

Supplementary materials

Effects of different yeasts on physicochemical and oenological properties of red dragon fruit wine fermented with *Saccharomyces cerevisiae*, *Torulaspora delbrueckii* and *Lachancea thermotolerans*

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Table S1. Major volatile compounds (GC-FID peak area x 10⁶) and their relative peak areas (RPA) identified in red dragon fruit juice and wines fermented with *Saccharomyces* and non-*Saccharomyces* yeast strains

Volatile compounds	LRI [§]	Day 0		Day 14						Organoleptics [¶]
		Peak area	RPA%	Biodiva [#]		Concerto [#]		EC-1118 [#]		
				Peak area	RPA %	Peak area	RPA%	Peak area	RPA %	
Acid										
Acetic acid	1453	1.27 ± 0.14 ^a	0.93	4.33 ± 0.37 ^b	0.10	5.85 ± 0.57 ^c	0.15	5.20 ± 0.49 ^c	0.13	Acidic, pungent, vinegar-like
Hexanoic acid	1836	20.00 ± 1.82 ^a	14.60	ND ^{&}		ND		ND		Cheesy, fruity, fatty
Octanoic acid	2052	9.71 ± 1.27 ^a	7.08	2.86 ± 0.17 ^b	0.06	2.06 ± 0.23 ^b	0.05	6.30 ± 0.46 ^c	0.15	Acidic, cheesy, fruity
Nonanoic acid	2160	1.29 ± 0.42 ^a	0.94	0.26 ± 0.01 ^b	0.01	ND		ND		Waxy, cheesy, dairy
Decanoic acid	2264	ND		ND		ND		2.29 ± 0.25	0.06	Fatty, coconut,
	Subtotal	32.28	23.55	7.46	0.17	7.92	0.21	13.79	0.33	
Alcohols										
Ethanol	992	ND		3959.6 ± 89.9 ^a	89.50	3476.0 ± 275.5 ^b	91.57	3780.1 ± 105.2 ^a	90.95	Alcoholic, solventy
1-Propanol	1025	ND		ND		5.63 ± 0.63 ^a	0.15	10.79 ± 0.38 ^b	0.26	Alcoholic, fruity, musty
Isoamyl alcohol	1229	ND		172.4 ± 9.7 ^a	3.90	108.5 ± 7.7 ^b	2.86	62.37 ± 3.35 ^c	1.50	Alcoholic, whiskey, fruity, banana
1-Hexanol	1371	79.24 ± 5.06 ^a	57.81	4.06 ± 0.12 ^a	0.09	ND		ND		Fusel oily, fruity, alcoholic, sweet, green
2-Phenylethyl alcohol	2005	ND		172.2 ± 17.1 ^a	3.89	98.71 ± 3.83 ^b	2.60	78.74 ± 1.48 ^c	1.89	Floral, rose, dried rose
	Subtotal	79.24	57.81	4308.23	97.38	3688.85	97.18	3932.04	94.61	
Aldehydes										
Hexanal	1085	11.60 ± 1.89 ^a	8.46	ND		ND		ND		Fresh, green, grass leafy
2-Hexenal	1222	2.01 ± 0.09 ^a	1.46	ND		ND		ND		Fruity, green, leafy, vegetable
Benzaldehyde	1538	ND		1.90 ± 0.14 ^a	0.04	ND		ND		Almond like
Phenyl acetaldehyde	1651	2.59 ± 0.23 ^a	1.89	ND		ND		ND		Floral, sweet
2,4-Dimethyl benzaldehyde	1838	ND		0.26 ± 0.01 ^a	0.01	ND		ND		Cherry, almond, spicy, vanilla
	Subtotal	16.19	11.81	2.16	0.05	ND		ND		

Table S1. Continued.

Volatile compounds	LRI ^s	Day 0		Day 14						Organoleptics ^o
		Peak area	RPA %	Biodiva [#]		Concerto [#]		EC-1118 [#]		
				Peak area	RPA %	Peak area	RPA %	Peak area	RPA %	
Ketones										
3-Hydroxy-2-butanone	1305	ND		1.14 ± 0.08 ^a	0.03	ND		4.50 ± 0.15 ^b	0.11	Sweet, buttery, creamy, milky
Ethylidene acetone	1391	ND		0.74 ± 0.06 ^a	0.02	ND		ND		Fruity, acetone, phenolic, fishy
	Subtotal	ND		1.89	0.04	ND		4.50	0.11	
Ester										
Ethyl acetate	968	ND		15.88 ± 0.76 ^a	0.36	25.58 ± 1.93 ^b	0.67	15.78 ± 1.67 ^a	0.38	Ethereal, fruity, solventy
Isoamyl acetate	1115	ND		19.06 ± 1.58 ^a	0.43	9.42 ± 0.63 ^b	0.25	8.08 ± 0.7 ^b	0.19	Sweet, banana, ripe
Methyl hexanoate	1174	2.16 ± 0.23	1.58	ND		ND		ND		Fruity, pineapple, ethereal
Ethyl hexanoate	1215	ND		20.93 ± 1.64 ^a	0.00	32.54 ± 4.37 ^b	0.86	41.93 ± 1.03 ^c	1.01	Sweet, fruity, pineapple, green
Hexyl acetate	1262	ND		5.69 ± 0.58 ^a	0.13	ND		5.78 ± 0.53 ^b	0.14	Fruity, green, apple, banana, sweet
Ethyl heptanoate	1320	ND		0.52 ± 0.01 ^a	0.01	0.43 ± 0.01 ^b	0.01	0.48 ± 0.00 ^c	0.01	Fruity, pineapple, cognac, rummy, winey
Ethyl octanoate	1425	0.22 ± 0.08	0.16	16.58 ± 0.47 ^a	0.37	12.94 ± 1.32 ^b	0.34	83.55 ± 5.68 ^c	2.01	Fruity, pineapple, creamy, dairy
Ethyl nonanoate	1523	ND		ND		1.01 ± 0.12 ^a	0.03	0.60 ± 0.04 ^b	0.01	Sweet, fruity, pear
Ethyl decanoate	1627	ND		5.87 ± 0.35 ^a	0.13	2.61 ± 0.49 ^b	0.07	21.02 ± 1.45 ^c	0.51	Sweet, waxy, apple
Diethyl succinate	1670	ND		0.24 ± 0.03 ^a	0.01	0.18 ± 0.02 ^b	0.00	0.18 ± 0.01 ^b	0.00	Fruity, cooked apple, passion fruit
Ethyl 9-decenoate	1681	ND		0.28 ± 0.04 ^a	0.01	ND		0.64 ± 0.08 ^b	0.02	Fruity, fatty Sweet, floral, honey, rose,
Ethyl phenylacetate	1784	ND		0.21 ± 0.03 ^a	0.00	0.30 ± 0.01 ^b	0.01	0.20 ± 0.02 ^a	0.00	balsamic, cocoa
2-Phenethyl acetate	1816	ND		1.55 ± 0.12 ^a	0.04	0.45 ± 0.02 ^b	0.01	2.34 ± 0.17 ^c	0.06	Floral, rose, sweet, honey, fruity, tropical
Ethyl dodecanoate	1834	ND		5.88 ± 0.41 ^a	0.13	5.36 ± 0.39 ^a	0.14	12.94 ± 2.81 ^b	0.31	Sweet, waxy, fruity, apple, grape, brandy
Isobutyl										
pentadecanoate	1855	ND		0.34 ± 0.00 ^a	0.01	ND		0.62 ± 0.05 ^b	0.01	Fatty

Table S1. Continued.

Volatile compounds	LRI [§]	Day 0		Day 14						Organoleptics ^o
		Peak area	RPA %	Biodiva [#]		Concerto [#]		EC-1118 [#]		
				Peak area	RPA %	Peak area	RPA %	Peak area	RPA %	
2-Phenethyl propionate	1884	ND		0.43 ± 0.08 ^a	0.01	ND		ND		Floral, rose, fruity, honey, balsamic
Ethyl myristate	2042	ND		2.21 ± 0.27 ^a	0.05	1.61 ± 0.07 ^b	0.04	2.63 ± 0.24 ^a	0.06	Sweet, waxy, violet Waxy, fruity, creamy, milky, balsamic
Ethyl palmitate	2253	ND		ND		ND		1.51 ± 0.06 ^a	0.04	
Subtotal		2.37	1.73	95.66	1.69	92.44	2.44	198.28	4.77	
Terpene derivatives										
β-Myrcene	1140	0.77 ± 0.09 ^a	0.56	2.74 ± 0.33 ^b	0.06	4.63 ± 0.52 ^c	0.12	3.37 ± 0.32 ^d	0.08	Peppery, terpenic, spicy, balsamic
D-Limonene	1170	ND		1.40 ± 0.09 ^a	0.03	ND		ND		Citrus, orange, fresh, sweet
Linalool	1539	4.96 ± 0.41 ^a	3.62	0.77 ± 0.07 ^b	0.02	0.90 ± 0.04 ^c	0.02	0.65 ± 0.07 ^b	0.02	Citrus, floral, sweet, rose
Longifolene	1554	0.94 ± 0.07 ^a	0.69	3.47 ± 0.42 ^b	0.08	1.26 ± 0.04 ^c	0.03	1.33 ± 0.05 ^c	0.03	Sweet, woody, rose
α-Terpineol	1697	0.30 ± 0.02 ^a	0.22	0.20 ± 0.03 ^b	0.00	ND		ND		Pine, terpenic, lilac, citrus, woody, floral
Subtotal		6.98	5.09	8.59	0.19	6.80	0.18	5.35	0.13	
Phenols										
2-Methoxy-4-vinylphenol	2211	ND		ND		ND		2.12 ± 0.15 ^a	0.05	Woody, fresh, cedar, peanut
Total		137.06	100.00	4423.98	100.00	3796.00	100.00	4156.08	100.00	

[§] LRI: liner retention index determined in the DB-FFAP column.

[#] Biodiva, *Torulaspora delbrueckii*; Concerto, *Lachancea thermotolerance*; EC-1118, *Saccharomyces cerevisiae*.

^o Organoleptic descriptors were obtained from <http://www.thegoodscentscompany.com> (accessed 8 October, 2018).

[&] ND: not detected.

^{a, b, c, d} Statistical analysis ANOVA (n=3) at 95% confidence level with the same letter indicating no significant difference.