Analysis of microbial community structure and volatile metabolites of JIUYAO in Fangxian, China

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Abstract: JIUYAO is an important saccharification starter in the production of Huangjiu, and also an important source of flavor. In this study, the microbial community structure of JIUYAO from Fangxian was studied by high-throughput sequencing (HTS) technology for the first time. The volatile flavor compounds of JIUYAO's metabolites were also analyzed by headspace solid phase microextraction combined with full two-dimensional gas chromatography-mass spectrometry (HS-SPME-GC×GC/MS) for the first time. The results showed that there were 15 dominant bacterial genera, including *Weissella*, *Pediococcus*, *unclasssified_k_norank_d_Bacteria*, *Lactobacillus* and *Leuconostoc*, etc. Thirteen species of dominant fungi were *Wickerhamomyces*, *Saccharomycopsis*, *Rhizopus*, etc. The different samples of JIUYAO were similar in microbial species, but the number of species was significantly different. A total of 191 volatile flavor compounds (VFCs) were detected, among which esters, alcohols, acids and alkenes were the main flavor compounds, and 21 terpenoids were also detected. In addition, the functional prediction of microorganisms in JIUYAO revealed that global and overview maps, amino acid metabolism and carbohydrate metabolism were dominant. Through correlation analysis, 538 potential correlations between dominant microorganisms and different flavor compounds were obtained. This study revealed the interactions between microorganisms and volatile metabolites in JIUYAO, which provided reliable data for the analysis of microbial community structure of Fangxian JIUYAO, and provide theoretical support for the quality evaluation of JIUYAO.

Keywords: JIUYAO, Microbial community structure, Volatile flavor compound, Correlation analysis, Microbial metabolic

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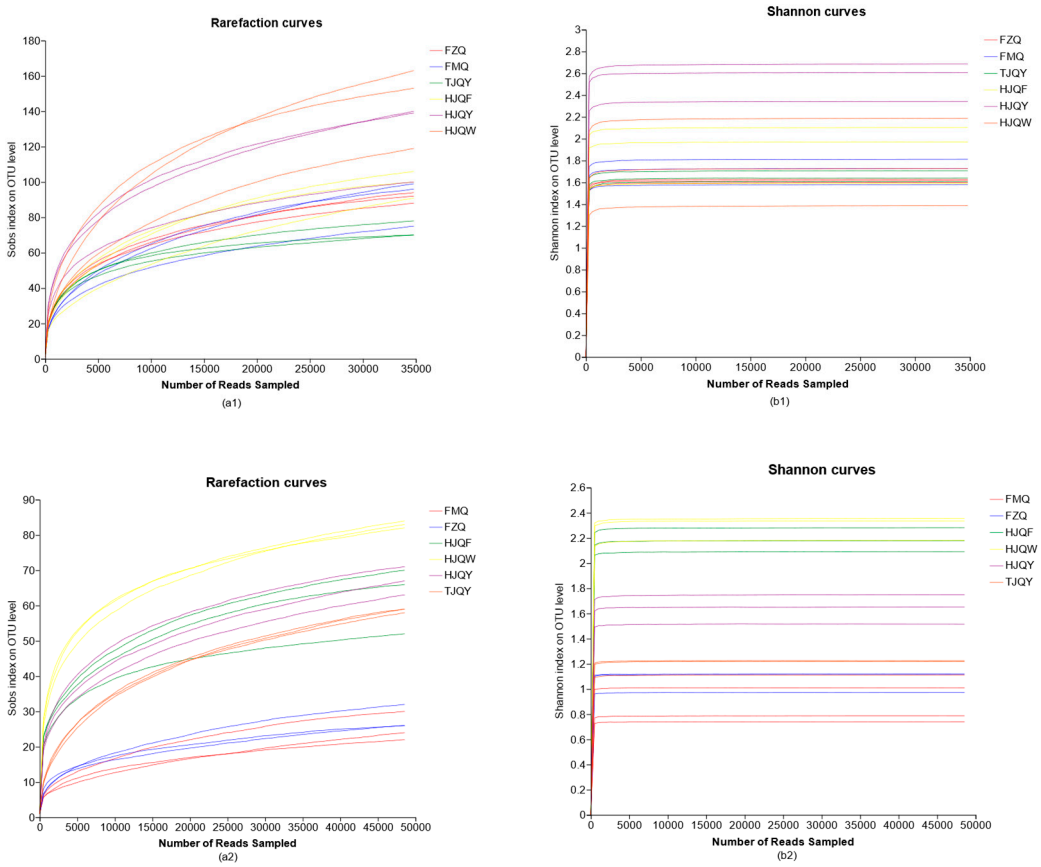
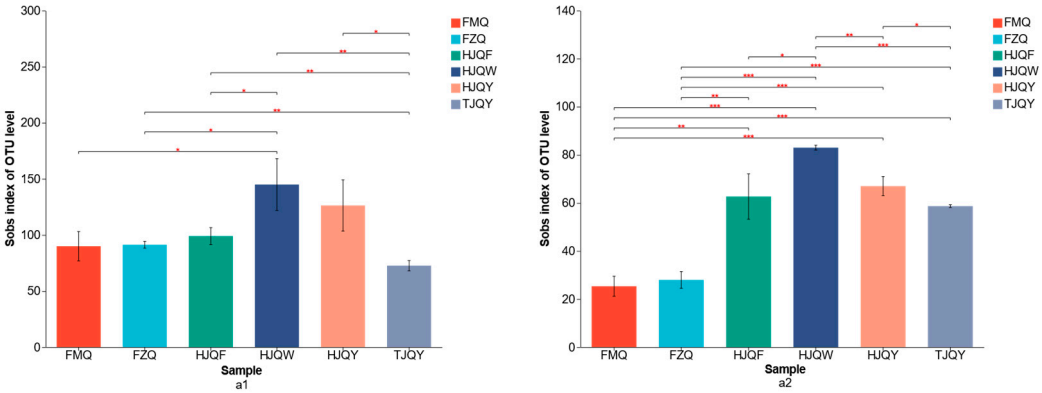
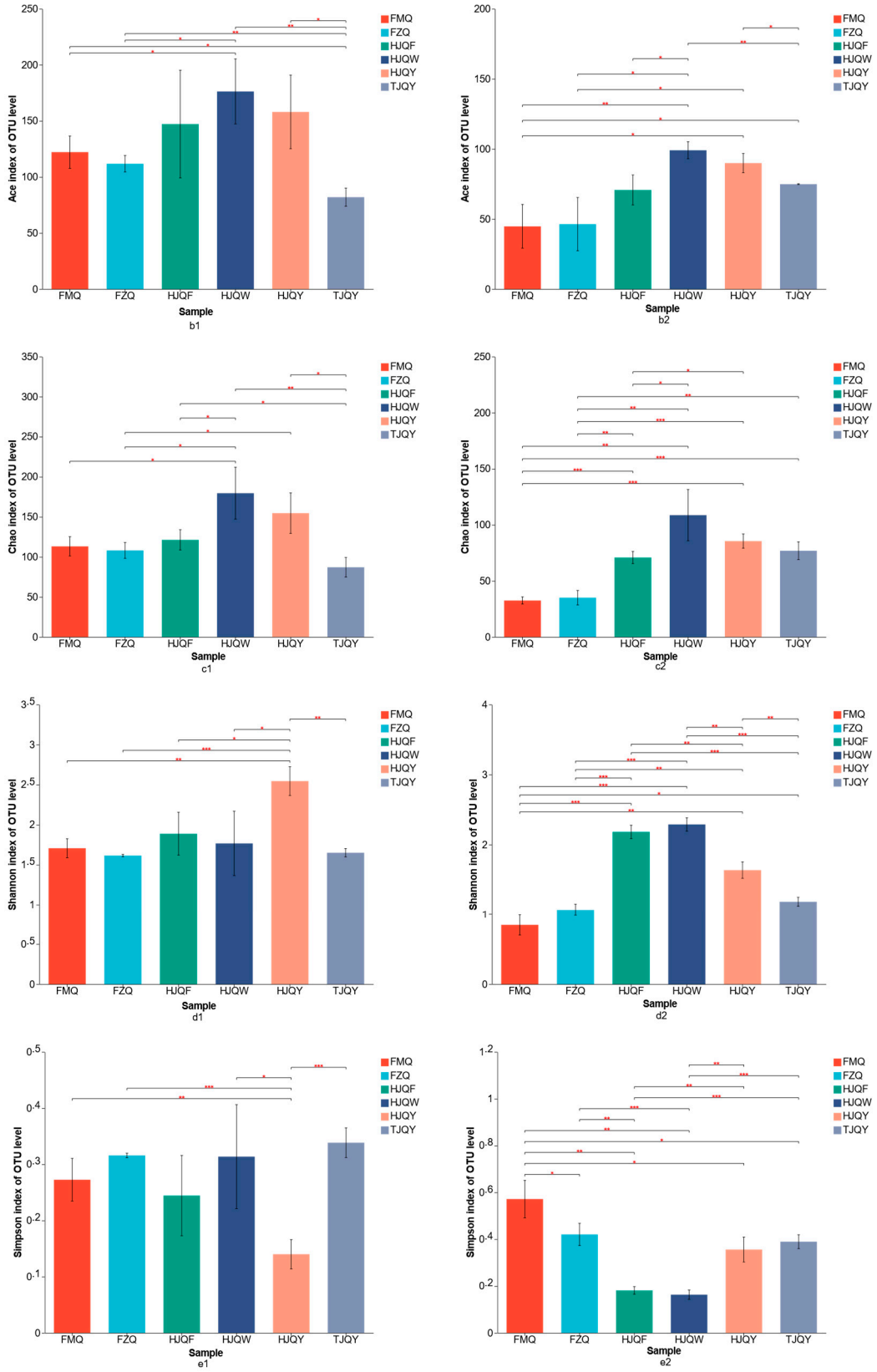


Figure S1. Dilution curves of α-diversity index (a1: sobs diversity index of bacterial, a2: sobs diversity index of fungi, b1: Shannon diversity index of bacterial, b2: Shannon diversity index of fungi)





Note: * means significant difference between samples ($P < 0.05$), ** means extremely significant difference between samples ($P < 0.01$), *** means extremely significant difference between samples ($P < 0.001$).

Figure S2. Distributions of alpha diversity indices(a1: sobs diversity index of bacterial, a2: sobs diversity index of fungi, b1: ace diversity index of bacterial, b2: ace diversity index of fungi, c1: Chao diversity index of bacterial, c2: Chao diversity index of fungi, d1: Shannon diversity index of bacterial, d2: Shannon diversity index of fungi, e1: Simpson diversity index of bacterial, e2: Simpson diversity index of fungi.)

Table S1. Contents of volatile flavor compounds in six JIUYAO

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
1	Ethyl Acetate	861	888	273.39±23.31^{b}	380.38±30.98^{c}	303.70±27.88^{b}	38.93±3.89^{a}	526.24±25.29^{d}	815.59±74.32^{e}
2	Propanoic acid ethyl ester	932	953	ND	84.95±2.40^{c}	ND	115.04±9.74^{d}	41.51±2.78^{a}	60.65±6.34^{b}
3	2-Methyl-propanoic acid ethyl ester	939	961	ND	54.92±3.32^{b}	ND	205.16±14.79^{c}	ND	18.89±1.92^{a}
4	Acetic acid, 2-methyl-propyl ester	992	1012	9.07±1.00^{a}	8.83±0.70^{a}	9.03±0.98^{a}	ND	23.93±1.55^{b}	35.66±2.43^{c}
5	Butanoic acid ethyl ester	1014	1035	23.45±2.06^{a}	233.10±12.39^{d}	22.79±1.48^{a}	72.07±5.22^{b}	163.64±7.01^{c}	164.94±18.89^{c}
6	2-Methyl-butanoic acid ethyl ester	1030	1051	36.40±1.18^{c}	83.11±6.70^{d}	6.65±0.66^{a}	218.90±15.72^{e}	35.15±1.40^{bc}	23.21±1.76^{b}
7	3-Methyl-butanoic acid ethyl ester	1045	1068	10.86±1.04^{b}	50.06±4.27^{d}	2.68±0.27^{a}	48.44±4.59^{d}	14.48±0.37^{bc}	19.25±2.29^{c}
8	Acetic acid butyl ester	1049	1074	ND	ND	6.33±0.55^{b}	2.06±0.23^{a}	12.83±1.3^{c}	28.72±1.55^{d}
9	3-Methyl-1-butanol acetate	1102	1122	ND	167.81±13.19^{b}	149.88±13.12^{b}	95.58±9.18^{a}	496.92±20.22^{c}	677.81±62.2^{d}
10	Pentanoic acid ethyl ester	1114	1134	224.45±7.08^{a}	395.12±21.40^{b}	209.69±19.89^{a}	478.63±34.60^{c}	462.52±32.19^{c}	239.63±15.44^{a}
11	Acetic acid pentyl ester	1152	1176	ND	ND	ND	ND	10.29±0.95^{a}	16.93±1.67^{b}
12	4-Methyl-pentanoic acid ethyl ester	1170	1190	1.79±0.08^{a}	5.36±0.30^{c}	2.27±0.20^{a}	3.19±0.27^{b}	14.76±0.48^{e}	9.57±0.83^{d}
13	Hexanoic acid ethyl ester	1216	1233	1427.66±56.98^{b}	1921.53±97.90^{c}	1147.49±104.42^{a}	2170.86±156.84^{d}	3187.42±61.79^{e}	2152.92±204.47^{d}
14	2-Oxo-propanoic acid ethyl ester	1248	1253	ND	ND	0.38±0.04^{a}	ND	ND	ND
15	Acetic acid hexyl ester	1251	1272	2.59±0.41^{a}	8.66±0.47^{c}	4.57±0.43^{b}	4.07±0.46^{b}	9.38±0.48^{c}	14.08±0.23^{d}
16	2-methyl-Butanoic acid 2-methyl-butyl ester	1277	1284	ND	1.86±0.13^{a}	ND	ND	ND	ND
17	Hexanoic acid, 2-methylpropyl ester	1304	1350	ND	ND	ND	ND	ND	0.34±0.03^{a}
18	Heptanoic acid, ethyl ester	1314	1331	183.90±1.28^{a}	233.78±7.65^{b}	181.66±18.75^{a}	250.97±16.56^{b}	527.85±16.76^{d}	279.48±18.95^{c}
19	(L)-Ethyl Lactate	1318	1349	17.48±2.86^{c}	3.55±0.18^{a}	3.90±0.39^{a}	12.13±1.20^{b}	26.66±0.12^{d}	26.82±1.26^{d}
20	Acetic acid heptyl ester	1352	1377	0.21±0.01^{a}	ND	ND	ND	ND	0.54±0.07^{b}
21	Octanoic acid ethyl ester	1414	1435	168.31±8.00^{a}	271.32±8.94^{c}	213.37±17.59^{b}	269.45±18.07^{c}	674.68±21.99^{e}	357.84±27.88^{d}
22	Nonanoic acid ethyl ester	1514	1531	367.87±37.88^{c}	93.83±2.56^{a}	89.21±8.10^{a}	124.39±10.17^{a}	467.29±13.40^{d}	214.49±22.34^{b}
23	2-Octenoic acid ethyl ester	1529	1557	1.26±0.18^{b}	0.59±0.07^{a}	ND	3.86±0.40^{c}	ND	ND

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
24	Bornyl acetate	1551	1581	12.44±1.09^{a}	ND	ND	ND	ND	84.52±7.08^{b}
25	Decanoic acid ethyl ester	1615	1638	22.87±2.35^{c}	16.60±1.21^{b}	9.85±0.93^{a}	19.46±0.68^{bc}	42.38±1.93^{e}	34.00±3.23^{d}
26	Ethyl benzoate	1633	1660	13.20±0.89^{c}	0.97±0.08^{a}	3.87±0.58^{b}	5.25±0.19^{b}	19.96±1.97^{d}	18.30±0.72^{d}
27	Butanedioic acid diethyl ester	1650	1680	0.93±0.11^{a}	3.72±0.33^{b}	4.85±0.60^{b}	25.31±1.58^{c}	ND	ND
28	Undecanoic acid ethyl ester	1720	1739	0.50±0.05^{b}	0.28±0.03^{a}	0.31±0.02^{a}	0.42±0.05^{ab}	1.41±0.02^{c}	1.26±0.20^{c}
29	n-Propyl benzoate	1726	1765	2.19±0.13^{b}	ND	0.66±0.10^{a}	0.57±0.07^{a}	2.42±0.35^{b}	2.92±0.10^{c}
30	2-Hydroxy-benzoicacimethylester	1743	1765	1.25±0.11^{bc}	0.73±0.09^{a}	1.05±0.08^{b}	1.25±0.16^{bc}	1.49±0.17^{c}	2.84±0.18^{d}
31	Benzeneacetic acid ethyl ester	1760	1783	26.00±2.14^{c}	22.28±1.27^{bc}	11.37±1.04^{a}	103.16±9.19^{e}	60.66±1.42^{d}	17.24±1.69^{ab}
32	Acetic acid 2-phenylethyl ester	1788	1813	ND	6.26±0.61^{c}	0.98±0.11^{a}	3.72±0.44^{b}	ND	4.08±0.26^{b}
33	Dodecanoic acid ethyl ester	1824	1841	21.77±2.79^{d}	7.49±0.59^{a}	11.53±1.04^{b}	16.54±1.07^{c}	23.73±2.18^{d}	17.00±1.60^{c}
34	Butyl benzoate	1836	1871	0.36±0.03^{a}	ND	ND	ND	ND	1.19±0.03^{b}
35	Tetradecanoic acid ethyl ester	2031	2049	9.99±1.28^{c}	3.72±0.42^{b}	3.19±0.34^{ab}	5.26±0.39^{c}	3.03±0.49^{ab}	2.19±0.23^{a}
36	Hexadecanoic acid ethyl ester	2232	2251	14.74±1.51^{d}	3.81±0.55^{a}	8.91±0.87^{c}	7.19±0.41^{b}	3.94±0.55^{a}	3.45±0.52^{a}
37	2-Butanol	998	1025	ND	ND	ND	ND	5.77±0.50^{a}	13.98±1.25^{b}
38	1-Propanol	1014	1035	ND	ND	ND	ND	ND	7.73±0.76^{a}
39	2-Methyl-1-propanol	1064	1092	6.05±0.39^{a}	15.00±1.46^{c}	12.52±1.09^{b}	12.21±0.74^{b}	15.57±0.61^{c}	25.14±2.57^{d}
40	2-Pentanol	1094	1119	ND	ND	ND	ND	18.27±1.23^{a}	26.62±2.32^{b}
41	1-Butanol	1116	1142	2.33±0.25^{a}	5.40±0.35^{b}	6.39±0.66^{b}	5.84±0.57^{b}	18.74±0.25^{c}	29.41±2.38^{d}
42	1-Penten-3-ol	1131	1159	ND	0.95±0.06^{b}	ND	0.51±0.06^{a}	1.58±0.22^{c}	2.31±0.13^{d}
43	3-Methyl-1-butanol	1180	1209	38.61±2.88^{a}	109.80±7.95^{c}	63.12±6.22^{b}	46.71±4.21^{ab}	196.76±2.78^{d}	357.99±20.45^{e}
44	1,8-Cineole	1185	1213	2.38±0.30^{a}	ND	5.43±0.54^{a}	18.67±1.58^{b}	3.11±0.12^{a}	98.01±10.22^{c}
45	2-Hexanol	1195	1220	ND	1.01±0.07^{b}	ND	0.76±0.07^{a}	3.44±0.08^{c}	6.35±0.15^{d}
46	1-Pentanol	1223	1250	33.33±0.63^{a}	82.75±4.47^{d}	45.09±3.36^{b}	66.25±4.62^{c}	59.44±2.24^{c}	97.31±7.39^{e}
47	2-Heptanol	1293	1320	1.65±0.01^{a}	2.91±0.28^{b}	1.90±0.27^{a}	2.91±0.28^{b}	7.56±0.25^{c}	8.82±0.82^{d}
48	3-Heptanol	1268	1290	0.76±0.07^{b}	0.38±0.03^{a}	0.34±0.03^{a}	0.29±0.02^{a}	0.63±0.10^{b}	0.93±0.13^{c}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
49	3-Methyl-1-pentanol	1301	1325	ND	0.25±0.02^{a}	ND	ND	ND	0.45±0.07^{b}
50	1-Hexanol	1325	1355	145.74±8.26^{bc}	134.07±4.80^{b}	82.10±8.53^{a}	171.04±8.43^{c}	306.24±8.27^{d}	424.89±42.06^{e}
51	(Z)-3-Hexen-1-ol	1357	1382	ND	ND	0.14±0.02^{a}	ND	0.98±0.06^{b}	1.25±0.10^{c}
52	3-Octanol	1369	1393	2.25±0.14^{b}	1.93±0.14^{ab}	ND	1.69±0.12^{a}	4.02±0.09^{c}	4.48±0.36^{d}
53	1-Octen-3-ol	1425	1450	88.97±3.46^{c}	89.53±4.68^{c}	67.14±6.02^{b}	79.42±7.77^{c}	49.36±0.60^{a}	101.11±9.31^{d}
54	2-Ethylhexanol	1464	1491	9.66±0.57^{a}	13.48±1.16^{ab}	20.90±2.23^{b}	ND	101.37±0.73^{c}	134.00±11.83^{d}
55	2,3-Butanediol	1510	1543	1006.08±77.17^{d}	440.93±15.61^{ab}	453.94±35.24^{ab}	581.72±25.29^{c}	398.81±5.62^{a}	488.59±41.34^{b}
56	3,7-dimethyl-1,6-Octadien-3-ol	1523	1547	6.53±0.19^{e}	2.45±0.09^{c}	1.08±0.07^{a}	1.62±0.18^{b}	1.59±0.06^{b}	4.32±0.46^{d}
57	1-Octanol	1528	1557	23.82±0.91^{c}	13.81±0.47^{a}	15.24±1.38^{a}	18.41±1.86^{b}	47.06±0.79^{d}	45.39±2.26^{d}
58	Fenchyl Alcohol	1553	1582	ND	0.64±0.07^{a}	ND	ND	2.59±0.37^{b}	6.05±0.56^{c}
59	Propylene Glycol	1558	1600	ND	ND	ND	ND	35.74±1.59^{b}	24.21±2.24^{a}
60	Terpinen-4-ol	1571	1602	3.22±0.27^{bc}	1.85±0.10^{ab}	4.77±0.48^{cd}	5.56±0.49^{d}	0.78±0.15^{a}	25.93±2.14^{e}
61	(E)-2-Octen-1-ol	1583	1614	7.37±0.43^{bc}	2.93±0.35^{a}	3.10±0.44^{a}	4.12±0.36^{a}	8.60±1.63^{c}	6.92±0.21^{b}
62	1-Nonanol	1631	1660	20.90±1.19^{c}	8.00±0.72^{a}	13.02±1.86^{b}	15.21±0.71^{b}	34.56±0.34^{d}	49.58±3.57^{e}
63	Isoborneol	1633	1660	ND	0.17±0.02^{a}	ND	ND	0.55±0.05^{b}	2.94±0.10^{c}
64	2-Borneol	1666	1702	ND	ND	ND	ND	ND	156.93±11.33^{a}
65	2-Nonen-1-ol	1685	1692	1.42±0.10^{c}	0.18±0.02^{a}	ND	0.79±0.08^{b}	2.16±0.16^{d}	3.54±0.27^{e}
66	2-Undecanol	1693	1717	0.76±0.05^{a}	ND	ND	ND	ND	4.66±0.37^{b}
67	1-Decanol	1736	1760	1.06±0.15^{a}	ND	ND	ND	3.41±0.10^{b}	5.37±0.50^{c}
68	Benzyl alcohol	1848	1870	13.82±1.29^{b}	8.88±0.53^{a}	9.31±0.95^{a}	24.63±1.66^{c}	35.10±1.71^{d}	27.39±1.66^{e}
69	Phenylethyl Alcohol	1877	1906	263.00±24.54^{b}	729.64±35.77^{c}	309.71±30.43^{c}	409.37±26.36^{d}	242.11±1.41^{b}	142.89±7.76^{a}
70	1-Dodecanol	1938	1966	1.11±0.10^{a}	ND	1.08±0.13^{a}	ND	1.00±0.09^{a}	1.15±0.16^{a}
71	2-Oxo-propanoic acid	1248	1253	ND	ND	ND	0.19±0.03^{a}	ND	ND
72	Acetic acid	1425	1450	95.01±6.17^{c}	187.31±3.84^{b}	80.77±8.17	189.77±4.82^{a}	100.37±2.48^{c}	121.88±8.10^{b}
73	Formic acid	1488	1503	0.31±0.05^{a}	ND	ND	ND	238.22±11.99^{b}	488.59±41.34^{c}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
74	2-Methyl-propanoic acid	1540	1570	14.36±1.06^{c}	23.90±2.44^{d}	10.18±1.07^{b}	38.87±2.34^{e}	6.70±0.16^{a}	9.51±1.01^{b}
75	Butanoic acid	1598	1625	10.28±0.76^{b}	33.34±2.45^{d}	4.43±0.63^{a}	8.06±0.79^{b}	22.50±1.02^{c}	20.18±1.45^{c}
76	3-methyl-Butanoic acid	1641	1666	27.39±1.66^{b}	118.32±10.05^{c}	14.20±1.02^{a}	39.66±3.80^{b}	18.61±0.28^{a}	15.44±1.49^{a}
77	Pentanoic acid	1708	1733	6.81±0.47^{a}	20.85±1.98^{d}	14.04±1.32^{b}	21.00±1.71^{d}	32.62±1.02^{e}	17.72±1.63^{c}
78	2-Methyl-pentanoic acid	1718	1764	5.40±0.19^{a}	ND	7.97±0.82^{b}	11.44±1.06^{c}	8.81±0.23^{b}	ND
79	Hexanoic acid	1819	1846	89.61±2.02^{bc}	81.29±6.86^{b}	47.60±4.64^{a}	100.96±12.69^{c}	288.81±1.11^{e}	175.14±16.55^{d}
80	Heptanoic acid	1923	1950	2.91±0.40^{ab}	3.53±0.08^{b}	2.06±0.28^{a}	5.65±0.34^{c}	13.03±1.19^{e}	6.81±0.75^{d}
81	Octanoic acid	2029	2060	2.12±0.20^{ab}	2.00±0.17^{ab}	1.64±0.02^{a}	2.36±0.26^{b}	13.19±0.56^{d}	4.39±0.61^{c}
82	Nonanoic acid	2133	2171	3.61±0.32^{b}	ND	ND	ND	4.57±0.19^{c}	3.14±0.33^{a}
83	Hexanal	1056	1083	96.92±8.32^{c}	137.86±9.26^{e}	110.81±6.00^{d}	49.01±4.25^{a}	80.13±5.21^{b}	57.81±5.96^{a}
84	(E)-2-Methyl-2-butenal	1068	1092	ND	2.81±0.24^{d}	2.14±0.20^{c}	3.61±0.24^{e}	1.07±0.20^{a}	1.50±0.13^{b}
85	3-Methyl-2-butenal	1172	1215	ND	ND	1.62±0.08^{b}	1.31±0.07^{a}	2.10±0.09^{c}	2.08±0.25^{c}
86	(E)-2-Hexenal	1195	1220	1.47±0.09^{a}	ND	ND	ND	ND	ND
87	Octanal	1266	1289	15.60±1.89^{d}	9.97±0.98^{c}	10.58±0.15^{c}	4.60±0.45^{a}	8.16±0.77^{b}	ND
88	(Z)-2-Heptenal	1296	1322	ND	ND	3.26±0.41^{a}	ND	ND	3.42±0.48^{a}
89	Nonanal	1369	1393	86.53±4.24^{e}	21.17±1.96^{c}	30.42±0.13^{d}	10.83±1.04^{b}	28.27±1.36^{d}	6.08±0.53^{a}
90	(E)-2-Octenal	1401	1429	4.60±0.41^{b}	2.13±0.22^{a}	ND	ND	7.78±0.51^{d}	5.34±0.53^{c}
91	Decyl aldehyde	1474	1498	4.70±0.20^{c}	ND	4.06±0.22^{b}	ND	4.66±0.46^{c}	1.85±0.10^{a}
92	Benzaldehyde	1491	1520	17.51±1.22^{a}	65.94±5.57^{e}	55.82±4.66^{d}	29.88±2.56^{b}	41.41±0.55^{c}	61.97±5.24^{de}
93	5-Methyl-2-furanaldehyde	1543	1570	ND	3.16±0.38^{b}	5.04±0.55^{c}	ND	ND	1.53±0.14^{a}
94	Hendecanaldehyde	1579	1604	0.29±0.03^{b}	ND	0.18±0.02^{a}	ND	ND	ND
95	Benzeneacetaldehyde	1609	1640	1.65±0.15^{a}	13.22±0.48^{c}	4.13±0.56^{b}	4.41±0.42^{b}	1.47±0.23^{a}	ND
96	(E)-2-Decenal	1612	1644	0.44±0.06^{ab}	0.40±0.02^{a}	0.57±0.10^{bc}	ND	0.68±0.13^{c}	0.71±0.09^{c}
97	2-Octenal, 2-butyl-	1639	1656	2.76±0.24^{a}	17.33±1.31^{d}	7.36±0.75^{b}	13.59±0.82^{c}	1.83±0.22^{a}	7.20±0.69^{b}
98	2-Hydroxy-benzaldehyde	1641	1666	1.51±0.14^{a}	2.81±0.18^{c}	3.07±0.43^{c}	2.30±0.26^{b}	1.82±0.25^{ab}	1.97±0.30^{ab}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
99	2-Phenyl-2-butenal	1898	1929	ND	0.47±0.09^{a}	ND	ND	0.61±0.01^{b}	0.58±0.05^{b}
100	2-Pentanone	952	981	10.29±1.26^{b}	29.63±1.55^{c}	ND	1.34±0.15^{a}	37.54±1.93^{d}	77.14±6.67^{e}
101	2,3-Butanedione	952	981	ND	8.07±0.57^{a}	ND	ND	ND	ND
102	(E)-3-Penten-2-one	1102	1122	ND	4.40±0.36^{b}	3.85±0.48^{b}	1.83±0.27^{a}	2.24±0.04^{a}	4.22±0.42^{b}
103	4-Methyl-3-penten-2-one	1108	1127	ND	ND	ND	1.29±0.10^{a}	1.75±0.28^{b}	2.57±0.31^{c}
104	2-Heptanone	1158	1182	ND	86.30±6.67^{a}	ND	ND	ND	ND
105	3-Octanone	1231	1253	3.15±0.40^{a}	6.89±1.99^{b}	5.36±0.55^{b}	5.21±0.23^{b}	10.04±0.15^{c}	15.41±1.62^{d}
106	3-Hydroxy-2-oxobutane	1256	1284	29.02±1.77^{b}	32.96±2.37^{c}	37.61±3.74^{d}	4.74±0.35^{a}	6.61±0.25^{a}	3.22±0.31^{a}
107	2-Octanone	1261	1287	28.92±3.78^{a}	36.14±4.61^{b}	35.13±1.80^{b}	33.80±2.44^{ab}	43.63±0.68^{c}	37.73±2.29^{b}
108	1-Hydroxy-2-propanone	1271	1303	ND	4.17±0.25^{a}	ND	ND	ND	ND
109	6-Methyl-5-hepten-2-one	1313	1338	21.12±0.21^{a}	26.45±1.81^{b}	20.27±2.09^{a}	17.7±1.57^{a}	29.86±1.29^{b}	33.89±3.70^{c}
110	5-Decanone	1326	1373	0.27±0.03^{ab}	ND	0.26±0.02^{ab}	0.40±0.01^{b}	1.99±0.05^{c}	2.76±0.36^{d}
111	3-Nonanone	1333	1360	5.65±0.29^{c}	ND	0.78±0.10^{a}	ND	ND	2.07±0.18^{b}
112	2-Nonanone	1365	1390	24.78±2.41^{c}	10.87±1.02^{ab}	13.31±1.17^{b}	9.97±0.53^{a}	34.73±1.72^{d}	11.17±1.07^{ab}
113	3-Octen-2-one	1379	1411	10.12±0.37^{a}	27.89±2.65^{e}	14.05±1.41^{b}	20.43±1.58^{c}	15.50±0.20^{bc}	17.81±1.67^{cd}
114	(-)-α-Thujone	1391	1430	16.91±0.90^{c}	ND	ND	ND	2.13±0.25^{a}	3.31±0.06^{b}
115	δ-Camphor	1479	1527	5.30±0.15^{a}	14.01±0.42^{cd}	14.76±1.08^{d}	12.77±1.04^{c}	7.61±0.10^{b}	24.88±1.09^{e}
116	Isophorone	1553	1582	3.95±0.28^{c}	ND	0.61±0.02^{a}	ND	ND	1.06±0.07^{b}
117	3-Methyl-2-cyclohexen-1-one	1556	1583	ND	ND	0.47±0.07^{a}	ND	ND	ND
118	6-Methyl-3,5-heptadiene-2-one	1561	1602	5.05±0.56^{d}	2.76±0.32^{b}	2.09±0.30^{a}	2.83±0.26^{b}	3.13±0.16^{bc}	3.45±0.08^{c}
119	2-Undecanone	1571	1602	29.17±2.00^{c}	12.34±1.22^{a}	20.17±1.86^{b}	21.14±1.70^{b}	27.81±0.41^{c}	21.73±1.76^{b}
120	Acetophenone	1614	1647	5.68±0.29^{a}	5.75±0.22^{a}	5.81±0.51^{a}	8.85±0.82^{b}	15.23±0.39^{c}	15.57±1.70^{c}
121	Carvone	1696	1740	0.30±0.02^{a}	ND	ND	ND	ND	0.78±0.09^{b}
122	2-Tridecanone	1785	1809	0.74±0.11^{b}	ND	0.23±0.03^{a}	0.24±0.03^{a}	ND	1.07±0.10^{c}
123	6,10-Dimethyl-5,9-undecadien-2-one	1828	1859	2.83±0.21^{c}	1.28±0.10^{a}	1.16±0.17^{a}	1.40±0.11^{a}	1.69±0.13^{b}	1.21±0.19^{a}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
124	Trans-*β*-ionone	1904	1940	ND	ND	ND	ND	ND	0.41±0.04^{a}
125	4-Methoxyacetophenone	2104	2132	ND	0.19±0.03^{a}	ND	ND	ND	ND
126	Methoxy-benzine	1318	1349	0.61±0.07^{a}	ND	1.88±0.19^{b}	1.14±0.17^{ab}	12.51±1.31^{c}	15.63±0.81^{d}
127	1-Methoxy-4-methyl-benzene	1413	1434	2.41±0.08^{a}	16.07±0.90^{c}	6.06±0.61^{b}	ND	30.93±0.16^{d}	44.14±3.76^{e}
128	1,2-Dimethoxy-benzene	1698	1718	ND	1.90±0.15^{a}	ND	ND	14.50±0.51^{b}	15.41±1.57^{b}
129	1,3-Dimethoxy-benzene	1719	1740	ND	ND	ND	ND	2.41±0.04^{a}	2.23±0.25^{a}
130	(E)-1-Methoxy-4-(1-propenyl) benzene	1798	1817	0.89±0.10^{b}	1.28±0.10^{c}	ND	ND	ND	0.75±0.09^{a}
131	2-Pentyl-furan	1211	1231	ND	153.40±6.71^{b}	ND	152.91±9.59^{b}	ND	87.63±9.08^{a}
132	3-Furaldehyde	1440	1451	ND	ND	9.94±1.15^{a}	ND	ND	ND
133	Furfural	1440	1451	ND	9.86±0.82^{c}	ND	4.69±0.20^{b}	0.29±0.01^{a}	ND
134	2-Furanmethanol	1633	1660	9.00±0.88^{b}	16.92±0.48^{c}	25.77±1.70^{d}	28.24±1.56^{e}	6.52±0.13^{a}	6.09±0.53^{a}
135	Pantolactone	1998	2029	8.97±0.31^{c}	ND	ND	19.49±1.86^{d}	5.73±0.42^{b}	3.55±0.07^{a}
136	Butyrolactone	1591	1632	34.64±2.16^{c}	21.6±1.33^{b}	16.40±1.54^{a}	41.01±2.96^{d}	21.73±1.13^{b}	16.52±0.59^{a}
137	5-Ethyldihydro-2(3H)-furanone	1663	1694	10.40±0.59^{b}	10.31±0.90^{b}	7.95±0.79^{a}	12.57±1.20^{c}	12.80±1.14^{c}	ND
138	Tetrahydro-6-methyl-2H-pyran-2-one	1753	1791	1.32±0.23^{c}	0.94±0.11^{ab}	0.85±0.12^{a}	1.15±0.13^{bc}	0.96±0.03^{ab}	0.92±0.09^{ab}
139	Dihydro-5-propyl-2(3H)-furanone	1767	1787	1.50±0.15^{b}	0.93±0.12^{a}	ND	1.08±0.17^{a}	1.59±0.14^{b}	1.00±0.07^{a}
140	*γ*-Octanoic lactone	1882	1910	2.54±0.21^{ab}	6.59±0.64^{d}	2.25±0.25^{a}	3.82±0.28^{c}	2.96±0.35^{b}	2.28±0.18^{a}
141	Dihydro-5-pentyl-2(3H)-furanone	1998	2029	5.05±0.19^{c}	2.54±0.36^{a}	3.39±0.44^{b}	2.80±0.06^{a}	6.56±0.17^{d}	3.48±0.23^{b}
142	Dimethyl disulfide	1049	1074	6.40±0.85^{c}	8.12±0.59^{d}	1.87±0.32^{a}	2.01±0.13^{a}	4.43±0.65^{b}	10.75±1.34^{e}
143	Dimethyl trisulfide	1350	1377	ND	ND	ND	ND	7.71±0.56^{a}	9.97±0.76^{b}
144	Pyridine	1151	1185	4.21±0.56^{ab}	4.00±0.58^{ab}	3.55±0.33^{a}	3.93±0.35^{ab}	4.57±0.04^{bc}	5.36±0.56^{c}
145	Pyrazine	1186	1212	ND	7.27±0.56^{d}	2.48±0.27^{c}	1.53±0.08^{b}	0.96±0.18^{a}	1.25±0.18^{ab}
146	2-Methyl-pyrazine	1238	1266	0.69±0.09^{a}	32.29±2.39^{d}	10.90±1.03^{c}	4.58±0.53^{b}	3.95±0.47^{b}	5.64±0.62^{b}
147	3-Methyl-pyridine	1261	1287	8.52±0.55^{d}	2.97±0.29^{b}	3.19±0.37^{b}	4.26±0.46^{c}	0.98±0.05^{a}	1.40±0.11^{a}
148	2,5-Dimethyl-pyrazine	1293	1320	ND	3.84±0.18^{c}	2.98±0.41^{b}	1.78±0.22^{a}	3.43±0.36^{bc}	2.91±0.38^{b}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
149	2,6-Dimethyl-pyrazine	1298	1328	8.90±0.43^{a}	14.21±0.88^{c}	13.51±1.46^{bc}	7.76±0.76^{a}	15.01±1.15^{c}	12.17±1.15^{b}
150	2-Ethyl-pyrazine	1306	1337	ND	9.93±0.82^{c}	3.11±0.29^{b}	1.56±0.07^{a}	1.69±0.10^{a}	1.66±0.24^{a}
151	2,3-Dimethyl-pyrazine	1316	1344	0.39±0.06^{a}	7.40±0.30^{b}	ND	0.74±0.04^{a}	18.70±0.85^{d}	14.71±0.80^{c}
152	3-Ethyl-pyridine	1347	1377	ND	ND	0.21±0.02^{a}	ND	ND	ND
153	2,3,5-Trimethyl pyrazine	1372	1402	2.27±0.07^{a}	12.84±0.47^{c}	5.01±0.54^{b}	2.15±0.16^{a}	36.89±0.88^{e}	29.76±2.74^{d}
154	2,3-Dimethyl-5-ethylpyrazine	1430	1460	0.23±0.02^{a}	ND	ND	ND	7.27±0.21^{b}	8.32±0.69^{c}
155	Tetramethyl-pyrazine	1443	1469	1.41±0.05^{a}	27.42±2.22^{b}	6.65±0.67^{a}	2.21±0.34^{a}	142.95±0.54^{c}	147.22±13.88^{c}
156	2-Pentyl-pyridine	1541	1578	ND	0.64±0.05^{b}	ND	0.49±0.05^{a}	ND	0.72±0.10^{b}
157	1-(2-Pyridinyl)-ethanone	1568	1597	ND	ND	ND	0.69±0.08^{a}	ND	ND
158	1-Methyl-2-pyrrolidinone	1628	1665	0.47±0.05^{a}	ND	ND	ND	ND	ND
159	1-(1H-Pyrrol-2-yl)-ethanone	1943	1973	0.46±0.04^{a}	2.61±0.39^{c}	4.84±0.61^{d}	1.25±0.10^{b}	ND	ND
160	Benzothiazole	1918	1958	0.46±0.04^{a}	ND	ND	ND	1.89±0.04^{b}	2.71±0.16^{c}
161	2-Methoxy-phenol	1831	1861	1.31±0.16^{b}	ND	ND	ND	ND	0.93±0.02^{a}
162	Phenol	1978	2000	8.05±0.54^{a}	7.84±0.38^{a}	ND	ND	ND	29.90±1.48^{b}
163	4-Ethyl-2-methoxy-phenol	2003	2032	1.35±0.11^{a}	6.47±0.06^{c}	ND	2.81±0.23^{b}	3.09±0.40^{b}	3.03±0.43^{b}
164	3-Methyl-phenol	2061	2091	3.87±0.39^{b}	ND	1.13±0.06^{a}	ND	ND	3.69±0.24^{b}
165	p-Methyiphenol	2050	2080	1.11±0.12^{a}	4.06±0.38^{b}	ND	5.43±0.50^{c}	7.61±0.73^{d}	7.19±0.65^{d}
166	4-Allyl-2-methoxy-pheno	2133	2171	ND	1.58±0.23^{b}	ND	0.89±0.03^{a}	ND	ND
167	2-Isopropyl-5-methyl-pheno	2151	2189	ND	ND	ND	0.49±0.05^{a}	ND	ND
168	2-Nonene	926	943	ND	ND	9.62±0.69^{ab}	ND	21.35±0.84^{b}	94.70±16.30^{c}
169	Trans-4-decene	1008	1039	247.36±24.02^{d}	ND	69.01±12.36^{b}	37.83±3.38^{a}	187.28±18.64^{c}	ND
170	α-Pinene	1007	1028	ND	ND	ND	ND	ND	646.10±32.50^{a}
171	Camphene	1042	1071	ND	ND	0.89±0.09^{a}	ND	ND	1202.16±143.23^{b}
172	4-Methylene-1-(1-methylethyl)-bicyclo[3.1.0]hexane	1099	1124	3.45±0.47^{b}	ND	0.96±0.11^{ab}	2.20±0.29^{ab}	ND	40.22±3.93^{c}
173	5-Undecene	1121	1092	ND	ND	52.61±5.22^{a}	46.40±4.53^{a}	89.94±5.99^{b}	121.95±14.42^{c}

number	Volatile flavor compound	RI	NIST RI	Contents (μg/kg)					
				TJQY	HJQF	HJQW	HJQY	FMQ	FZQ
174	1-Undecene	1129	1147	142.58±13.66^{c}	ND	32.26±3.15^{a}	39.17±3.68^{a}	119.00±7.72^{b}	191.69±18.66^{d}
175	7-Methyl-3-methylene-1,6-octadiene	1143	1161	26.90±1.70^{c}	ND	0.67±0.05^{a}	5.94±0.55^{b}	ND	66.83±5.50^{d}
176	(1-Methylethyl)-benzene	1149	1178	30.17±2.60^{d}	0.5±0.02^{a}	8.74±0.86^{b}	10.6±0.86^{b}	25.38±2.40^{c}	49.66±4.12^{e}
177	Limonene	1176	1200	61.80±2.70^{b}	ND	ND	ND	22.16±0.64^{a}	185.87±15.53^{c}
178	*γ*-Terpinene	1224	1246	1.87±0.26^{ab}	1.65±0.17^{ab}	2.29±0.26^{ab}	2.78±0.42^{b}	ND	85.09±3.38^{c}
179	3,7-Dimethyl-1,3,6-octatriene	1232	1250	0.27±0.04^{a}	ND	ND	ND	ND	3.50±0.55^{b}
180	Ethenyl benzene	1234	1261	58.52±3.08^{c}	34.82±1.03^{b}	20.16±0.87^{a}	19.36±1.64^{a}	72.97±0.64^{d}	117.92±9.12^{e}
181	1-Methyl-4-(1-methylethyl)-benzen	1246	1272	ND	7.42±0.39^{a}	6.77±0.65^{a}	ND	ND	261.51±20.93^{b}
182	1-Methyl-4-(1-methylethylidene)-cyclohexene	1259	1283	0.73±0.06^{ab}	0.93±0.10^{abc}	1.36±0.16^{bc}	1.87±0.21^{c}	ND	11.28±1.36^{d}
183	(Z)-4-Tridecene	1322	1334	38.44±4.19^{a}	ND	ND	ND	50.99±4.47^{b}	66.65±4.39^{c}
184	1-Tridecene	1334	1343	80.64±2.19^{b}	ND	13.53±1.33^{a}	15.47±1.06^{a}	76.66±3.46^{b}	99.27±5.01^{c}
185	Copaene	1470	1492	9.56±0.34^{a}	ND	ND	ND	ND	34.06±3.56^{b}
186	*β*-Caryophyllene	1567	1595	12.30±0.93^{a}	143.04±4.95^{d}	33.85±3.42^{b}	56.91±3.27^{c}	16.62±0.33^{a}	39.22±3.25^{b}
187	*α*-Caryophyllene	1637	1667	1.03±0.12^{a}	5.73±0.03^{e}	1.84±0.27^{b}	3.14±0.10^{c}	ND	3.55±0.23^{d}
188	2,6,10,14-Tetramethyl-pentadecane	1676	1670	ND	ND	ND	ND	4.38±0.32^{a}	8.57±0.47^{b}
189	Naphthalene	1701	1745	4.13±0.23^{a}	17.46±1.21^{b}	24.42±2.46^{c}	34.66±1.95^{d}	6.14±0.23^{a}	15.08±1.51^{b}
190	2-Methyl-naphthalene	1815	1858	0.30±0.02^{a}	7.27±0.69^{c}	10.51±0.96^{d}	12.36±0.91^{e}	3.72±0.50^{b}	7.30±0.66^{c}
191	1-Methyl-naphthalene	1853	1884	1.08±0.06^{a}	3.64±0.39^{b}	6.27±0.64^{c}	7.43±0.38^{d}	ND	4.15±0.18^{b}

ND -, not detected; The letters a, b, c were used to indicate the significance, the same marked letter was not significant difference ($P \geqslant 0.05$), different marked letter was significant difference ($P < 0.05$).

Table S2. The relationship between flavor compounds and dominant microbial genera

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*unclassified_o__Saccharomycetales*	Ethyl Acetate	0.0499	-0.8117
interacts with	*Saccharomycopsis*	Pentanoic acid ethyl ester	0.0416	0.8286

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Lactococcus*	2-Nonanone	0.0048	-0.9429
interacts with	*Weissella*	2-Nonanone	0.0188	0.8857
interacts with	*Millerozyma*	2-Nonanone	0.0244	-0.8697
interacts with	*Wickerhamomyces*	2-Nonanone	0.0416	0.8286
interacts with	*Rhizopus*	3-Octen-2-one	0.0048	-0.9429
interacts with	*Saccharomycopsis*	3-Octen-2-one	0.0188	0.8857
interacts with	*unclassified_f__Enterobacteriaceae*	(-)-α-Thujone	0.0458	0.8197
interacts with	*Acetobacter*	(-)-α-Thujone	0.0401	-0.8317
interacts with	*Kosakonia*	(-)-α-Thujone	0.0051	0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	(-)-α-Thujone	0.0206	-0.8804
interacts with	*Weissella*	(-)-α-Thujone	0.0206	0.8804
interacts with	*Millerozyma*	(-)-α-Thujone	0.0401	-0.8317
interacts with	*Leuconostoc*	Isophorone	0.0206	-0.8804
interacts with	*Apiotrichum*	6-Methyl-3,5-heptadiene-2-one	0.0499	-0.8117
interacts with	*unclassified_f__Enterobacteriaceae*	6-Methyl-3,5-heptadiene-2-one	0.0149	0.8986
interacts with	*Pseudomonas*	6-Methyl-3,5-heptadiene-2-one	0.0361	-0.8407
interacts with	*Rhodococcus*	6-Methyl-3,5-heptadiene-2-one	0.0361	-0.8407
interacts with	*Kosakonia*	6-Methyl-3,5-heptadiene-2-one	0.0149	0.8986
interacts with	*unclassified_k__norank_d__Bacteria*	6-Methyl-3,5-heptadiene-2-one	0.0077	-0.9276
interacts with	*Kodamaea*	2-Undecanone	0.0048	-0.9429
interacts with	*Issatchenkia*	2-Undecanone	0.0048	-0.9429
interacts with	*Candida*	2-Undecanone	0.0048	-0.9429
interacts with	*Kozakia*	2-Undecanone	0.0341	-0.8452
interacts with	*Acetobacter*	2-Undecanone	0.0003	-0.9856
interacts with	*Kosakonia*	2-Undecanone	0.0048	0.9429
interacts with	*Weissella*	2-Undecanone	0.0416	0.8286
interacts with	*Millerozyma*	2-Undecanone	0.0077	-0.9276
interacts with	*Pseudomonas*	Carvone	0.0341	-0.8452

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Rhodococcus*	Carvone	0.0341	-0.8452
interacts with	*Staphylococcus*	Carvone	0.0341	0.8452
interacts with	*Leuconostoc*	Carvone	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	Carvone	0.0341	-0.8452
interacts with	*Leuconostoc*	2-Tridecanone	0.0012	-0.9710
interacts with	*Clavispora*	Acetic acid pentyl ester	0.0341	-0.8452
interacts with	*Apiotrichum*	Acetic acid pentyl ester	0.0341	-0.8452
interacts with	*Pediococcus*	Acetic acid pentyl ester	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	Acetic acid pentyl ester	0.0441	-0.8232
interacts with	*unclassified_f__Metschnikowiaceae*	Acetic acid pentyl ester	0.0341	-0.8452
interacts with	*Apiotrichum*	(1-Methylethyl)-benzene	0.0188	-0.8857
interacts with	*Kozakia*	(1-Methylethyl)-benzene	0.0341	-0.8452
interacts with	*unclassified_f__Enterobacteriaceae*	(1-Methylethyl)-benzene	0.0416	0.8286
interacts with	*Pseudomonas*	(1-Methylethyl)-benzene	0.0188	-0.8857
interacts with	*Rhodococcus*	(1-Methylethyl)-benzene	0.0188	-0.8857
interacts with	*Acetobacter*	(1-Methylethyl)-benzene	0.0499	-0.8117
interacts with	*Kosakonia*	(1-Methylethyl)-benzene	0.0048	0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	(1-Methylethyl)-benzene	0.0048	-0.9429
interacts with	*Pediococcus*	(1-Methylethyl)-benzene	0.0048	0.9429
interacts with	*Geotrichum*	Ethenyl benzene	0.0188	-0.8857
interacts with	*Clavispora*	Ethenyl benzene	0.0048	-0.9429
interacts with	*Apiotrichum*	Ethenyl benzene	0.0416	-0.8286
interacts with	*unclassified_f__Metschnikowiaceae*	Ethenyl benzene	0.0048	-0.9429
interacts with	*Wickerhamomyces*	Ethenyl benzene	0.0416	0.8286
interacts with	*norank_f__norank_o__Chloroplast*	1-Methyl-4-(1-methylethyl)-benzen	0.0206	-0.8804
interacts with	*unclassified_o__Saccharomycetales*	1-Methoxy-4-methyl-benzene	0.0499	-0.8117
interacts with	*Acinetobacter*	Benzaldehyde	0.0416	-0.8286
interacts with	*Clavispora*	Benzeneacetaldehyde	0.0048	0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Apiotrichum*	Benzeneacetaldehyde	0.0416	0.8286
interacts with	*Pediococcus*	Benzeneacetaldehyde	0.0048	-0.9429
interacts with	*unclassified_f__Metschnikowiaceae*	Benzeneacetaldehyde	0.0048	0.9429
interacts with	*Millerozyma*	Benzeneacetaldehyde	0.0499	0.8117
interacts with	*unclassified_o__Saccharomycetales*	Acetophenone	0.0199	-0.8824
interacts with	*unclassified_o__Saccharomycetales*	4-Methyl-Pentanoic acid ethyl ester	0.0003	-0.9856
interacts with	*Geotrichum*	Ethyl benzoate	0.0416	-0.8286
interacts with	*Kodamaea*	Ethyl benzoate	0.0048	-0.9429
interacts with	*Issatchenkia*	Ethyl benzoate	0.0048	-0.9429
interacts with	*Apiotrichum*	Ethyl benzoate	0.0188	-0.8857
interacts with	*Candida*	Ethyl benzoate	0.0048	-0.9429
interacts with	*Kozakia*	Ethyl benzoate	0.0341	-0.8452
interacts with	*Acetobacter*	Ethyl benzoate	0.0149	-0.8986
interacts with	*Pediococcus*	Ethyl benzoate	0.0048	0.9429
interacts with	*unclassified_f__Dipodascaceae*	Ethyl benzoate	0.0048	-0.9429
interacts with	*Millerozyma*	Ethyl benzoate	0.0361	-0.8407
interacts with	*unclassified_o__Saccharomycetales*	1,2-Dimethoxy-benzene	0.0084	-0.9241
interacts with	*Lactobacillus*	Naphthalene	0.0416	0.8286
interacts with	*Weissella*	Naphthalene	0.0048	-0.9429
interacts with	*Millerozyma*	Naphthalene	0.0499	0.8117
interacts with	*Wickerhamomyces*	Naphthalene	0.0048	-0.9429
interacts with	*Geotrichum*	1,3-Dimethoxy-benzene	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	1,3-Dimethoxy-benzene	0.0441	-0.8232
interacts with	*unclassified_f__Dipodascaceae*	1,3-Dimethoxy-benzene	0.0341	-0.8452
interacts with	*Clavispora*	n-Propyl benzoate	0.0048	-0.9429
interacts with	*Apiotrichum*	n-Propyl benzoate	0.0416	-0.8286
interacts with	*Pediococcus*	n-Propyl benzoate	0.0048	0.9429
interacts with	*unclassified_f__Metschnikowiaceae*	n-Propyl benzoate	0.0048	-0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Millerozyma*	n-Propyl benzoate	0.0499	-0.8117
interacts with	*Rhizopus*	Acetic acid 2-phenylethyl ester	0.0149	-0.8986
interacts with	*Millerozyma*	Acetic acid 2-phenylethyl ester	0.0440	0.8235
interacts with	*Lactobacillus*	2-Methyl-naphthalene	0.0149	0.8986
interacts with	*Weissella*	2-Methyl-naphthalene	0.0149	-0.8986
interacts with	*Wickerhamomyces*	2-Methyl-naphthalene	0.0077	-0.9276
interacts with	*Pseudomonas*	Butyl benzoate	0.0341	-0.8452
interacts with	*Rhodococcus*	Butyl benzoate	0.0341	-0.8452
interacts with	*Staphylococcus*	Butyl benzoate	0.0341	0.8452
interacts with	*Leuconostoc*	Butyl benzoate	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	Butyl benzoate	0.0341	-0.8452
interacts with	*Kodamaea*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Issatchenkia*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Apiotrichum*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Candida*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Kozakia*	Benzyl alcohol	0.0341	-0.8452
interacts with	*Pediococcus*	Benzyl alcohol	0.0188	0.8857
interacts with	*unclassified_f__Dipodascaceae*	Benzyl alcohol	0.0188	-0.8857
interacts with	*Lactococcus*	1-Methyl-naphthalene	0.0416	0.8286
interacts with	*Lactobacillus*	1-Methyl-naphthalene	0.0188	0.8857
interacts with	*Wickerhamomyces*	1-Methyl-naphthalene	0.0048	-0.9429
interacts with	*Clavispora*	Phenylethyl alcohol	0.0048	0.9429
interacts with	*Apiotrichum*	Phenylethyl alcohol	0.0416	0.8286
interacts with	*Pediococcus*	Phenylethyl alcohol	0.0048	-0.9429
interacts with	*unclassified_f__Metschnikowiaceae*	Phenylethyl alcohol	0.0048	0.9429
interacts with	*Millerozyma*	Phenylethyl alcohol	0.0499	0.8117
interacts with	*unclassified_o__Saccharomycetales*	2-Phenyl-2-butenal	0.0054	-0.9393
interacts with	*Apiotrichum*	2-Hydroxy-benzoicacimethylester	0.0188	-0.8857

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Kozakia*	2-Hydroxy-benzoicacimethylester	0.0341	-0.8452
interacts with	*Pediococcus*	2-Hydroxy-benzoicacimethylester	0.0048	0.9429
interacts with	*unclassified_f__Dipodascaceae*	2-Hydroxy-benzoicacimethylester	0.0416	-0.8286
interacts with	*Kodamaea*	2-Hydroxy-benzaldehyde	0.0188	0.8857
interacts with	*Issatchenkia*	2-Hydroxy-benzaldehyde	0.0188	0.8857
interacts with	*Candida*	2-Hydroxy-benzaldehyde	0.0188	0.8857
interacts with	*unclassified_f__Enterobacteriaceae*	2-Hydroxy-benzaldehyde	0.0416	-0.8286
interacts with	*Acetobacter*	2-Hydroxy-benzaldehyde	0.0077	0.9276
interacts with	*Kosakonia*	2-Hydroxy-benzaldehyde	0.0188	-0.8857
interacts with	*unclassified_k__norank_d__Bacteria*	2-Hydroxy-benzaldehyde	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	2-Hydroxy-benzaldehyde	0.0416	0.8286
interacts with	*Millerozyma*	2-Hydroxy-benzaldehyde	0.0499	0.8117
interacts with	*Rhizopus*	2-Pentyl-furan	0.0206	-0.8804
interacts with	*Saccharomycopsis*	2-Pentyl-furan	0.0206	0.8804
interacts with	*Millerozyma*	2-Pentyl-furan	0.0401	0.8317
interacts with	*Leuconostoc*	Furfural	0.0206	0.8804
interacts with	*Geotrichum*	2-Furanmethanol	0.0188	0.8857
interacts with	*Clavispora*	2-Furanmethanol	0.0048	0.9429
interacts with	*Apiotrichum*	2-Furanmethanol	0.0416	0.8286
interacts with	*unclassified_f__Metschnikowiaceae*	2-Furanmethanol	0.0048	0.9429
interacts with	*Wickerhamomyces*	2-Furanmethanol	0.0416	-0.8286
interacts with	*Kozakia*	Pantolactone	0.0441	-0.8232
interacts with	*Acinetobacter*	Pantolactone	0.0244	0.8697
interacts with	*norank_f__norank_o__Chloroplast*	5-Ethyldihydro-2(3H)-furanone	0.0416	0.8286
interacts with	*Acinetobacter*	Tetrahydro-6-methyl-2H-pyran-2-one	0.0499	0.8117
interacts with	*Kodamaea*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857
interacts with	*Issatchenkia*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857
interacts with	*Candida*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Acetobacter*	Dihydro-5-propyl-2(3H)-furanone	0.0244	-0.8697
interacts with	*unclassified_f__Dipodascaceae*	Dihydro-5-propyl-2(3H)-furanone	0.0416	-0.8286
interacts with	*Kodamaea*	Dihydro-5-propyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*Issatchenkia*	Dihydro-5-propyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*Candida*	Dihydro-5-propyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*Acetobacter*	Dihydro-5-propyl-2(3H)-furanone	0.0077	-0.9276
interacts with	*Weissella*	Dihydro-5-propyl-2(3H)-furanone	0.0188	0.8857
interacts with	*Millerozyma*	Dihydro-5-propyl-2(3H)-furanone	0.0003	-0.9856
interacts with	*Wickerhamomyces*	Dihydro-5-propyl-2(3H)-furanone	0.0416	0.8286
interacts with	*Clavispora*	Dimethyl trisulfide	0.0341	-0.8452
interacts with	*Apiotrichum*	Dimethyl trisulfide	0.0341	-0.8452
interacts with	*Pediococcus*	Dimethyl trisulfide	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	Dimethyl trisulfide	0.0441	-0.8232
interacts with	*unclassified_f__Metschnikowiaceae*	Dimethyl trisulfide	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	Acetic acid hexyl ester	0.0077	-0.9276
interacts with	*Geotrichum*	Pyridine	0.0048	-0.9429
interacts with	*Clavispora*	Pyridine	0.0416	-0.8286
interacts with	*Apiotrichum*	Pyridine	0.0048	-0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	Pyridine	0.0188	-0.8857
interacts with	*Pediococcus*	Pyridine	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	Pyridine	0.0188	-0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	Pyridine	0.0416	-0.8286
interacts with	*Kodamaea*	Pyrazine	0.0048	0.9429
interacts with	*Issatchenkia*	Pyrazine	0.0048	0.9429
interacts with	*Candida*	Pyrazine	0.0048	0.9429
interacts with	*Kozakia*	Pyrazine	0.0341	0.8452
interacts with	*Acetobacter*	Pyrazine	0.0003	0.9856
interacts with	*Kosakonia*	Pyrazine	0.0048	-0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Weissella*	Pyrazine	0.0416	-0.8286
interacts with	*Millerozyma*	Pyrazine	0.0077	0.9276
interacts with	*Kodamaea*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Issatchenkia*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Candida*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Kozakia*	2-Methyl-pyrazine	0.0341	0.8452
interacts with	*Acinetobacter*	2-Methyl-pyrazine	0.0416	-0.8286
interacts with	*Acetobacter*	2-Methyl-pyrazine	0.0077	0.9276
interacts with	*Kosakonia*	2-Methyl-pyrazine	0.0416	-0.8286
interacts with	*Millerozyma*	2-Methyl-pyrazine	0.0499	0.8117
interacts with	*unclassified_o__Saccharomycetales*	2-Methyl-pyrazine	0.0077	0.9276
interacts with	*Acinetobacter*	2,5-Dimethyl-pyrazine	0.0048	-0.9429
interacts with	*Kozakia*	2-Ethyl-pyrazine	0.0290	0.8575
interacts with	*unclassified_f__Enterobacteriaceae*	2-Ethyl-pyrazine	0.0361	-0.8407
interacts with	*Acinetobacter*	2-Ethyl-pyrazine	0.0003	-0.9856
interacts with	*Kosakonia*	2-Ethyl-pyrazine	0.0499	-0.8117
interacts with	*Geotrichum*	2,3-Dimethyl-pyrazine	0.0416	-0.8286
interacts with	*unclassified_o__Saccharomycetales*	2,3-Dimethyl-pyrazine	0.0077	-0.9276
interacts with	*unclassified_o__Saccharomycetales*	2,3,5-Trimethyl pyrazine	0.0499	-0.8117
interacts with	*Geotrichum*	2,3-Dimethyl-5-ethylpyrazine	0.0206	-0.8804
interacts with	*Clavispora*	2,3-Dimethyl-5-ethylpyrazine	0.0051	-0.9411
interacts with	*Apiotrichum*	2,3-Dimethyl-5-ethylpyrazine	0.0051	-0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	2,3-Dimethyl-5-ethylpyrazine	0.0206	-0.8804
interacts with	*Pediococcus*	2,3-Dimethyl-5-ethylpyrazine	0.0051	0.9411
interacts with	*unclassified_f__Dipodascaceae*	2,3-Dimethyl-5-ethylpyrazine	0.0206	-0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	2,3-Dimethyl-5-ethylpyrazine	0.0051	-0.9411
interacts with	*Rhizopus*	2-Pentyl-pyridine	0.0206	-0.8804
interacts with	*Geotrichum*	1-(1H-Pyrrol-2-yl)-ethanone	0.0077	0.9276

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Kodamaea*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*Issatchenkia*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*Apiotrichum*	1-(1H-Pyrrol-2-yl)-ethanone	0.0003	0.9856
interacts with	*Candida*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*unclassified_k__norank_d__Bacteria*	1-(1H-Pyrrol-2-yl)-ethanone	0.0149	0.8986
interacts with	*Pediococcus*	1-(1H-Pyrrol-2-yl)-ethanone	0.0077	-0.9276
interacts with	*unclassified_f__Dipodascaceae*	1-(1H-Pyrrol-2-yl)-ethanone	0.0003	0.9856
interacts with	*Geotrichum*	Benzothiazole	0.0206	-0.8804
interacts with	*Clavispora*	Benzothiazole	0.0051	-0.9411
interacts with	*Apiotrichum*	Benzothiazole	0.0051	-0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	Benzothiazole	0.0206	-0.8804
interacts with	*Pediococcus*	Benzothiazole	0.0051	0.9411
interacts with	*unclassified_f__Dipodascaceae*	Benzothiazole	0.0206	-0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	Benzothiazole	0.0051	-0.9411
interacts with	*unclassified_o__Saccharomycetales*	Tetramethyl-pyrazine	0.0077	-0.9276
interacts with	*unclassified_f__Enterobacteriaceae*	2-Methoxy-phenol	0.0341	0.8452
interacts with	*Kosakonia*	2-Methoxy-phenol	0.0341	0.8452
interacts with	*Staphylococcus*	Phenol	0.0051	0.9411
interacts with	*Leuconostoc*	3-Methyl-phenol	0.0206	-0.8804
interacts with	*unclassified_o__Saccharomycetales*	p-Methyiphenol	0.0244	-0.8697
interacts with	*unclassified_f__Dipodascaceae*	p-Methyiphenol	0.0416	-0.8286
interacts with	*Millerozyma*	4-Allyl-2-methoxy-pheno	0.0290	0.8575
interacts with	*Clavispora*	2-Nonene	0.0458	-0.8197
interacts with	*unclassified_f__Metschnikowiaceae*	2-Nonene	0.0458	-0.8197
interacts with	*Rhizopus*	Trans-4-decene	0.0077	0.9276
interacts with	*Pseudomonas*	4-Methylene-1-(1-methylethyl)-bicyclo[3.1.0]hexane	0.0499	-0.8117
interacts with	*Rhodococcus*	4-Methylene-1-(1-methylethyl)-bicyclo[3.1.0]hexane	0.0499	-0.8117
interacts with	*Leuconostoc*	4-Methylene-1-(1-methylethyl)-bicyclo[3.1.0]hexane	0.0077	-0.9276

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Apiotrichum*	1-Undecene	0.0188	-0.8857
interacts with	*Kozakia*	1-Undecene	0.0341	-0.8452
interacts with	*unclassified_f__Enterobacteriaceae*	1-Undecene	0.0416	0.8286
interacts with	*Pseudomonas*	1-Undecene	0.0188	-0.8857
interacts with	*Rhodococcus*	1-Undecene	0.0188	-0.8857
interacts with	*Acetobacter*	1-Undecene	0.0499	-0.8117
interacts with	*Kosakonia*	1-Undecene	0.0048	0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	1-Undecene	0.0048	-0.9429
interacts with	*Pediococcus*	1-Undecene	0.0048	0.9429
interacts with	*unclassified_o__Saccharomycetales*	Heptanoic acid ethyl ester	0.0244	-0.8697
interacts with	*unclassified_f__Dipodascaceae*	Heptanoic acid ethyl ester	0.0416	-0.8286
interacts with	*Pseudomonas*	7-Methyl-3-methylene-1,6-octadiene	0.0499	-0.8117
interacts with	*Rhodococcus*	7-Methyl-3-methylene-1,6-octadiene	0.0499	-0.8117
interacts with	*Leuconostoc*	7-Methyl-3-methylene-1,6-octadiene	0.0077	-0.9276
interacts with	*Clavispora*	Limonene	0.0206	-0.8804
interacts with	*Apiotrichum*	Limonene	0.0206	-0.8804
interacts with	*Pseudomonas*	Limonene	0.0458	-0.8197
interacts with	*Rhodococcus*	Limonene	0.0458	-0.8197
interacts with	*Kosakonia*	Limonene	0.0206	0.8804
interacts with	*unclassified_k__norank_d__Bacteria*	Limonene	0.0051	-0.9411
interacts with	*Pediococcus*	Limonene	0.0206	0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	Limonene	0.0206	-0.8804
interacts with	*Pseudomonas*	3,7-Dimethyl-1,3,6-octatriene	0.0341	-0.8452
interacts with	*Rhodococcus*	3,7-Dimethyl-1,3,6-octatriene	0.0341	-0.8452
interacts with	*Staphylococcus*	3,7-Dimethyl-1,3,6-octatriene	0.0341	0.8452
interacts with	*Leuconostoc*	3,7-Dimethyl-1,3,6-octatriene	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	3,7-Dimethyl-1,3,6-octatriene	0.0341	-0.8452
interacts with	*Lactococcus*	1-Methyl-4-(1-methylethylidene)-cyclohexene	0.0188	0.8857

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Lactobacillus*	1-Methyl-4-(1-methylethylidene)-cyclohexene	0.0188	0.8857
interacts with	*Apiotrichum*	1-Tridecene	0.0188	-0.8857
interacts with	*Kozakia*	1-Tridecene	0.0341	-0.8452
interacts with	*unclassified_f__Enterobacteriaceae*	1-Tridecene	0.0416	0.8286
interacts with	*Pseudomonas*	1-Tridecene	0.0188	-0.8857
interacts with	*Rhodococcus*	1-Tridecene	0.0188	-0.8857
interacts with	*Acetobacter*	1-Tridecene	0.0499	-0.8117
interacts with	*Kosakonia*	1-Tridecene	0.0048	0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	1-Tridecene	0.0048	-0.9429
interacts with	*Pediococcus*	1-Tridecene	0.0048	0.9429
interacts with	*Pseudomonas*	Copaene	0.0341	-0.8452
interacts with	*Rhodococcus*	Copaene	0.0341	-0.8452
interacts with	*Staphylococcus*	Copaene	0.0341	0.8452
interacts with	*Leuconostoc*	Copaene	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	Copaene	0.0341	-0.8452
interacts with	*Rhizopus*	*β*-Caryophyllene	0.0188	-0.8857
interacts with	*Acetobacter*	*β*-Caryophyllene	0.0499	0.8117
interacts with	*Weissella*	*β*-Caryophyllene	0.0188	-0.8857
interacts with	*Millerozyma*	*β*-Caryophyllene	0.0077	0.9276
interacts with	*Rhizopus*	*α*-Caryophyllene	0.0416	-0.8286
interacts with	*norank_f__norank_o__Chloroplast*	*α*-Caryophyllene	0.0416	-0.8286
interacts with	*Millerozyma*	*α*-Caryophyllene	0.0499	0.8117
interacts with	*Clavispora*	(L)-Ethyl lactate	0.0416	-0.8286
interacts with	*Kodamaea*	(L)-Ethyl lactate	0.0416	-0.8286
interacts with	*Issatchenkia*	(L)-Ethyl lactate	0.0416	-0.8286
interacts with	*Apiotrichum*	(L)-Ethyl lactate	0.0048	-0.9429
interacts with	*Candida*	(L)-Ethyl lactate	0.0416	-0.8286
interacts with	*Kozakia*	(L)-Ethyl lactate	0.0341	-0.8452

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Acetobacter*	(L)-Ethyl lactate	0.0499	-0.8117
interacts with	*Kosakonia*	(L)-Ethyl lactate	0.0416	0.8286
interacts with	*unclassified_k__norank_d__Bacteria*	(L)-Ethyl lactate	0.0188	-0.8857
interacts with	*Pediococcus*	(L)-Ethyl lactate	0.0000	1.0000
interacts with	*unclassified_f__Dipodascaceae*	(L)-Ethyl lactate	0.0188	-0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	(L)-Ethyl lactate	0.0416	-0.8286
interacts with	*Geotrichum*	(Z)-4-Tridecene	0.0206	-0.8804
interacts with	*Clavispora*	(Z)-4-Tridecene	0.0051	-0.9411
interacts with	*Apiotrichum*	(Z)-4-Tridecene	0.0051	-0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	(Z)-4-Tridecene	0.0206	-0.8804
interacts with	*Pediococcus*	(Z)-4-Tridecene	0.0051	0.9411
interacts with	*unclassified_f__Dipodascaceae*	(Z)-4-Tridecene	0.0206	-0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	(Z)-4-Tridecene	0.0051	-0.9411
interacts with	*Clavispora*	2,6,10,14-Tetramethyl-pentadecane	0.0341	-0.8452
interacts with	*Apiotrichum*	2,6,10,14-Tetramethyl-pentadecane	0.0341	-0.8452
interacts with	*Pediococcus*	2,6,10,14-Tetramethyl-pentadecane	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	2,6,10,14-Tetramethyl-pentadecane	0.0441	-0.8232
interacts with	*unclassified_f__Metschnikowiaceae*	2,6,10,14-Tetramethyl-pentadecane	0.0341	-0.8452
interacts with	*Rhizopus*	Propanoic acid ethyl ester	0.0499	-0.8117
interacts with	*Saccharomycopsis*	Propanoic acid ethyl ester	0.0003	0.9856
interacts with	*Pseudomonas*	Acetic acid heptyl ester	0.0341	-0.8452
interacts with	*Rhodococcus*	Acetic acid heptyl ester	0.0341	-0.8452
interacts with	*Staphylococcus*	Acetic acid heptyl ester	0.0341	0.8452
interacts with	*Leuconostoc*	Acetic acid heptyl ester	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	Acetic acid heptyl ester	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	Octanoic acid ethyl ester	0.0003	-0.9856
interacts with	*Geotrichum*	Nonanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Kodamaea*	Nonanoic acid ethyl ester	0.0048	-0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Issatchenkia*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Apiotrichum*	Nonanoic acid ethyl ester	0.0416	-0.8286
interacts with	*Candida*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Acetobacter*	Nonanoic acid ethyl ester	0.0077	-0.9276
interacts with	*unclassified_f__Dipodascaceae*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Millerozyma*	Nonanoic acid ethyl ester	0.0499	-0.8117
interacts with	*Wickerhamomyces*	Nonanoic acid ethyl ester	0.0416	0.8286
interacts with	*Pseudomonas*	Bornyl acetate	0.0341	-0.8452
interacts with	*Rhodococcus*	Bornyl acetate	0.0341	-0.8452
interacts with	*Staphylococcus*	Bornyl acetate	0.0341	0.8452
interacts with	*Leuconostoc*	Bornyl acetate	0.0341	-0.8452
interacts with	*unclassified_k__norank_d__Bacteria*	Bornyl acetate	0.0341	-0.8452
interacts with	*Geotrichum*	Decanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Kodamaea*	Decanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Issatchenkia*	Decanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Apiotrichum*	Decanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Candida*	Decanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Acetobacter*	Decanoic acid ethyl ester	0.0361	-0.8407
interacts with	*unclassified_k__norank_d__Bacteria*	Decanoic acid ethyl ester	0.0416	-0.8286
interacts with	*Pediococcus*	Decanoic acid ethyl ester	0.0188	0.8857
interacts with	*unclassified_f__Dipodascaceae*	Decanoic acid ethyl ester	0.0000	-1.0000
interacts with	*Geotrichum*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*Clavispora*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*Apiotrichum*	Butanedioic acid diethyl ester	0.0499	0.8117
interacts with	*unclassified_f__Dipodascaceae*	Butanedioic acid diethyl ester	0.0499	0.8117
interacts with	*unclassified_f__Metschnikowiaceae*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*Wickerhamomyces*	Butanedioic acid diethyl ester	0.0149	-0.8986
interacts with	*Geotrichum*	Undecanoic acid ethyl ester	0.0149	-0.8986

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Kodamaea*	Undecanoic acid ethyl ester	0.0077	-0.9276
interacts with	*Issatchenkia*	Undecanoic acid ethyl ester	0.0077	-0.9276
interacts with	*Apiotrichum*	Undecanoic acid ethyl ester	0.0077	-0.9276
interacts with	*Candida*	Undecanoic acid ethyl ester	0.0077	-0.9276
interacts with	*Kozakia*	Undecanoic acid ethyl ester	0.0441	-0.8232
interacts with	*Acetobacter*	Undecanoic acid ethyl ester	0.0199	-0.8824
interacts with	*unclassified_k__norank_d__Bacteria*	Undecanoic acid ethyl ester	0.0499	-0.8117
interacts with	*Pediococcus*	Undecanoic acid ethyl ester	0.0077	0.9276
interacts with	*unclassified_f__Dipodascaceae*	Undecanoic acid ethyl ester	0.0003	-0.9856
interacts with	*Kodamaea*	Dodecanoic acid ethyl ester	0.0000	-1.0000
interacts with	*Issatchenkia*	Dodecanoic acid ethyl ester	0.0000	-1.0000
interacts with	*Candida*	Dodecanoic acid ethyl ester	0.0000	-1.0000
interacts with	*Kozakia*	Dodecanoic acid ethyl ester	0.0341	-0.8452
interacts with	*Acetobacter*	Dodecanoic acid ethyl ester	0.0003	-0.9856
interacts with	*Kosakonia*	Dodecanoic acid ethyl ester	0.0416	0.8286
interacts with	*Pediococcus*	Dodecanoic acid ethyl ester	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	Dodecanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Millerozyma*	Dodecanoic acid ethyl ester	0.0077	-0.9276
interacts with	*unclassified_o__Saccharomycetales*	Tetradecanoic acid ethyl ester	0.0499	0.8117
interacts with	*Saccharomycopsis*	2-Methyl-propanoic acid ethyl ester	0.0051	0.9411
interacts with	*Lactococcus*	2-Methyl-propanoic acid ethyl ester	0.0206	0.8804
interacts with	*Weissella*	2-Methyl-propanoic acid ethyl ester	0.0458	-0.8197
interacts with	*Rhizopus*	Hexadecanoic acid ethyl ester	0.0188	0.8857
interacts with	*unclassified_o__Saccharomycetales*	Hexadecanoic acid ethyl ester	0.0149	0.8986
interacts with	*Clavispora*	2-Butanol	0.0341	-0.8452
interacts with	*Apiotrichum*	2-Butanol	0.0341	-0.8452
interacts with	*Pediococcus*	2-Butanol	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	2-Butanol	0.0441	-0.8232

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*unclassified_f__Metschnikowiaceae*	2-Butanol	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	2-Methyl-1-propanol	0.0077	-0.9276
interacts with	*Clavispora*	2-Pentanol	0.0341	-0.8452
interacts with	*Apiotrichum*	2-Pentanol	0.0341	-0.8452
interacts with	*Pediococcus*	2-Pentanol	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	2-Pentanol	0.0441	-0.8232
interacts with	*unclassified_f__Metschnikowiaceae*	2-Pentanol	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	1-Penten-3-ol	0.0013	-0.9706
interacts with	*unclassified_o__Saccharomycetales*	3-Methyl-1-butanol	0.0077	-0.9276
interacts with	*unclassified_o__Saccharomycetales*	2-Hexanol	0.0013	-0.9706
interacts with	*Clavispora*	Acetic acid, 2-methyl-propyl ester	0.0000	-1.0000
interacts with	*Pediococcus*	Acetic acid, 2-methyl-propyl ester	0.0416	0.8286
interacts with	*unclassified_f__Metschnikowiaceae*	Acetic acid, 2-methyl-propyl ester	0.0000	-1.0000
interacts with	*Rhizopus*	1-Pentanol	0.0048	-0.9429
interacts with	*unclassified_o__Saccharomycetales*	2-Heptanol	0.0013	-0.9706
interacts with	*Geotrichum*	3-Heptanol	0.0499	-0.8117
interacts with	*Clavispora*	3-Heptanol	0.0361	-0.8407
interacts with	*Apiotrichum*	3-Heptanol	0.0361	-0.8407
interacts with	*unclassified_k__norank_d__Bacteria*	3-Heptanol	0.0149	-0.8986
interacts with	*unclassified_f__Metschnikowiaceae*	3-Heptanol	0.0361	-0.8407
interacts with	*Apiotrichum*	1-Hexanol	0.0048	-0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	1-Hexanol	0.0416	-0.8286
interacts with	*Pediococcus*	1-Hexanol	0.0188	0.8857
interacts with	*unclassified_f__Dipodascaceae*	1-Hexanol	0.0188	-0.8857
interacts with	*Clavispora*	(Z)-3-Hexen-1-ol	0.0458	-0.8197
interacts with	*unclassified_f__Metschnikowiaceae*	(Z)-3-Hexen-1-ol	0.0458	-0.8197
interacts with	*Geotrichum*	3-Octanol	0.0048	-0.9429
interacts with	*Clavispora*	3-Octanol	0.0416	-0.8286

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Apiotrichum*	3-Octanol	0.0048	-0.9429
interacts with	*unclassified_k__norank_d__Bacteria*	3-Octanol	0.0188	-0.8857
interacts with	*Pediococcus*	3-Octanol	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	3-Octanol	0.0188	-0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	3-Octanol	0.0416	-0.8286
interacts with	*Clavispora*	2-Ethylhexanol	0.0416	-0.8286
interacts with	*unclassified_f__Metschnikowiaceae*	2-Ethylhexanol	0.0416	-0.8286
interacts with	*Acinetobacter*	2,3-Butanediol	0.0416	0.8286
interacts with	*Rhizopus*	Butanoic acid ethyl ester	0.0188	-0.8857
interacts with	*unclassified_f__Enterobacteriaceae*	3,7-Dimethyl-1,6-octadien-3-ol	0.0499	0.8117
interacts with	*Geotrichum*	1-Octanol	0.0416	-0.8286
interacts with	*Kodamaea*	1-Octanol	0.0048	-0.9429
interacts with	*Issatchenkia*	1-Octanol	0.0048	-0.9429
interacts with	*Apiotrichum*	1-Octanol	0.0188	-0.8857
interacts with	*Candida*	1-Octanol	0.0048	-0.9429
interacts with	*Kozakia*	1-Octanol	0.0341	-0.8452
interacts with	*Acetobacter*	1-Octanol	0.0149	-0.8986
interacts with	*Pediococcus*	1-Octanol	0.0048	0.9429
interacts with	*unclassified_f__Dipodascaceae*	1-Octanol	0.0048	-0.9429
interacts with	*Millerozyma*	1-Octanol	0.0361	-0.8407
interacts with	*unclassified_o__Saccharomycetales*	Fenchyl alcohol	0.0084	-0.9241
interacts with	*Geotrichum*	Propylene glycol	0.0341	-0.8452
interacts with	*unclassified_o__Saccharomycetales*	Propylene glycol	0.0441	-0.8232
interacts with	*unclassified_f__Dipodascaceae*	Propylene glycol	0.0341	-0.8452
interacts with	*Kodamaea*	(E)-2-Octen-1-ol	0.0000	-1.0000
interacts with	*Issatchenkia*	(E)-2-Octen-1-ol	0.0000	-1.0000
interacts with	*Candida*	(E)-2-Octen-1-ol	0.0000	-1.0000
interacts with	*Kozakia*	(E)-2-Octen-1-ol	0.0341	-0.8452

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Acetobacter*	(E)-2-Octen-1-ol	0.0003	-0.9856
interacts with	*Kosakonia*	(E)-2-Octen-1-ol	0.0416	0.8286
interacts with	*Pediococcus*	(E)-2-Octen-1-ol	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	(E)-2-Octen-1-ol	0.0188	-0.8857
interacts with	*Millerozyma*	(E)-2-Octen-1-ol	0.0077	-0.9276
interacts with	*Clavispora*	1-Nonanol	0.0416	-0.8286
interacts with	*Kodamaea*	1-Nonanol	0.0416	-0.8286
interacts with	*Issatchenkia*	1-Nonanol	0.0416	-0.8286
interacts with	*Apiotrichum*	1-Nonanol	0.0048	-0.9429
interacts with	*Candida*	1-Nonanol	0.0416	-0.8286
interacts with	*Kozakia*	1-Nonanol	0.0341	-0.8452
interacts with	*Acetobacter*	1-Nonanol	0.0499	-0.8117
interacts with	*Kosakonia*	1-Nonanol	0.0416	0.8286
interacts with	*unclassified_k__norank_d__Bacteria*	1-Nonanol	0.0188	-0.8857
interacts with	*Pediococcus*	1-Nonanol	0.0000	1.0000
interacts with	*unclassified_f__Dipodascaceae*	1-Nonanol	0.0188	-0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	1-Nonanol	0.0416	-0.8286
interacts with	*Geotrichum*	2-Nonen-1-ol	0.0188	-0.8857
interacts with	*Apiotrichum*	2-Nonen-1-ol	0.0000	-1.0000
interacts with	*Pseudomonas*	2-Nonen-1-ol	0.0416	-0.8286
interacts with	*Rhodococcus*	2-Nonen-1-ol	0.0416	-0.8286
interacts with	*unclassified_k__norank_d__Bacteria*	2-Nonen-1-ol	0.0048	-0.9429
interacts with	*Pediococcus*	2-Nonen-1-ol	0.0048	0.9429
interacts with	*unclassified_f__Dipodascaceae*	2-Nonen-1-ol	0.0048	-0.9429
interacts with	*Pseudomonas*	2-Undecanol	0.0341	-0.8452
interacts with	*Rhodococcus*	2-Undecanol	0.0341	-0.8452
interacts with	*Staphylococcus*	2-Undecanol	0.0341	0.8452
interacts with	*Leuconostoc*	2-Undecanol	0.0341	-0.8452

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*unclassified_k__norank_d__Bacteria*	2-Undecanol	0.0341	-0.8452
interacts with	*Geotrichum*	1-Decanol	0.0206	-0.8804
interacts with	*Clavispora*	1-Decanol	0.0051	-0.9411
interacts with	*Apiotrichum*	1-Decanol	0.0051	-0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	1-Decanol	0.0206	-0.8804
interacts with	*Pediococcus*	1-Decanol	0.0051	0.9411
interacts with	*unclassified_f__Dipodascaceae*	1-Decanol	0.0206	-0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	1-Decanol	0.0051	-0.9411
interacts with	*Leuconostoc*	1-Dodecanol	0.0198	-0.8827
interacts with	*unclassified_o__Saccharomycetales*	Isoborneol	0.0084	-0.9241
interacts with	*Saccharomycopsis*	Acetic acid	0.0000	1.0000
interacts with	*Geotrichum*	Formic acid	0.0206	-0.8804
interacts with	*Clavispora*	Formic acid	0.0051	-0.9411
interacts with	*Apiotrichum*	Formic acid	0.0051	-0.9411
interacts with	*unclassified_k__norank_d__Bacteria*	Formic acid	0.0206	-0.8804
interacts with	*Pediococcus*	Formic acid	0.0051	0.9411
interacts with	*unclassified_f__Dipodascaceae*	Formic acid	0.0206	-0.8804
interacts with	*unclassified_f__Metschnikowiaceae*	Formic acid	0.0051	-0.9411
interacts with	*Clavispora*	2-Methyl-propanoic acid	0.0188	0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	2-Methyl-propanoic acid	0.0188	0.8857
interacts with	*Rhizopus*	3-Methyl-butanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Saccharomycopsis*	3-Methyl-butanoic acid ethyl ester	0.0048	0.9429
interacts with	*Staphylococcus*	2-Methyl-pentanoic acid	0.0149	-0.8986
interacts with	*norank_f__norank_o__Chloroplast*	2-Methyl-pentanoic acid	0.0244	0.8697
interacts with	*Geotrichum*	Hexanoic acid	0.0416	-0.8286
interacts with	*Apiotrichum*	Hexanoic acid	0.0188	-0.8857
interacts with	*Pediococcus*	Hexanoic acid	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	Hexanoic acid	0.0048	-0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*unclassified_o__Saccharomycetales*	Heptanoic acid	0.0244	-0.8697
interacts with	*unclassified_f__Dipodascaceae*	Heptanoic acid	0.0416	-0.8286
interacts with	*Geotrichum*	Octanoic acid	0.0416	-0.8286
interacts with	*Apiotrichum*	Octanoic acid	0.0188	-0.8857
interacts with	*Pediococcus*	Octanoic acid	0.0416	0.8286
interacts with	*unclassified_f__Dipodascaceae*	Octanoic acid	0.0048	-0.9429
interacts with	*Geotrichum*	Nonanoic acid	0.0206	-0.8804
interacts with	*Kodamaea*	Nonanoic acid	0.0051	-0.9411
interacts with	*Issatchenkia*	Nonanoic acid	0.0051	-0.9411
interacts with	*Candida*	Nonanoic acid	0.0051	-0.9411
interacts with	*Acetobacter*	Nonanoic acid	0.0084	-0.9241
interacts with	*Weissella*	Nonanoic acid	0.0206	0.8804
interacts with	*unclassified_f__Dipodascaceae*	Nonanoic acid	0.0206	-0.8804
interacts with	*Millerozyma*	Nonanoic acid	0.0084	-0.9241
interacts with	*Wickerhamomyces*	Nonanoic acid	0.0051	0.9411
interacts with	*Kozakia*	Hexanal	0.0341	0.8452
interacts with	*Acetobacter*	(E)-2-Methyl-2-butenal	0.0499	0.8117
interacts with	*Weissella*	(E)-2-Methyl-2-butenal	0.0000	-1.0000
interacts with	*Millerozyma*	(E)-2-Methyl-2-butenal	0.0077	0.9276
interacts with	*Wickerhamomyces*	(E)-2-Methyl-2-butenal	0.0188	-0.8857
interacts with	*Rhizopus*	Nonanal	0.0416	0.8286
interacts with	*Geotrichum*	(E)-2-Octenal	0.0003	-0.9856
interacts with	*Clavispora*	(E)-2-Octenal	0.0361	-0.8407
interacts with	*Apiotrichum*	(E)-2-Octenal	0.0361	-0.8407
interacts with	*unclassified_f__Dipodascaceae*	(E)-2-Octenal	0.0149	-0.8986
interacts with	*unclassified_f__Metschnikowiaceae*	(E)-2-Octenal	0.0361	-0.8407
interacts with	*Wickerhamomyces*	(E)-2-Octenal	0.0077	0.9276
interacts with	*Kozakia*	5-Methyl-2-furanaldehyde	0.0427	0.8262

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Rhizopus*	Hendecanaldehyde	0.0341	0.8452
interacts with	*unclassified_o__Saccharomycetales*	Hendecanaldehyde	0.0290	0.8575
interacts with	*Clavispora*	(E)-2-Decenal	0.0198	-0.8827
interacts with	*unclassified_f__Metschnikowiaceae*	(E)-2-Decenal	0.0198	-0.8827
interacts with	*Kodamaea*	2-Octenal, 2-butyl-	0.0048	0.9429
interacts with	*Issatchenkia*	2-Octenal, 2-butyl-	0.0048	0.9429
interacts with	*Candida*	2-Octenal, 2-butyl-	0.0048	0.9429
interacts with	*Acetobacter*	2-Octenal, 2-butyl-	0.0077	0.9276
interacts with	*Weissella*	2-Octenal, 2-butyl-	0.0188	-0.8857
interacts with	*Millerozyma*	2-Octenal, 2-butyl-	0.0003	0.9856
interacts with	*Wickerhamomyces*	2-Octenal, 2-butyl-	0.0416	-0.8286
interacts with	*Lactococcus*	Decyl aldehyde	0.0198	-0.8827
interacts with	*Weissella*	Decyl aldehyde	0.0112	0.9122
interacts with	*Millerozyma*	Decyl aldehyde	0.0081	-0.9255
interacts with	*Geotrichum*	2-Pentanone	0.0188	-0.8857
interacts with	*Apiotrichum*	2-Pentanone	0.0416	-0.8286
interacts with	*unclassified_o__Saccharomycetales*	2-Pentanone	0.0499	-0.8117
interacts with	*unclassified_o__Saccharomycetales*	3-Methyl-1-butanol acetate	0.0077	-0.9276
interacts with	*Acinetobacter*	(E)-3-Penten-2-one	0.0416	-0.8286
interacts with	*Apiotrichum*	4-Methyl-3-penten-2-one	0.0458	-0.8197
interacts with	*Pediococcus*	4-Methyl-3-penten-2-one	0.0458	0.8197
interacts with	*unclassified_o__Saccharomycetales*	3-Octanone	0.0077	-0.9276
interacts with	*Apiotrichum*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*Pseudomonas*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*Rhodococcus*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*unclassified_o__Saccharomycetales*	2-Octanone	0.0077	-0.9276
interacts with	*Geotrichum*	6-Methyl-5-hepten-2-one	0.0416	-0.8286
interacts with	*Clavispora*	6-Methyl-5-hepten-2-one	0.0416	-0.8286

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*unclassified_f__Metschnikowiaceae*	6-Methyl-5-hepten-2-one	0.0416	-0.8286
interacts with	*Apiotrichum*	5-Decanone	0.0499	-0.8117
interacts with	*Pediococcus*	5-Decanone	0.0149	0.8986
interacts with	*Leuconostoc*	3-Nonanone	0.0206	-0.8804

Table S3. The relationship between flavor compounds (VIP > 1) and dominant microbial genera

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Saccharomycopsis*	Acetic acid	0	1
interacts with	*Saccharomycopsis*	Propanoic acid ethyl ester	3.00E-04	0.9856
interacts with	*Apiotrichum*	1-(1H-Pyrrol-2-yl)-ethanone	3.00E-04	0.9856
interacts with	*unclassified_f__Dipodascaceae*	1-(1H-Pyrrol-2-yl)-ethanone	3.00E-04	0.9856
interacts with	*Acetobacter*	Pyrazine	3.00E-04	0.9856
interacts with	*Saccharomycopsis*	3-Methyl-butanoic acid ethyl ester	0.0048	0.9429
interacts with	*Candida*	Pyrazine	0.0048	0.9429
interacts with	*Issatchenkia*	Pyrazine	0.0048	0.9429
interacts with	*Kodamaea*	Pyrazine	0.0048	0.9429
interacts with	*Clavispora*	2-Furanmethanol	0.0048	0.9429
interacts with	*unclassified_f__Metschnikowiaceae*	2-Furanmethanol	0.0048	0.9429
interacts with	*Saccharomycopsis*	2-Methyl-propanoic acid ethyl ester	0.0051	0.9411
interacts with	*Kosakonia*	(-)-*α*-Thujone	0.0051	0.9411
interacts with	*Rhizopus*	Trans-4-decene	0.0077	0.9276
interacts with	*Clavispora*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*Geotrichum*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*Geotrichum*	1-(1H-Pyrrol-2-yl)-ethanone	0.0077	0.9276
interacts with	*Millerozyma*	(E)-2-Methyl-2-butenal	0.0077	0.9276
interacts with	*Millerozyma*	Pyrazine	0.0077	0.9276

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Millerozyma*	*β*-Caryophyllene	0.0077	0.9276
interacts with	*unclassified_f__Metschnikowiaceae*	Butanedioic acid diethyl ester	0.0077	0.9276
interacts with	*unclassified_o__Saccharomycetales*	3-Methyl-pyridine	0.0077	0.9276
interacts with	*Acetobacter*	2-Methyl-pyrazine	0.0077	0.9276
interacts with	*Weissella*	Decyl aldehyde	0.0112	0.9122
interacts with	*unclassified_k__norank_d__Bacteria*	1-(1H-Pyrrol-2-yl)-ethanone	0.0149	0.8986
interacts with	*Lactobacillus*	2-Methyl-naphthalene	0.0149	0.8986
interacts with	*Kosakonia*	6-Methyl-3,5-heptadiene-2-one	0.0149	0.8986
interacts with	*unclassified_f__Enterobacteriaceae*	6-Methyl-3,5-heptadiene-2-one	0.0149	0.8986
interacts with	*Candida*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Issatchenkia*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Kodamaea*	2-Methyl-pyrazine	0.0188	0.8857
interacts with	*Clavispora*	2-Methyl-propanoic acid	0.0188	0.8857
interacts with	*Geotrichum*	2-Furanmethanol	0.0188	0.8857
interacts with	*unclassified_f__Metschnikowiaceae*	2-Methyl-propanoic acid	0.0188	0.8857
interacts with	*Weissella*	2-Nonanone	0.0188	0.8857
interacts with	*Weissella*	Dihydro-5-pentyl-2(3H)-furanone	0.0188	0.8857
interacts with	*Pediococcus*	Benzyl alcohol	0.0188	0.8857
interacts with	*Lactobacillus*	1-Methyl-naphthalene	0.0188	0.8857
interacts with	*Saccharomycopsis*	2-Pentyl-furan	0.0206	0.8804
interacts with	*Weissella*	(-)-*α*-Thujone	0.0206	0.8804
interacts with	*Leuconostoc*	Furfural	0.0206	0.8804
interacts with	*Lactococcus*	2-Methyl-propanoic acid ethyl ester	0.0206	0.8804
interacts with	*norank_f__norank_o__Chloroplast*	2-Methyl-pentanoic acid	0.0244	0.8697
interacts with	*Acinetobacter*	Pantolactone	0.0244	0.8697
interacts with	*Millerozyma*	4-Allyl-2-methoxy-pheno	0.029	0.8575
interacts with	*unclassified_o__Saccharomycetales*	Hendecanaldehyde	0.029	0.8575
interacts with	*Kozakia*	2-Ethyl-pyrazine	0.029	0.8575

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Rhizopus*	Hendecanaldehyde	0.0341	0.8452
interacts with	*Kosakonia*	2-Methoxy-phenol	0.0341	0.8452
interacts with	*unclassified_f__Enterobacteriaceae*	2-Methoxy-phenol	0.0341	0.8452
interacts with	*Kozakia*	Hexanal	0.0341	0.8452
interacts with	*Kozakia*	Pyrazine	0.0341	0.8452
interacts with	*Kozakia*	2-Methyl-pyrazine	0.0341	0.8452
interacts with	*Candida*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*Issatchenkia*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*Kodamaea*	1-(1H-Pyrrol-2-yl)-ethanone	0.0361	0.8407
interacts with	*Millerozyma*	2-Pentyl-furan	0.0401	0.8317
interacts with	*Wickerhamomyces*	Nonanoic acid ethyl ester	0.0416	0.8286
interacts with	*Wickerhamomyces*	2-Nonanone	0.0416	0.8286
interacts with	*Wickerhamomyces*	Dihydro-5-pentyl-2(3H)-furanone	0.0416	0.8286
interacts with	*Saccharomycopsis*	Pentanoic acid ethyl ester	0.0416	0.8286
interacts with	*Rhizopus*	Nonanal	0.0416	0.8286
interacts with	*Apiotrichum*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*Apiotrichum*	2-Furanmethanol	0.0416	0.8286
interacts with	*Pediococcus*	Octanoic acid	0.0416	0.8286
interacts with	*Lactobacillus*	Naphthalene	0.0416	0.8286
interacts with	*Lactococcus*	1-Methyl-naphthalene	0.0416	0.8286
interacts with	*norank_f__norank_o__Chloroplast*	5-Ethyldihydro-2(3H)-furanone	0.0416	0.8286
interacts with	*Rhodococcus*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*Acinetobacter*	2,3-Butanediol	0.0416	0.8286
interacts with	*Pseudomonas*	3-Hydroxy-2-oxobutane	0.0416	0.8286
interacts with	*Kozakia*	5-Methyl-2-furanaldehyde	0.0427	0.8262
interacts with	*Millerozyma*	Acetic acid 2-phenylethyl ester	0.044	0.8235
interacts with	*unclassified_f__Enterobacteriaceae*	(-)-*α*-Thujone	0.0458	0.8197
interacts with	*Apiotrichum*	Butanedioic acid diethyl ester	0.0499	0.8117

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Millerozyma*	Naphthalene	0.0499	0.8117
interacts with	*Millerozyma*	2-Methyl-pyrazine	0.0499	0.8117
interacts with	*Millerozyma*	*α*-Caryophyllene	0.0499	0.8117
interacts with	*unclassified_f__Dipodascaceae*	Butanedioic acid diethyl ester	0.0499	0.8117
interacts with	*unclassified_o__Saccharomycetales*	Tetradecanoic acid ethyl ester	0.0499	0.8117
interacts with	*Acetobacter*	(E)-2-Methyl-2-butenal	0.0499	0.8117
interacts with	*Acetobacter*	*β*-Caryophyllene	0.0499	0.8117
interacts with	*Acinetobacter*	Tetrahydro-6-methyl-2H-pyran-2-one	0.0499	0.8117
interacts with	*unclassified_f__Enterobacteriaceae*	3,7-Dimethyl-1,6-octadien-3-ol	0.0499	0.8117
interacts with	*Rhizopus*	Propanoic acid ethyl ester	0.0499	-0.8117
interacts with	*Apiotrichum*	6-Methyl-3,5-heptadiene-2-one	0.0499	-0.8117
interacts with	*Millerozyma*	Nonanoic acid ethyl ester	0.0499	-0.8117
interacts with	*Kosakonia*	2-Ethyl-pyrazine	0.0499	-0.8117
interacts with	*Weissella*	2-Methyl-propanoic acid ethyl ester	0.0458	-0.8197
interacts with	*Kozakia*	Pantolactone	0.0441	-0.8232
interacts with	*Wickerhamomyces*	2-Furanmethanol	0.0416	-0.8286
interacts with	*Rhizopus*	*α*-Caryophyllene	0.0416	-0.8286
interacts with	*Candida*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Apiotrichum*	Nonanoic acid ethyl ester	0.0416	-0.8286
interacts with	*Apiotrichum*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Issatchenkia*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Kodamaea*	Benzyl alcohol	0.0416	-0.8286
interacts with	*Geotrichum*	Octanoic acid	0.0416	-0.8286
interacts with	*unclassified_f__Dipodascaceae*	Heptanoic acid ethyl ester	0.0416	-0.8286
interacts with	*unclassified_f__Dipodascaceae*	Heptanoic acid	0.0416	-0.8286
interacts with	*unclassified_f__Dipodascaceae*	Dihydro-5-propyl-2(3H)-furanone	0.0416	-0.8286
interacts with	*Weissella*	Pyrazine	0.0416	-0.8286
interacts with	*norank_f__norank_o__Chloroplast*	*α*-Caryophyllene	0.0416	-0.8286

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Kosakonia*	2-Methyl-pyrazine	0.0416	-0.8286
interacts with	*Acinetobacter*	(E)-3-Penten-2-one	0.0416	-0.8286
interacts with	*Acinetobacter*	Benzaldehyde	0.0416	-0.8286
interacts with	*Acinetobacter*	2-Methyl-pyrazine	0.0416	-0.8286
interacts with	*Millerozyma*	(-)-*α*-Thujone	0.0401	-0.8317
interacts with	*Acetobacter*	(-)-*α*-Thujone	0.0401	-0.8317
interacts with	*Rhodococcus*	6-Methyl-3,5-heptadiene-2-one	0.0361	-0.8407
interacts with	*Pseudomonas*	6-Methyl-3,5-heptadiene-2-one	0.0361	-0.8407
interacts with	*unclassified_f__Enterobacteriaceae*	2-Ethyl-pyrazine	0.0361	-0.8407
interacts with	*Kozakia*	Benzyl alcohol	0.0341	-0.8452
interacts with	*Millerozyma*	2-Nonanone	0.0244	-0.8697
interacts with	*unclassified_o__Saccharomycetales*	Heptanoic acid ethyl ester	0.0244	-0.8697
interacts with	*unclassified_o__Saccharomycetales*	Heptanoic acid	0.0244	-0.8697
interacts with	*Acetobacter*	Dihydro-5-propyl-2(3H)-furanone	0.0244	-0.8697
interacts with	*Rhizopus*	2-Pentyl-furan	0.0206	-0.8804
interacts with	*Rhizopus*	2-Pentyl-pyridine	0.0206	-0.8804
interacts with	*unclassified_k__norank_d__Bacteria*	(-)-*α*-Thujone	0.0206	-0.8804
interacts with	*Leuconostoc*	3-Nonanone	0.0206	-0.8804
interacts with	*Leuconostoc*	Isophorone	0.0206	-0.8804
interacts with	*Leuconostoc*	3-Methyl-phenol	0.0206	-0.8804
interacts with	*Clavispora*	(E)-2-Decenal	0.0198	-0.8827
interacts with	*unclassified_f__Metschnikowiaceae*	(E)-2-Decenal	0.0198	-0.8827
interacts with	*Leuconostoc*	1-Dodecanol	0.0198	-0.8827
interacts with	*Lactococcus*	Decyl aldehyde	0.0198	-0.8827
interacts with	*Wickerhamomyces*	(E)-2-Methyl-2-butenal	0.0188	-0.8857
interacts with	*Rhizopus*	Butanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Rhizopus*	3-Methyl-butanoic acid ethyl ester	0.0188	-0.8857
interacts with	*Rhizopus*	*β*-Caryophyllene	0.0188	-0.8857

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Candida*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857
interacts with	*Apiotrichum*	Octanoic acid	0.0188	-0.8857
interacts with	*Issatchenkia*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857
interacts with	*Kodamaea*	Dihydro-5-propyl-2(3H)-furanone	0.0188	-0.8857
interacts with	*Geotrichum*	Nonanoic acid ethyl ester	0.0188	-0.8857
interacts with	*unclassified_f__Dipodascaceae*	Benzyl alcohol	0.0188	-0.8857
interacts with	*Weissella*	*β*-Caryophyllene	0.0188	-0.8857
interacts with	*Wickerhamomyces*	Butanedioic acid diethyl ester	0.0149	-0.8986
interacts with	*Rhizopus*	Acetic acid 2-phenylethyl ester	0.0149	-0.8986
interacts with	*Weissella*	2-Methyl-naphthalene	0.0149	-0.8986
interacts with	*Staphylococcus*	2-Methyl-pentanoic acid	0.0149	-0.8986
interacts with	*Millerozyma*	Decyl aldehyde	0.0081	-0.9255
interacts with	*Wickerhamomyces*	2-Methyl-naphthalene	0.0077	-0.9276
interacts with	*Pediococcus*	1-(1H-Pyrrol-2-yl)-ethanone	0.0077	-0.9276
interacts with	*unclassified_k__norank_d__Bacteria*	6-Methyl-3,5-heptadiene-2-one	0.0077	-0.9276
interacts with	*Acetobacter*	Nonanoic acid ethyl ester	0.0077	-0.9276
interacts with	*Acetobacter*	Dihydro-5-pentyl-2(3H)-furanone	0.0077	-0.9276
interacts with	*Wickerhamomyces*	Naphthalene	0.0048	-0.9429
interacts with	*Wickerhamomyces*	1-Methyl-naphthalene	0.0048	-0.9429
interacts with	*Candida*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Candida*	Dihydro-5-pentyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*Issatchenkia*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Issatchenkia*	Dihydro-5-pentyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*Kodamaea*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*Kodamaea*	Dihydro-5-pentyl-2(3H)-furanone	0.0048	-0.9429
interacts with	*unclassified_f__Dipodascaceae*	Nonanoic acid ethyl ester	0.0048	-0.9429
interacts with	*unclassified_f__Dipodascaceae*	Octanoic acid	0.0048	-0.9429
interacts with	*Weissella*	Naphthalene	0.0048	-0.9429

interaction	Microorganism	Flavor compounds	p_value	Correlation
interacts with	*Lactococcus*	2-Nonanone	0.0048	-0.9429
interacts with	*Kosakonia*	Pyrazine	0.0048	-0.9429
interacts with	*Acinetobacter*	2,5-Dimethyl-pyrazine	0.0048	-0.9429
interacts with	*Leuconostoc*	2-Tridecanone	0.0012	-0.971
interacts with	*Millerozyma*	Dihydro-5-pentyl-2(3H)-furanone	3.00E-04	-0.9856
interacts with	*unclassified_o__Saccharomycetales*	Octanoic acid ethyl ester	3.00E-04	-0.9856
interacts with	*Acinetobacter*	2-Ethyl-pyrazine	3.00E-04	-0.9856
interacts with	*Weissella*	(E)-2-Methyl-2-butenal	0	-1