



















Supplementary material

Table S1 Information about six cultivars of red jujube in Xinjiang Province, China

Code	Cultivar	Origin	Traits		
QYX	Qiyuexian	Xinjiang, Akesu			
JC	Jinchang	Xinjiang, Akesu			
HTDZ	Hetiandazao	Xinjiang, Khotan			
YZ	Yuanzao	Xinjiang, Hami			
HZ	Huizao	Xinjiang, Charkhlik			
JZ	Junzao	Xinjiang, Khotan			

Note: Jinchang—'JC', Junzao—'JZ', Huizao—'HZ', Qiyuexian—'QYX', Hetiandazao—'HTDZ', and Yuanzao—'YZ'.

Table S2 Response characteristics and repeatability of response values of ten sensors in E-nose

Number	Sensors	Response characteristics	RSD%
1	W1C	aromatic compounds	0.18
2	W5S	nitroxide	4.54
3	W3C	ammonia and aromatic components	0.28
4	W6S	hydrogen selective	0.85
5	W5C	alkanes and aromatic components	1.65
6	W1S	methane	0.81
7	W1W	sulfides	0.65
8	W2S	ethyl alcohol	0.74
9	W2W	aromatic components and organic sulfide	0.59
10	W3S	alkanes	0.56

RSD: relative standard deviation

Table S3 The GC-IMS results of the volatile composition of the six red jujube cultivars.

	Compound	RI	Rt [sec]	Dt [a.u.]	Concentration($\mu\text{g/g}$)					
					Qiyuexian (QYX)	Jinchang (JC)	Hetianda zao (HTDZ)	Yuanzao (YZ)	Huizao (HZ)	Junzao (JZ)
Acids (14)	formic acid	568.30	130.64	1.16	0.30 \pm 0.08c	0.27 \pm 0.07a	0.32 \pm 0.03a	0.37 \pm 0.07b	0.26 \pm 0.14a	0.40 \pm 0.05d
	hexanoic acid	576.70	134.37	1.18	0.26 \pm 0.02ab	1.01 \pm 0.04a	0.26 \pm 0.08ab	0.40 \pm 0.04b	1.47 \pm 0.05c	0.42 \pm 0.11b
	propionic acid	659.50	170.83	1.44	0.05 \pm 0.02bc	0.08 \pm 0.01cd	0.06 \pm 0.01b	0.07 \pm 0.02a	0.18 \pm 0.02d	0.05 \pm 0.03a
	acetic acid	659.90	170.99	1.48	0.04 \pm 0.01d	0.06 \pm 0.04b	0.04 \pm 0.01d	0.06 \pm 0.04c	0.07 \pm 0.01a	0.04 \pm 0.01c
	isobutyric acid	749.20	234.36	1.56	0.58 \pm 0.02ab	1.26 \pm 0.02b	0.55 \pm 0.02a	0.73 \pm 0.01b	2.52 \pm 0.02c	0.83 \pm 0.01c
	3-methyl butanoic acid	749.20	234.36	1.45	0.14 \pm 0.02ab	0.37 \pm 0.05a	0.13 \pm 0.02a	0.22 \pm 0.04c	0.62 \pm 0.02b	0.27 \pm 0.01c
	pentanoic acid	844.30	333.33	1.61	2.16 \pm 0.03bc	1.30 \pm 0.03ab	2.83 \pm 0.05a	2.26 \pm 0.05a	0.96 \pm 0.03c	1.73 \pm 0.04d
	3-heptenoic acid	1055.60	692.06	1.53	3.22 \pm 0.02d	9.07 \pm 0.01c	3.26 \pm 0.01c	4.62 \pm 0.02d	10.95 \pm 0.02b	4.68 \pm 0.04a
	crotonic acid	807.30	290.37	1.41	1.91 \pm 0.01c	2.82 \pm 0.01b	1.90 \pm 0.02c	2.03 \pm 0.02b	1.84 \pm 0.01a	1.92 \pm 0.04c
	nonanoic acid	1024.20	632.73	1.39	0.21 \pm 0.01b	0.54 \pm 0.01a	0.74 \pm 0.01b	0.65 \pm 0.03a	1.24 \pm 0.02a	0.15 \pm 0.02b
	7-octenoic acid	905.90	414.10	1.23	0.04 \pm 0.01c	0.08 \pm 0.00bc	0.05 \pm 0.01bc	0.09 \pm 0.01b	0.16 \pm 0.01a	0.06 \pm 0.01d
	n-decanoic acid	887.30	383.31	1.56	0.05 \pm 0.01b	0.06 \pm 0.01a	0.08 \pm 0.01b	0.07 \pm 0.02b	0.07 \pm 0.01a	0.06 \pm 0.03b
	heptanoic acid	1219.70	1002.43	1.54	0.96 \pm 0.02b	1.19 \pm 0.01a	1.32 \pm 0.04b	1.62 \pm 0.05b	0.97 \pm 0.02a	1.20 \pm 0.01b
	2-heptenoic acid	1012.90	611.23	2.11	0.10 \pm 0.01e	0.25 \pm 0.01b	0.17 \pm 0.01d	0.08 \pm 0.02c	0.46 \pm 0.04a	0.41 \pm 0.01e
Alcohols (6)	Total				10.02 \pm 0.29f	18.36 \pm 0.32c	11.71 \pm 0.33e	13.27 \pm 0.44d	21.77 \pm 0.42b	22.22 \pm 0.42a
	ethanol	532.50	114.88	1.16	2.31 \pm 0.14b	3.15 \pm 0.04ab	3.00 \pm 0.03a	2.53 \pm 0.02ab	3.06 \pm 0.17a	1.71 \pm 0.09b
	E-2-hexenol	730.10	218.38	1.47	0.14 \pm 0.01e	0.44 \pm 0.02b	0.18 \pm 0.01e	0.17 \pm 0.04d	0.83 \pm 0.07a	0.25 \pm 0.03c
	1-octen-3-ol	771.00	252.57	1.26	0.09 \pm 0.02c	0.18 \pm 0.04b	0.11 \pm 0.03c	0.08 \pm 0.02c	0.26 \pm 0.02a	0.12 \pm 0.01c
	5-methyl-2-furanmethanol	1041.70	665.70	1.14	0.77 \pm 0.01e	1.14 \pm 0.02b	0.66 \pm 0.01d	0.63 \pm 0.01de	0.78 \pm 0.04a	0.80 \pm 0.01c

Aldehydes(11)	6-methyl-5-hepten-2-ol	650.60	166.89	1.28	0.19±0.00e	0.1±0.01b	0.28±0.00e	0.15±0.01d	0.07±0.02a	0.09±0.03c
	1-nonen-4-ol	812.20	296.10	1.79	0.16±0.00cd	0.19±0.03b	0.22±0.02c	0.15±0.02d	0.11±0.00a	0.24±0.05d
	Total				3.66±0.18bc	5.20±0.16a	4.45±0.97ab	3.71±0.12bc	5.11±0.54a	3.21±0.22d
	butanal	563.50	128.57	1.22	0.54±0.01cd	0.52±0.01b	0.57±0.02c	0.52±0.02c	0.42±0.05a	0.45±0.02d
	2-methylbutanal	642.20	163.20	1.20	0.53±0.00b	0.59±0.00a	0.61±0.01a	0.62±0.02b	0.51±0.03d	0.30±0.01c
	3-methylbutanal	652.10	167.55	1.35	0.10±0.02cd	0.77±0.01a	0.15±0.04c	0.09±0.06d	0.48±0.02b	0.65±0.04d
	hexanal	742.10	228.36	1.26	0.19±0.01c	0.37±0.01e	0.25±0.07a	0.32±0.07b	0.42±0.01f	0.17±0.07d
	furfurol	735.80	223.09	1.09	0.19±0.00b	0.38±0.02a	0.22±0.01bc	0.21±0.01c	0.72±0.01d	0.15±0.01e
	benzaldehyde	815.40	299.81	0.95	0.03±0.03e	0.06±0.08b	0.04±0.03e	0.03±0.04c	0.17±0.01a	0.04±0.05d
	E-2-heptenal	973.50	538.12	1.11	0.08±0.01c	0.07±0.01b	0.10±0.03c	0.12±0.01c	0.44±0.01a	0.06±0.01c
	E-2-octenal	645.60	164.68	1.31	5.38±0.01de	6.60±0.01b	6.71±0.01cd	6.70±0.01e	4.46±0.01a	5.12±0.01c
	n-nonanal	890.40	386.83	1.11	0.41±0.02b	0.58±0.03e	0.44±0.01a	0.62±0.02d	0.55±0.01f	0.43±0.01c
	phenylacetaldehyde	729.40	217.77	1.44	0.46±0.01c	0.54±0.01a	0.71±0.01bc	0.70±0.02c	0.46±0.01ab	0.52±0.03c
	pentanal	1181.60	930.25	1.82	0.02±0.02d	0.03±0.01bc	0.03±0.01cd	0.03±0.02a	0.07±0.01ab	0.03±0.01e
	Total				7.93±0.14e	10.51±0.20a	9.83±0.25bc	9.96±0.30b	8.70±0.18d	7.92±0.27e
Ketones (8)	acetoin	705.00	197.35	1.23	0.08±0.02d	0.09±0.01b	0.08±0.01d	0.10±0.04c	0.24±0.03a	0.06±0.01c
	6-methyl-5-hepten-2-one	772.50	253.78	1.34	0.29±0.01c	0.18±0.02b	0.31±0.01b	0.23±0.02c	0.15±0.01a	0.26±0.02d
	1-octen-3-one	1059.50	699.44	1.22	0.03±0.03d	0.05±0.02b	0.04±0.01d	0.06±0.02e	0.08±0.01a	0.04±0.01c
	2-pentanone	1022.70	629.87	1.23	0.29±0.01d	0.66±0.01c	0.39±0.01c	0.46±0.01b	0.84±0.01a	0.25±0.01d
	acetone	1016.50	618.22	1.90	0.76±0.02bc	1.16±0.07a	0.97±0.00bc	0.65±0.06b	1.04±0.20c	0.94±0.02bc
	3-octanone	1017.80	620.55	1.20	0.03±0.03b	0.05±0.04b	0.03±0.02b	0.02±0.04b	0.08±0.05a	0.06±0.03c
	2-hexanone	921.30	442.41	1.50	0.26±0.01d	0.31±0.02b	0.29±0.03c	0.15±0.01b	0.53±0.03a	0.82±0.02cd
	2-heptanone	1015.20	615.62	1.68	0.40±0.01d	0.18±0.03de	0.64±0.01c	0.76±0.01b	1.00±0.01a	0.24±0.04e
	Total				2.14±0.14bc	2.68±0.42abc	2.75±0.46ab	2.43±0.21bcd	3.96±0.89a	2.67±0.16bc

Esters (17)	methyl acetate	545.70	120.69	1.19	2.10±0.03bc	2.20±0.04ab	2.15±0.03cd	2.07±0.04d	1.33±0.12b	2.04±0.01b
	ethyl acetate	583.80	137.48	1.24	0.58±0.09b	0.60±0.06a	0.63±0.06a	0.39±0.06a	0.53±0.30c	0.33±0.03c
	ethyl propanoate	733.10	220.87	1.39	0.04±0.01d	0.11±0.01e	0.06±0.02b	0.05±0.02a	0.16±0.01f	0.05±0.02c
	propyl acetate	767.10	249.34	1.23	1.46±0.02d	2.42±0.06a	1.67±0.01b	1.42±0.01c	1.26±0.01b	1.46±0.05d
	ethyl 2-hydroxypropanoate	767.70	249.84	1.54	0.35±0.03e	0.89±0.02d	0.37±0.05b	0.36±0.07c	1.20±0.01a	0.32±0.01e
	ethyl 3-methylbutyrate	746.10	231.70	1.48	0.03±0.01b	0.04±0.01d	0.03±0.01a	0.03±0.01c	0.05±0.01e	0.03±0.00de
	butyl acetate	759.40	242.88	1.12	0.54±0.03b	0.63±0.03c	0.61±0.01a	0.52±0.01b	0.40±0.02d	0.46±0.03c
	isoamyl acetate	779.20	259.43	1.08	0.85±0.05d	2.00±0.01c	0.89±0.01b	0.82±0.04d	1.22±0.03e	0.81±0.01a
	ethyl pentanoate	811.90	295.77	1.46	0.28±0.02c	0.30±0.00e	0.27±0.02b	0.25±0.02a	0.16±0.01f	0.12±0.01d
	butyrolactone	815.40	299.81	1.37	0.58±0.04b	1.14±0.06a	0.62±0.01b	0.90±0.01a	1.24±0.03a	0.72±0.02b
	ethyl hexanoate	899.10	401.57	1.34	0.02±0.02c	0.04±0.03b	0.03±0.02a	0.02±0.04a	0.03±0.06c	0.02±0.05bc
	methyl myristoleate	881.20	376.19	1.41	0.10±0.01c	0.14±0.01b	0.13±0.01c	0.27±0.02c	0.58±0.01a	0.09±0.00c
	methyl hexanoate	826.10	312.30	1.26	0.29±0.01e	0.20±0.02b	0.60±0.01d	0.79±0.03c	0.14±0.01a	0.40±0.01f
	ethyl benzoate	880.50	375.38	1.33	0.05±0.01b	0.11±0.01a	0.09±0.01b	0.07±0.01a	0.09±0.01b	0.06±0.01b
	methyl benzoate	759.30	242.76	1.38	0.01±0.00c	0.12±0.01a	0.01±0.00c	0.01±0.02c	0.10±0.04b	0.01±0.01bc
	ethyl heptanoate	766.60	248.85	1.43	0.15±0.02b	0.25±0.01b	0.17±0.01a	0.15±0.01b	0.21±0.01b	0.17±0.01b
	hexyl butanoate	765.20	247.72	1.47	0.08±0.01c	0.08±0.01bc	0.12±0.06a	0.09±0.01b	0.07±0.03ab	0.07±0.01bc
Terpenoids (6)	Total				7.51±0.41e	11.27±0.40a	8.45±0.34bc	8.21±0.43bcd	8.77±0.72b	7.16±0.29ef
	gamma-terpinene	693.40	187.66	1.29	0.04±0.03d	0.05±0.05c	0.05±0.03b	0.04±0.05a	0.06±0.02d	0.05±0.07c
	alpha-phellandrene	1055.90	692.69	1.19	0.18±0.02e	0.22±0.01c	0.20±0.01d	0.26±0.01f	0.24±0.02a	0.09±0.01b
	myrcene	909.60	420.86	1.37	0.06±0.02de	0.10±0.01c	0.06±0.01cd	0.04±0.00b	0.25±0.03a	0.09±0.01f
	limonene	810.50	294.08	1.69	0.11±0.02d	0.08±0.06b	0.15±0.02c	0.12±0.01e	0.06±0.02a	0.08±0.02c
	linalool	766.50	248.84	1.56	0.04±0.01d	0.08±0.01b	0.05±0.01d	0.06±0.01c	0.16±0.01a	0.05±0.01c
	o-cymene	783.00	262.64	1.41	1.11±0.02c	1.15±0.03c	1.09±0.04c	1.15±0.02d	1.33±0.02b	2.76±0.02a

Furans (2)	Total				1.54±0.12de	1.68±0.17c	1.60±0.12cd	1.67±0.10c	2.10±0.12b	3.12±0.14a
	2-acetylfuran	970.60	532.87	1.22	0.29±0.01b	0.36±0.02b	0.37±0.01b	0.28±0.02b	0.54±0.02a	0.24±0.01b
	2-pentyl furan	1013.50	612.40	2.02	0.02±0.01d	0.03±0.02b	0.03±0.01c	0.04±0.01d	0.06±0.01a	0.02±0.01b
	Total				0.31±0.02c	0.39±0.04b	0.40±0.02b	0.32±0.03c	0.60±0.03a	0.26±0.02d

Mean values with different letters in the same row correspond to significant differences at $p < 0.05$. Data are represented as the mean \pm SD.

GC-IMS: gas chromatography ion mobility spectrometry.

'The six red jujube cultivars' includes Jinchang-'JC', Junzao-'JZ', Huizao-'HZ', Qiyuexian-'QYX', Hetiandazao-'HTDZ', and Yuanzao-'YZ'.

'RI' means 'retention index', 'Rt' means 'retention time', 'Dt' means 'drift time'.

Table S4 The composition of fatty acids, amino acids, organic acids, and sugars of six red jujube cultivars from Xinjiang Province, China

Composition	Concentration(mg/g)					
	Qiyuexian (QYX)	Jinchang (JC)	Hetiandazao (HTDZ)	Yuanzao (YZ)	Huizao (HZ)	Junzao (JZ)
malic acid	105.38±22.54a	106.01±18.34a	131.57±33.67a	145.47±43.23a	154.50±21.34a	159.01±54.42a
citric acid	22.87±3.46c	31.29±4.56bc	25.75±6.76bc	34.67±4.32b	23.96±3.50c	44.97±7.67a
quinic acid	91.37±10.22a	92.26±10.23a	100.67±12.89a	106.79±20.98a	111.19±23.56a	112.84±18.76a
lactic acid	56.38±6.44c	61.68±6.46c	85.59±7.74b	101.80±9.09ab	116.45±89.76a	121.84±20.03a
tartaric acid	55.49±9.87d	59.77±5.78d	86.97±6.43c	105.54±8.90b	118.82±9.76ab	123.57±12.65a
glucose	126.02±13.45a	84.70±7.65c	108.37±9.80b	87.22±6.73c	96.93±7.83bc	55.25±4.56d
fructose	150.67±1.24a	104.24±1.43d	121.68±1.23b	98.87±1.20e	118.61±41.10c	70.99±1.20f
maltose	28.64±3.00a	26.07±8.00a	27.71±5.00a	25.04±2.13a	26.15±2.23a	20.59±1.80a
capric acid	0.22±0.01c	nd	nd	0.35±0.01a	0.26±0.01b	0.26±0.01b
lauric acid	1.98±0.01b	0.81±0.01e	0.77±0.01f	2.91±0.01a	1.68±0.01c	1.21±0.01d
myristic acid	2.16±0.01b	0.74±0.01e	0.68±0.01f	3.44±0.02a	1.27±0.01c	1.16±0.01d
myristoleic acid	1.45±0.01b	0.54±0.01e	0.57±0.03d	5.08±0.01a	0.40±0.01f	1.02±0.01c
palmitic acid	12.30±0.01b	4.44±0.01f	4.67±0.01e	1.74±0.01a	5.47±0.01d	7.13±0.01c
palmitoleic acid	4.28±0.02b	2.22±0.02e	2.39±0.02d	6.35±0.02a	1.35±0.02f	3.91±0.02c
margaric acid	nd	nd	0.02±1.00E-4a	nd	nd	0.18±0.03b
stearic acid	2.32±0.03a	0.84±0.03d	0.73±0.03e	0.14±0.03b	0.76±0.03f	0.94±0.03c

oleic acid	5.89±0.02a	0.84±0.002e	0.79±0.02e	1.43±0.02d	0.37±0.02c	1.37±0.02b
linoleic acid	3.46±0.01a	0.71±0.01d	0.69±0.01d	0.77±0.01b	1.04±0.01d	1.52±0.01c
arachidic acid	0.34±0.01b	nd	nd	0.28±0.02c	nd	0.21±0.01a
alpha-linolenic acid	0.28±0.01b	0.17±0.01d	0.19±0.01d	0.20±0.01d	0.28±0.01c	0.47±0.01a
gamma-linolenic acid	nd	nd	nd	0.18±0.01a	nd	nd
behenic acid	0.27±0.01d	nd	nd	nd	0.26±0.01e	0.31±0.01c
lignoceric acid	nd	nd	nd	0.24±0.01a	nd	nd
ASP	4.40E-2±2.00E-4c	3.60E-2±2.00E-4b	3.30E-2±2.00E-4a	5.30E-2±2.00E-4e	2.10E-2±2.00E-4f	4.20E-2±2.00E-4d
THR	0.28±1.00E-3d	0.51±1.00E-3a	0.48±1.00E-3b	0.17±1.00E-3f	0.19±1.00E-3e	0.34±1.00E-3c
SER	nd	nd	nd	nd	nd	nd
GLU	1.10E-2±3.00E-4c	3.20E-2±3.00E-4e	2.60E-2±3.00E-4e	3.50E-3±3.00E-4b	1.30E-2±3.00E-4d	0.02±3.00E-4a
GLY	4.90E-3±1.00E-4d	5.50E-3±1.00E-4a	5.90E-3±2.00E-4b	3.10E-3±2.00E-4f	3.00E-3±1.00E-4e	0.0043±1.00E-4c
ALA	1.50E-2±1.00E-4c	2.80E-2±1.00E-4d	2.60E-2±1.00E-4b	5.10E-3±1.00E-4e	8.00E-3±1.00E-4b	2.30E-2±1.00E-4a
VAL	5.30E-3±4.00E-4d	4.20E-2±3.00E-4a	3.70E-2±2.00E-4b	0.01±2.00E-4e	1.40E-2±4.00E-4d	2.80E-2±1.00E-4c
MET	nd	nd	nd	nd	nd	nd
ILE	0.03±1.00E-4d	1.50E-2±1.00E-4b	1.50E-2±1.00E-4a	4.70E-2±1.00E-4e	2.90E-2±1.00E-4c	5.10E-2±1.00E-4b
LEU	2.40E-3±1.00E-4c	1.90E-2±1.00E-4e	1.50E-2±1.00E-4e	1.60E-3±1.00E-4b	2.00E-3±1.00E-4d	8.70E-3±1.00E-4a
TYR	1.80E-2±2.00E-4d	1.30E-2±2.00E-4a	2.10E-2±2.00E-4b	1.00E-3±2.00E-4f	0.021±2.00E-4e	0.04±2.00E-4c
PHE	9.30E-3±1.00E-4c	2.20E-2±1.00E-4c	2.10E-2±2.00E-4b	1.00E-3±1.00E-4c	9.20E-3±2.00E-4b	1.40E-3±1.00E-4a
LYS	7.00E-4±1.00E-4d	4.30E-3±3.00E-4a	3.90E-3±2.00E-4b	nd	2.50E-3±1.00E-4d	3.90E-3±1.00E-4c
HIS	nd	0.01±1.00E-4c	9.30E-3±1.00E-4d	nd	nd	3.10E-3±1.00E-4a
ARG	2.30E-2±1.00E-4d	4.70E-2±1.00E-4b	5.80E-2±1.00E-4a	nd	2.80E-2±1.00E-4c	4.70E-2±1.00E-4b

PRO	1.70±0.12b	1.64±0.12b	1.55±0.12b	2.25±0.12a	1.66±0.12b	2.17±0.12a
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nd: not detected. Mean values with different letters in the same row correspond to significant differences at $p < 0.05$. Data are represented as the mean \pm SD.

'E' represents the corresponding power of '10' in the scientific notation of the table.

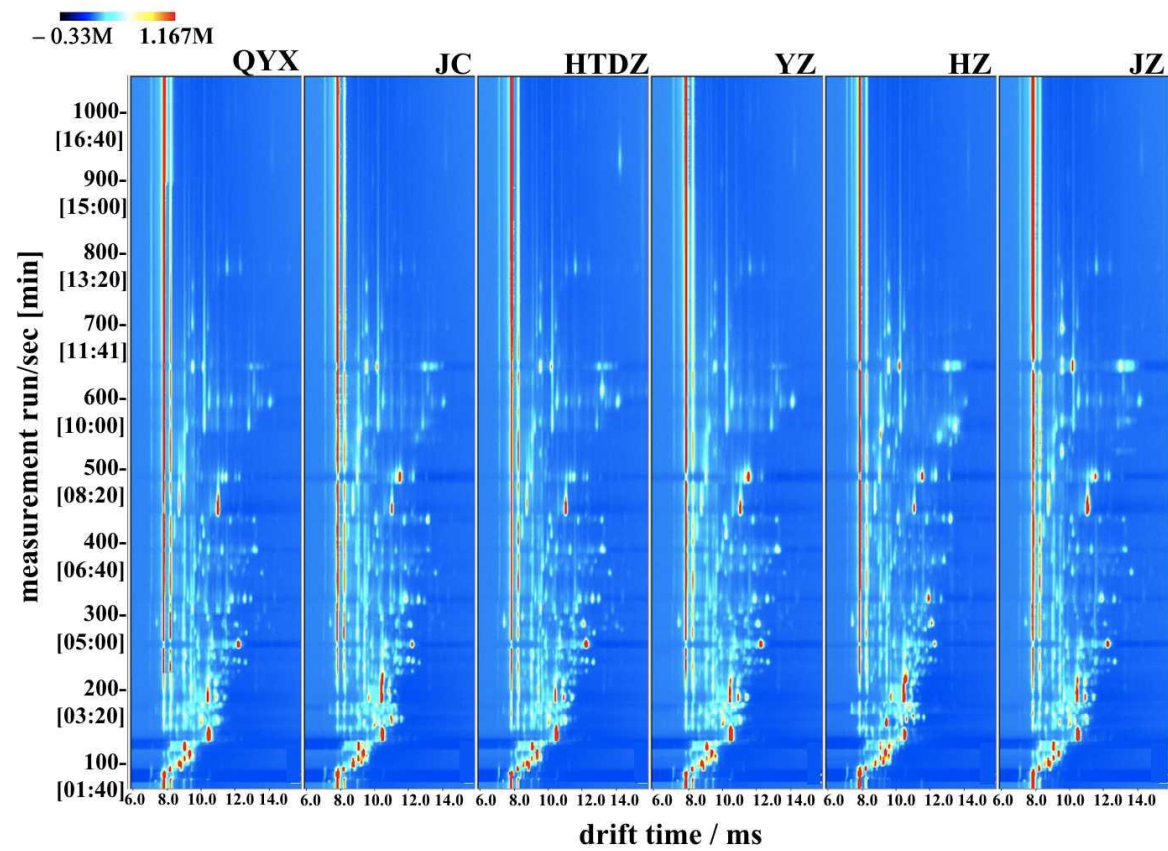


Figure S1 The combined chromatograms of the six red jujube cultivars in Xinjiang province, China (Jinchang-‘JC’, Junzao-‘JZ’, Huizao-‘HZ’, Qiyuexian-‘QYX’, Hetiandazao-‘HTDZ’, and Yuanzao-‘YZ’)

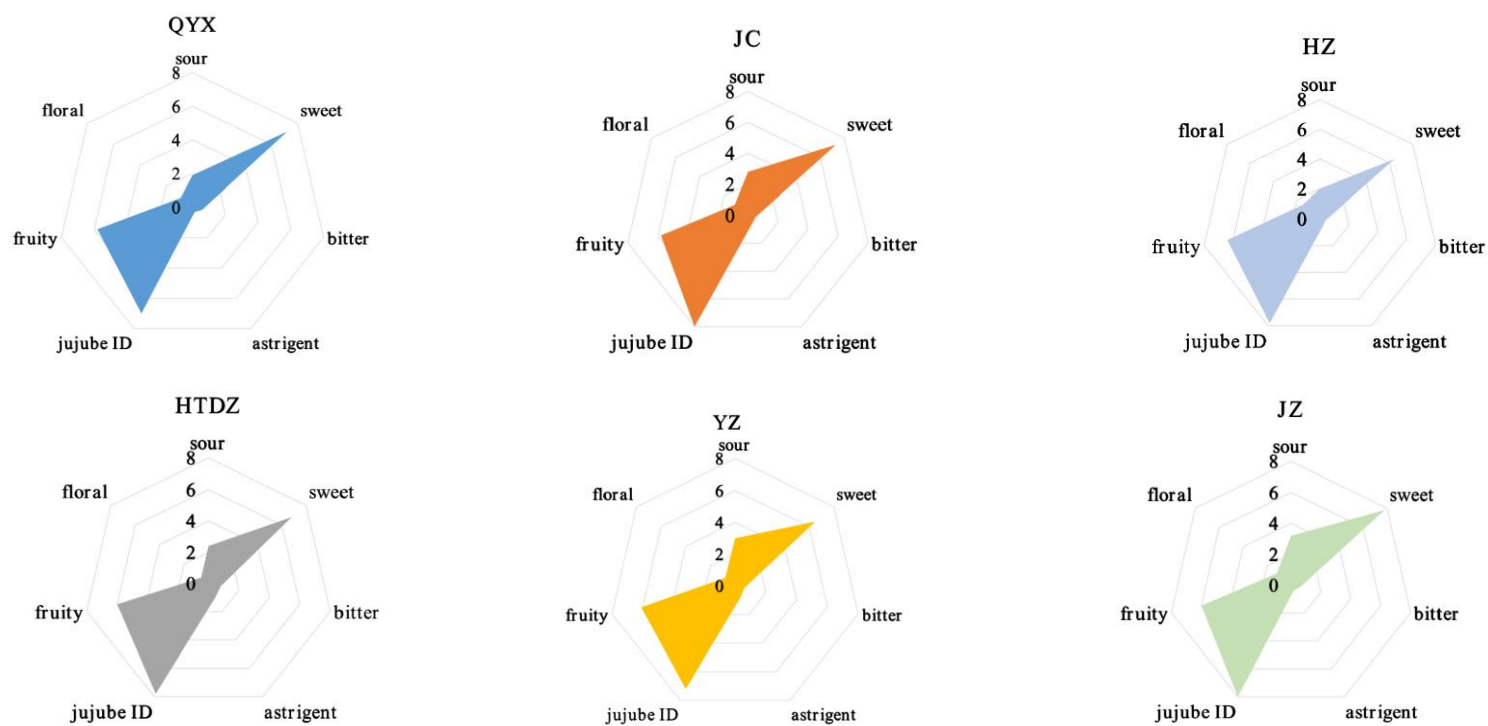


Figure S2 Sensory profiles of the six red jujube cultivars in Xinjiang province, China (Jinchang-‘JC’, ‘blue color’; Junzao-‘JZ’, ‘orange color’, Huizao-‘HZ’, ‘light blue color’; Qiyuexian-‘QYX’, ‘grey color’; Hetiandazao-‘HTDZ’, ‘light orange color’; and Yuanzao-‘YZ’, ‘green color’)

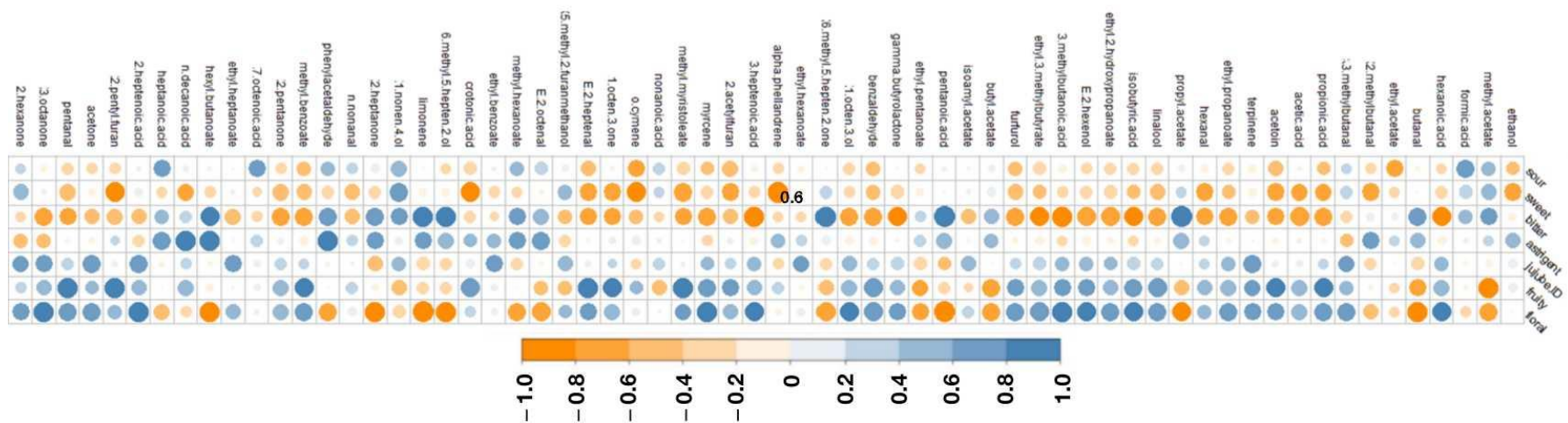


Figure. S3 Correlation analysis among sensory attributes and VOCs of the six red jujube cultivars from Xinjiang province, China (Jinchang-‘JC’, Junzao-‘JZ’, Huizao-‘HZ’, Qiyuexian-‘QYX’, Hetiandazao-‘HTDZ’, and Yuanzao-‘YZ’)