediol	1545	ND	ND	ND	ND	ND	2.39 ± 0.06a	ND	150000	<0.1	nf
1-Octanol	1557	0.46 ± 0.07b	0.24 ± 0.01c	ND	ND	ND	0.37 ± 0.14bc	1.00 ± 0.14a	120	<0.1	Fresh orange, rose, sweet herb
1-Nonanol	1654	0.40 ± 0.10b	0.09 ± 0.03d	ND	ND	0.59 ± 0.06a	0.23 ± 0.06c	0.47 ± 0.06b	58	0.1-1	Green
α-Terpineol	1697	ND	0.30 ± 0.12a	ND	ND	ND	0.14 ± 0.01b	ND	330	<0.1	nf
Nerol	1805	0.98 ± 0.15b	1.64 ± 0.06a	ND	ND	ND	ND	ND	3600	<0.1	Rose, lemon
Benzyl alcohol	1870	1.51 ± 0.03c	1.05 ± 0.03c	ND	ND	5.06 ± 0.16b	11.33 ± 1.27a	1.62 ± 0.09c	200000	<0.1	Sweet, fruity
Phenylethyl alcohol	1906	5.84 ± 2.02d	3.94 ± 0.06d	37.51 ± 3.46a	ND	11.13 ± 1.05c	23.99 ± 2.34b	5.04 ± 0.13d	10000	<0.1	Rose, sweet
Esters											
Ethyl Acetate	890	ND	ND	ND	ND	5.12 ± 2.04a	2.76 ± 0.05b	ND	7500	<0.1	Fruity, sweet
Ethyl butyrate	1036	ND	ND	130.77 ± 6.89a	ND	13.48 ± 3.09b	2.02 ± 0.01c	ND	20	0.1-1	Sour fruity, fruity
Isoamyl acetate	1123	0.49 ± 0.15a	ND	ND	ND	ND	ND	0.53 ± 0.15a	30	>1	Banana, sweet
Ethyl hexanoate	1232	ND	ND	ND	ND	4.49 ± 1.05a	2.55 ± 0.07b	3.06 ± 1.23b	5	>1	Fruity, green apple, floral, violet
Ethyl 3-Methyl valerate	1245	7.27 ± 0.25a	0.67 ± 0.03c	ND	ND	ND	5.21 ± 0.04b	ND	360	0.1-1	Pineapple
Hexyl acetate	1275	ND	ND	ND	ND	7.83 ± 2.09a	ND	ND	670	<0.1	Fruity, peer, cherry
Methyl 2-hexenoate	1296	9.02 ± 0.24c	ND	ND	ND	43.56 ± 3.19a	28.61 ± 1.17b	1.68 ± 0.24d	1.5	>1	nf
Methyl caprylate	1390	11.23 ± 0.15c	ND	66.96 ± 4.37a	ND	34.67 ± 6.29b	10.63 ± 2.19c	ND	320	0.1-1	nf
Ethyl caprylate	1437	1.49 ± 0.23bc	1.91 ± 0.13b	ND	ND	3.48 ± 0.69a	3.74 ± 0.27a	1.16 ± 0.27c	580	>1	Fruity, apple, pineapple, brandy
Ethyl pelargonate	1535	1.73 ± 0.09b	ND	ND	ND	2.37 ± 0.01a	1.19 ± 0.07c	ND	0.1	>1	Fruity, grape, rose

Octyl formate	1563	1.03 ± 0.14b	ND	ND	ND	1.45 ± 0.04a	ND	ND	25482	<0.1	Fruity
Methyl decanoate	1591	ND	ND	6.29 ± 2.89a	ND	ND	0.41 ± 0.01b	ND	3	0.1-1	nf
Ethyl caprate	1639	2.13 ± 0.03c	ND	ND	ND	20.79 ± 1.89a	10.39 ± 0.06b	2.71 ± 0.06c	200	>1	Coconut fragrance
Ethyl benzoate	1663	ND	0.22 ± 0.03a	ND	ND	ND	ND	ND	95	0.1-1	Orange, flowery,
Diethyl succinate	1682	ND	ND	ND	ND	0.43 ± 0.06a	0.33 ± 0.04b	ND	200000	<0.1	nf
Ethyl 9-decenoate	1694	0.29 ± 0.01b	0.14 ± 0.02c	ND	ND	ND	1.53 ± 0.01a	ND	100	>1	Green, fruity, fatty
Geranyl acetate	1760	0.52 ± 0.19a	ND	ND	ND	ND	ND	ND	11000	>1	Rose, lemon
Propyl benzoate	1765	0.20 ± 0.04d	0.47 ± 0.04c	ND	ND	2.35 ± 0.04a	ND	0.63 ± 0.04b	6550	<0.1	Fruity, nutty
Methyl salicylate	1792	0.11 ± 0.03b	0.08 ± 0.01b	ND	ND	9.05 ± 0.49a	ND	ND	500	<0.1	Holly flavor
Citronellyl formate	1770	0.81 ± 0.34a	0.09 ± 0.04b	ND	ND	0.16 ± 0.09b	ND	0.28 ± 0.15b	5	0.1-1	Fruity, rose, melon
Ethyl phenylacetate	1804	0.29 ± 0.12a	ND	ND	ND	ND	0.01±0.01b	ND	250	<0.1	Fruity, sweet
linalyl formate	1830	0.53 ± 0.11a	0.31 ± 0.01b	ND	ND	ND	ND	ND	56	0.1-1	Lemon, herb, orange
Phenethyl acetate	1936	1.71 ± 0.17bc	ND	1.94±0.09b	ND	1.34 ± 0.04d	1.5 ± 0.04c	2.09 ± 0.04a	45.5	>1	Rose, honey, tobacco flavor
Ethyl laurate	1835	0.27 ± 0.18c	ND	ND	ND	0.58 ± 0.03b	0.82 ± 0.02a	ND	500	<0.1	Sweet, floral, fruity
Aldehydes											
Hexanal	1089	ND	8.55 ± 0.12e	22.34 ± 2.34d	43.45 ± 5.78b	4.13 ± 0.59a	13.2 ± 0.04e	ND	1088	>1	Green, fruity
2-Hexene aldehyde	1228	0.14 ± 0.07e	26.29 ± 0.43d	66.68 ± 6.54c	106.76 ± 8.34a	8.18 ± 1.48ef	90.43 ± 3.78b	6.71 ± 0.16f	24.2	>1	Green, fruity
2,4-Nonadienal, (E,E)-	1478	15.35 ± 0.47b	1.71 ± 0.9bc	ND	ND	3.33 ± 0.27a	1.45 ± 0.27bc	0.99 ± 0.27c	123.23	<0.1	Flowery, oil incense, chicken soup flavor
Decanal	1495	2.02 ± 0.39c	0.82 ± 0.04b	ND	ND	1.63 ± 0.15a	0.96 ± 0.15b	0.41 ± 0.15c	0.1	>1	Orange
Benzaldehyde	1520	0.44 ± 0.12c	1.57 ± 0.85c	ND	ND	9.44 ± 1.39a	6.41 ± 0.78b	1.94 ± 0.78c	800	<0.1	Bitter almond, nut
Benzaldehyde, 2,5-dimethyl	1829	1.51 ± 0.06d	5.42 ± 0.03a	ND	ND	4.08 ± 1.28b	2.49 ± 0.02c	0.51 ± 0.02	40	0.1-1	nf
Acids											
Acetic acid	1463	7.47 ± 0.46b	1.35 ± 0.02c	ND	ND	48.97 ± 4.58a	2.73 ± 1.16c	10.07 ± 1.16b	200000	<0.1	sour
Hexanoic acid	1855	2.50 ± 0.07d	4.25 ± 0.06c	ND	ND	7.10 ± 1.27a	4.87 ± 1.27bc	5.80 ± 1.27ab	420	<0.1	Cheese, rancid
Butanoic acid	1950	0.28 ± 0.13a	ND	ND	ND	ND	ND	ND	2200	<0.1	Sharp, cheesy, rancid
2-Hexenoic acid	1967	0.01 ± 0d	0.70 ± 0.01b	ND	ND	0.54 ± 0.04c	1.78 ± 0.04a	0.73 ± 0.04b	3000	<0.1	Fatty
Octanoic acid	2060	0.58 ± 0.25cd	0.77 ± 0.04bc	ND	ND	0.50 ± 0.12d	0.93 ± 0.12b	1.60 ± 0.12a	500	0.1-1	Rancid, cheese, fatty acid
n-Decanoic acid	2276	0.04 ± 0.03c	0.21 ± 0.05a	ND	ND	ND	0.15 ± 0.01b	ND	1000	<0.1	Fatty, unpleasant
Nonanoic acid	2171	ND	ND	5.03 ± 1.34a	ND	ND	ND	ND	800	<0.1	Cheese, waxy flavor

Dodecanoic Acid	2276	0.12 ± 0.01b	ND	6.53 ± 2.51a	ND	0.22 ± 0.14b	0.5 ± 0.02b	ND	1000	<0.1	Daurel oil flavor
Ketones											
Acetoin	1284	19.4 ± 0.37a	ND	ND	ND	1.34 ± 0.09b	0.18 ± 0.01c	0.13 ± 0.01c	150000	<0.1	Buttery, fatty
3-Octanone	1258	0.40 ± 0.12d	1.09 ± 0.04c	ND	ND	2.05 ± 1.03b	ND	3.04 ± 0.07a	890	<0.1	Soup, gas
6-Methyl-5-hepten-2-One	1338	ND	ND	ND	ND	13.76 ± 2.32a	8.18 ± 0.03b	ND	0.068	>1	nf
Isophorone	1578	0.76 ± 0.21b	0.66 ± 0.01b	ND	ND	ND	1.46 ± 0.01a	ND	2546.21	<0.1	Camphor
β-damascenone	1833	ND	3.45 ± 0.04a	ND	ND	ND	ND	ND	0.05	<0.1	Apple, rose, sweet
Geranyl acetone	1858	ND	ND	ND	ND	1.05 ± 0.09a	0.29 ± 0.04b	ND	60	<0.1	Rose
β-ionone	2308	ND	ND	ND	ND	ND	0.28 ± 0.07a	ND	0.09	>1	Violet
Others											
Limonene	1198	ND	ND	110.34 ± 4.78a	ND	1.31 ± 0.07b	ND	ND	200	0.1-1	Lemon
Styrene	1267	7.82 ± 0.71b	3.72 ± 0.63c	ND	ND	5.67 ± 2.31bc	5.98 ± 1.02bc	16.53 ± 2.56a	650	<0.1	nf
Geranyl acetone	1858	ND	ND	ND	ND	1.05 ± 0.09a	0.29 ± 0.04b	ND	60	<0.1	Rose
β-ionone	2308	ND	ND	ND	ND	ND	0.28 ± 0.07a	ND	0.09	>1	Violet

Mass spectrum and Kovats index agreed with literature data. Data were expressed as the means ± standard (n = 3). The different lowercase letters in each row indicate a significant difference between the samples (P < 0.05). ¹Odor threshold value were referred literature 104-107 (in manuscript). ²OAV was calculated by dividing by the odor threshold value of the compound. The scope of OAV is shown but not the specific value. The ND represented not detected. ³Odors were referred literature 86-92 (in manuscript).

Table S3. Selected volatile compounds found in seven varieties of wine (µg/L).

Compounds	RI	MSLW	Y73W	MHW	KDKW	MLW	CSW	CPW	¹ Odor threshold (µg/L)	² OAV	³ Odors
Alcohols											
Isopropyl alcohol	1209	ND	ND	ND	ND	1.42 ± 0.02b	ND	160.27 ± 6.73a	30000	<0.1	spicy
3-methyl-2-pentanol	1173	ND	ND	2.43 ± 0.06c	6.82 ± 0.13a	6.33 ± 0.29b	1.65 ± 0.1d	ND	50000	<0.1	nf
2-hexanol	1184	ND	ND	0.1 ± 0.02a	ND	ND	ND	ND	14000	<0.1	flowery, born green
Isoamyl alcohol	1206	2211.63 ± 104.28b	2867.63 ± 113.32a	1868.71 ± 99.1bc	3335.76 ± 130.65a	2249.06 ± 118.24b	1565.27 ± 115.71c	2190.88 ± 94.23d	5000	0.1-1	Whiskey, malt
1-Hexanol	1355	18.42 ± 0.55c	28.09 ± 1.25b	16.37 ± 0.25c	50.03 ± 2.59a	24.99 ± 0.71bc	51.05 ± 2.21a	33.27 ± 0.72b	150	0.1-1	Green, herb
(E)-3-Hexen-1-ol	1409	ND	ND	ND	ND	ND	0.81 ± 0.05a	ND	830	<0.1	Green grass, herb
(Z)-2-Hexen-1-ol	1415	ND	ND	ND	ND	ND	5.22 ± 0.34a	ND	nf	—	Fruity, unripe banana
1-Heptanol	1457	7.51 ± 0.09a	7.26 ± 0.41a	6.15 ± 0.32a	ND	ND	ND	6.07 ± 0.32a	1000	<0.1	Fruity, waxy flavor, born green
2,3-Butanediol	1545	19.28 ± 0.48b	15.78 ± 0.68b	17.59 ± 0.48b	40.93 ± 1.65b	111.02 ± 0.86a	16.07 ± 0.93b	142.33 ± 8.45a	150000	<0.1	nf
1-Octanol	1557	10.3 ± 0.24b	5.24 ± 0.14bc	7.26 ± 0.41bc	18.3 ± 0.75a	ND	11.62 ± 0.6b	5.56 ± 0.1bc	120	<0.1	Orange, rose, herb
1-Nonanol	1654	9.32 ± 0.2c	8.33 ± 0.06c	ND	ND	17.59 ± 0.77a	14.95 ± 0.37b	3.73 ± 0.26d	58	0.1-1	Green
α-Terpineol	1697	ND	0.27 ± 0.01cd	8.46 ± 0.44a	ND	2.1 ± 0.05b	0.5 ± 0.03c	ND	330	<0.1	nf
3-Methylthio propanol	1726	4.22 ± 0.19b	5.48 ± 0.02a	ND	ND	0.95 ± 0.02d	3.03 ± 0.11c	ND	8	0.1-1	Gravy flavor, oil
1-Decanol	1752	4.16 ± 0.17ab	ND	ND	8.33 ± 0.35a	ND	5.84 ± 0.2ab	1.34 ± 0.08b	400	<0.1	Orange flowery, special fatty
Nerol	1805	ND	ND	43.09 ± 0.98a	ND	ND	ND	ND	3600	<0.1	Rose, lemon
Benzyl alcohol	1870	1.93 ± 0.07c	ND	1.54 ± 0.05d	ND	9.55 ± 0.33a	9.36 ± 0.31a	4.13 ± 0.24b	200000	<0.1	Sweet, fruity
Phenylethyl alcohol	1906	989.29 ± 38.44b	599.58 ± 17.99c	522.04 ± 14.24c	538.35 ± 26.82c	1008.77 ± 5.98b	1475.8 ± 81.71a	495.16 ± 19.06c	10000	<0.1	Rose, sweet
Esters											
Ethyl Acetate	890	190.39 ± 1.34c	ND	ND	1056.12 ± 39.8b	1472.28 ± 50.52a	205.1 ± 1.4c	ND	7500	<0.1	Fruity,sweet
Ethyl butyrate	1036	18.8 ± 0.12a	ND	15.64 ± 0.43b	ND	4.01 ± 0.18a	ND	ND	20	0.1-1	Sour fruity, fruity
Ethyl trans-2-butenate	1168	6.92 ± 0.06a	ND	ND	ND	ND	ND	ND	1000	<0.1	nf
Ethyl hexanoate	1232	216.59 ± 7.15c	559.96 ± 14.19a	243.85 ± 12.61c	319.94 ± 16.68b	80.92 ± 4.09d	68.17 ± 3.51d	116.29 ± 6.96d	5	>1	Fruity, apple, floral,
Ethyl 3-Methyl valerate	1245	ND	ND	ND	ND	50.26 ± 2.27a	39.18 ± 2.7b	ND	360	0.1-1	Pineapple

Hexyl acetate	1275	ND	4.03 ± 0.22e	8.1 ± 0.19d	14.24 ± 0.59c	52.39 ± 1.15a	31.03 ± 2.02b	ND	670	<0.1	Fruity, peer, cherry
Methyl 2-hexenoate	1296	15.17 ± 0.66b	ND	ND	43.3 ± 1.91a	38.77 ± 1.84a	4.22 ± 0.19c	ND	1.5	>1	nf
Methyl caprylate	1390	37.61 ± 1.54bc	3.7 ± 0.18c	ND	ND	129.93 ± 5.91a	66.79 ± 0.46b	ND	320	0.1-1	nf
Ethyl caprylate	1437	609.4 ± 15.21b	887 ± 45.52a	599.24 ± 27.34b	931.73 ± 27.68a	389.53 ± 2.8c	132.96 ± 5.3d	311.82 ± 14.45c	580	>1	Fruity, apple, pineapple, brandy
Isopentyl hexanoate	1458	ND	ND	ND	6.68 ± 0.24b	12.71 ± 0.56a	5.56 ± 0.28c	ND	99000	<0.1	Apple, pineapple
Ethyl pelargonate	1535	1.28 ± 0.01b	ND	ND	ND	3.52 ± 0.16a	0.79 ± 0.05c	ND	0.1	>1	Fruity, grape, rose
Octyl formate	1563	2.97 ± 0.08b	ND	1.31 ± 0.04c	ND	7.85 ± 0.21a	ND	ND	25482	<0.1	Fruity
Methyl decanoate	1591	1.16 ± 0.04d	1.96 ± 0.11b	1.1 ± 0.05d	1.8 ± 0.04c	3.59 ± 0.11a	3.46 ± 0.15a	ND	3	0.1-1	nf
Ethyl caprate	1639	245.04 ± 10.85e	434.37 ± 25.16c	323.55 ± 13.07d	753.75 ± 38.72a	654.68 ± 16.89b	236.64 ± 6.62e	108.07 ± 6.88f	200	>1	Coconut fragrance
Isoamyl caprylate	1659	ND	5.52 ± 0.07b	ND	4.43 ± 0.22c	5.5 ± 0.31b	6.02 ± 0.23a	0.62 ± 0.03d	125	<0.1	nf
Ethyl benzoate	1663	ND	ND	22.37 ± 0.83a	10.58 ± 0.4b	6.3 ± 0.32c	4.17 ± 0.09d	ND	95	0.1-1	Orange, flowery,
Diethyl succinate	1682	7.93 ± 0.3a	5.94 ± 0.32b	0.76 ± 0.03e	ND	1.6 ± 0.09d	3.14 ± 0.14c	1.27 ± 0.06e	200000	<0.1	nf
Ethyl 9-decenoate	1694	42.4 ± 0.34bc	33.59 ± 0.44bc	3.28 ± 0.13c	145.95 ± 7.64a	159.35 ± 7.03a	66 ± 4.79b	14.54 ± 0.97bc	100	>1	Green, fruity, fatty
Geranyl acetate	1760	0.72 ± 0.03a	ND	ND	ND	ND	ND	ND	11000	>1	Rose, lemon
Propyl benzoate	1765	0.9 ± 0.01d	1.31 ± 0.06c	ND	5.36 ± 0.2a	2.72 ± 0.1b	0.43 ± 0.02e	0.5 ± 0.04e	6550	<0.1	Fruity, nutty
Methyl salicylate	1792	ND	1.3 ± 0.06c	6.01 ± 0.05b	ND	15.51 ± 0.72a	ND	ND	500	<0.1	Holly flavor
Citronellyl formate	1770	2.39 ± 0.11cd	1.42 ± 0.05de	50.06 ± 2.75a	3.67 ± 0.07c	2.75 ± 0.09cd	5.75 ± 0.39b	ND	5	0.1-1	Fruity, rose, melon
Ethyl phenylacetate	1804	0.95 ± 0.04d	ND	ND	ND	1.48 ± 0.05c	4.44 ± 0.19b	5.96 ± 0.44a	250	<0.1	Fruity, sweet
linalyl formate	1830	ND	ND	36.24 ± 1.2a	ND	ND	ND	ND	56	0.1-1	Lemon, herb, orange
Phenethyl acetate	1936	53.54 ± 2.12cde	126.44 ± 5.91c	363.24 ± 12.86a	254.08 ± 10.77b	47.11 ± 2.21de	111.62 ± 6.81cd	15.63 ± 0.79e	45.5	>1	Rose, honey, tobacco flavor
Ethyl laurate	1835	12.38 ± 0.4e	28.1 ± 0.75c	18.39 ± 0.6d	34.28 ± 1.32b	209.8 ± 5.4a	33.25 ± 1.91b	14.14 ± 0.58e	500	<0.1	Sweet, floral, fruity
Aldehydes											
2-Hexenal	1228	ND	ND	ND	ND	71.99 ± 58.54a	7.16 ± 0.12b	ND	24.2	>1	Green, fruity
2,4-Nonadienal, (E,E)-	1478	2.96 ± 0.1a	ND	ND	ND	ND	ND	ND	123.23	<0.1	Flowery, oil incense, chicken soup flavor
Decanal	1495	2.83 ± 0.08b	2.33 ± 0.09c	ND	5.76 ± 0.24a	ND	ND	ND	0.1	>1	Orange
Benzaldehyde	1520	3.94 ± 0.12b	3.91 ± 0.05b	1.03 ± 0.01c	4.17 ± 0.22b	5.61 ± 0.3a	3.92 ± 0.18b	ND	800	<0.1	Bitter almond, nut
Benzaldehyde, 2,5-dimethyl	1829	11.52 ± 0.43d	18.57 ± 0.55c	18.11 ± 0.93c	38.26 ± 0.52b	35.1 ± 1.16b	81.2 ± 5.76a	4.73 ± 0.13e	40	0.1-1	nf
Acids											
Acetic acid	1463	30.41 ± 0.9cd	38.12 ± 1.53cd	15.99 ± 0.19d	56.66 ± 2.94c	163.8 ± 7.06a	33.18 ± 0.47cd	114.17 ± 7.41b	200000	<0.1	sour
Isobutyric acid	1583	1.78 ± 0.04e	2.58 ± 0.12d	1.98 ± 0.05e	7.09 ± 0.14b	4.89 ± 0.23c	9.3 ± 0.39a	ND	200000	<0.1	nf
Hexanoic acid	1855	25.51 ± 0.85e	33.14 ± 1.1d	35.42 ± 1.28c	42.62 ± 2.05a	15.74 ± 0.15g	38.07 ± 2.02b	18.86 ± 0.18f	420	<0.1	Cheese, rancid

Butanoic acid	1950	1.85 ± 0.03b	ND	ND	ND	ND	3.4 ± 0.15a	ND	2200	<0.1	Sharp, cheesy, rancid
2-Hexenoic acid	1967	ND	ND	ND	ND	4.28 ± 0.2b	7.15 ± 0.06a	ND	3000	<0.1	Fatty
Octanoic acid	2060	127.38 ± 2.69c	272.09 ± 10.99a	197.23 ± 10.25b	202.89 ± 5.87b	47.85 ± 0.53d	228.21 ± 15.76a	36.82 ± 2d	500	0.1-1	Rancid, cheese, fatty acid
n-Decanoic acid	2276	20.46 ± 0.84cd	71.99 ± 2.24a	27.2 ± 0.82c	54.58 ± 2.38b	10.06 ± 0.41cd	66.65 ± 4.95ab	4.58 ± 0.19d	1000	<0.1	Fatty, unpleasant
Nonanoic acid	2171	ND	ND	ND	ND	ND	1.84 ± 0.07a	ND	800	<0.1	Cheese, waxy flavor
Dodecanoic Acid	2276	1.06 ± 0.04d	1.96 ± 0.04b	1.44 ± 0.06c	ND	2.24 ± 0.01a	1.99 ± 0.13b	ND	1000	<0.1	Daurel oil flavor
Ketones											
Acetoin	1284	ND	ND	ND	384.17 ± 8.87a	37.02 ± 1.16b	6.27 ± 0.04c	ND	150000	<0.1	Buttery, fatty
3-Octanone	1258	ND	ND	25.92 ± 1.38a	ND	2.22 ± 0.11d	6.79 ± 0.38c	8.61 ± 0.6b	890	<0.1	Soup, gas
Methyl-5-hepten-2-One	1338	ND	ND	ND	ND	89.11 ± 4.25a	21.5 ± 1.52b	ND	0.068	>1	nf
Isophorone	1578	2.97 ± 0.11b	ND	ND	ND	27.82 ± 1.22a	3.26 ± 0.19b	ND	2546.21	<0.1	Camphor
β-damascenone	1833	ND	ND	ND	ND	ND	ND	18.08 ± 1.17a	0.05	<0.1	Apple, rose, sweet
Geranyl acetone	1858	5.92 ± 0.14c	5.28 ± 0.25d	ND	12.51 ± 0.16a	1.4 ± 0.07f	6.7 ± 0.37b	2.17 ± 0.16e	60	<0.1	Rose
β-ionone	2308	0.48 ± 0.01c	ND	ND	1.39 ± 0.04b	ND	7.75 ± 0.51a	ND	0.09	>1	Violet
Others											
α-phellandrene	1160	ND	ND	27.92 ± 0.75a	ND	ND	11.45 ± 0.76b	ND	3000	<0.1	Mint, turpentine
β-myrcene	1160	69.18 ± 0.37a	ND	ND	ND	ND	ND	ND	100	0.1-1	nf
Limonene	1198	69.18 ± 2.34b	ND	0.35 ± 0.01c	ND	170.34 ± 8.83a	ND	ND	200	0.1-1	Lemon
Styrene	1267	14.06 ± 0.44b	5.67 ± 0.28c	1.53 ± 0.08e	ND	16.35 ± 0.5a	4.51 ± 0.2d	ND	650	<0.1	nf
2,4-Di-tert-butylphenol	2318	25.13 ± 0.63bc	51.76 ± 2.26ab	16.26 ± 0.64cd	8.9 ± 0.4d	9.44 ± 0.51d	35.83 ± 1.74b	4.47 ± 0.15d	200	0.1-1	Phenolic

Mass spectrum and Kovats index agreed with literature data. Data were expressed as the means ± standard (n = 3). The different lowercase letters in each row indicate a significant difference between the samples (P < 0.05). ¹Odor threshold value were referred literature 104-107 (in manuscript). ²OAV was calculated by dividing by the odor threshold value of the compound. The scope of OAV is shown but not the specific value. The ND represented not detected. ³Odors were referred literature 86-92 (in manuscript).