

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 1 Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2017.

Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Esters												
Leaf or petiole level (% w/w)	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
Leaves												
0 L ^a	381.00	823.80	5.57	507.74	6.84	135.61	61.12	946.01	8.64	54.84	0.89	
0.5 L	521.33	908.97	5.88	525.25	10.91	132.32	67.42	1121.1	9.31	60.18	0.92	
2 L	384.28	680.44	5.17	399.21	12.09	116.39	53.38	857.18	6.83	57.58	1.00	
Pr > F	0.507	0.197	0.872	0.225	0.047	0.738	0.726	0.505	0.553	0.866	0.895	
Significant	NS ^b	NS	NS	NS	*L ^c	NS	NS	NS	NS	NS	NS	
Petioles												
0 P	381.00	823.80	5.57	507.74	6.84	135.61	61.12	946.01	8.64	54.84	0.888	
1 P	332.60	743.87	4.68	543.23	12.41	151.57	45.92	740.29	6.83	56.59	1.28	
5 P	222.04	738.30	5.98	534.49	11.93	135.50	44.89	819.23	7.21	62.33	1.26	
Pr > F	0.101	0.640	0.524	0.866	0.148	0.817	0.349	0.701	0.676	0.488	0.216	
Significant	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Leaf or petiole level (% w/w)	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
Leaves												
0 L	368.47	1215.9	8356.7	160.08	48.24	162.13	17 292.7	15.82	0.68	0.48	26.08	0.98
0.5 L	477.34	1366.3	12 065.0	225.54	68.53	186.96	20 368.9	18.80	1.20	0.83	29.29	1.26
2 L	435.14	1194.2	11 908.3	174.41	58.19	202.51	22 713.2	15.96	1.47	1.17	33.47	1.22
Pr > F	0.674	0.755	0.241	0.376	0.140	0.517	0.508	0.668	0.090	0.010	0.458	0.612
Significant	NS	NS	NS	NS	NS	NS	NS	NS	*L	**L	NS	NS
Petioles												
0 P	368.47	1215.9	8356.6	160.08	48.24	162.13	17 292.7	15.82	0.683	0.479	26.08	0.984
1 P	386.37	1273.1	10 074.9	200.27	52.59	206.05	26 535.5	12.56	0.611	0.358	35.12	1.35
5 P	286.63	1167.6	9122.4	183.97	64.86	190.31	25 716.2	17.73	0.812	0.490	86.01	9.27
Pr > F	0.249	0.729	0.908	0.796	0.096	0.728	0.303	0.413	0.039	0.838	<0.0001	<0.0001
Significant	NS	NS	NS	NS	NS	NS	NS	NS	*L	NS	***L	***L

Continued on next page.

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Supplemental Table 1 continued Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2017.
Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Terpenes												
Leaf or petiole level (% w/w)	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
Leaves												
0 L	6.61	3.74	0.17	25.52	5.10	0.91	0.20	24.00	4.04	0.75	0.28	0.90
0.5 L	9.73	6.79	0.00	33.74	9.46	1.46	0.41	31.13	4.12	0.18	0.47	0.36
2 L	10.04	8.09	0.00	49.09	15.27	4.37	0.78	30.75	5.74	0.46	0.82	0.21
Pr > F	0.337	0.209	0.383	0.070	<0.0001	0.010	<0.0001	0.551	0.040	0.292	<0.0001	0.462
Significant	NS	NS	NS	NS	****L	**L	***L	NS	*L	NS	****L	NS
Petioles												
0 P	6.61	3.74	0.172	25.52	5.10	0.907	0.204	24.00	4.04	0.752	0.276	0.898
1 P	6.95	7.24	0.000	23.17	6.27	0.179	0.364	27.51	4.49	0.313	0.618	0.126
5 P	22.14	19.23	19.66	68.19	26.44	0.236	1.331	98.99	5.09	3.053	3.608	0.927
Pr > F	<0.0001	<0.0001	0.011	0.0001	<0.0001	0.373	<0.0001	<0.0001	0.336	0.004	<0.0001	0.323
Significant	****L	****L	*L	****L	****L	NS	****L	****L	NS	**L	****L	NS
Leaf or petiole level (% w/w)												
Leaves												
0 L	15.13	0.09	0.02	1.12	0.86	3.52						
0.5 L	45.40	0.15	0.03	0.91	1.34	10.48						
2 L	74.41	0.16	0.04	1.06	1.78	20.11						
Pr > F	0.010	<0.0001	<0.0001	0.860	0.311	<0.0001						
Significant	**L	****L	***L	NS	NS	****L						
Petioles												
0 P	15.13	0.093	0.018	1.123	0.863	3.52						
1 P	13.74	0.074	0.021	0.457	1.226	4.89						
5 P	53.65	0.413	0.103	1.511	7.309	26.11						
Pr > F	<0.0001	0.178	<0.0001	0.166	0.015	<0.0001						
Significant	****L	NS	***L	NS	*L	****L						

^a0 L, 0.5 L, or 2 L: 0, 0.5%, or 2% (w/w) leaves, respectively; 0 P, 1 P, or 5 P: 0, 1%, or 5% (w/w) petioles, respectively.

^{b*}, ^{**}, ^{****}, or NS: significant at $p \leq 0.05$, 0.01, 0.0001, or not significant, respectively.

^cL: linear trend.

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Supplemental Table 2 Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2018. Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Esters											
Leaf or petiole level (% w/w)	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate
Leaves											
0 L ^a	97.62	261.14	5.60	175.38	2.68	39.63	185.69	648.34	2.09	37.77	0.373
0.5 L	74.29	266.49	4.81	154.23	1.69	35.26	155.45	618.59	3.43	37.01	0.453
2 L	74.71	304.19	5.39	138.63	1.60	31.74	157.72	643.99	6.27	39.57	0.567
Pr > F	0.724	0.208	0.849	0.098	0.139	0.167	0.885	0.849	<0.0001	0.609	0.019
Significant	NS ^b	NS	NS	NS	NS	NS	NS	NS	****L ^c	NS	*L
Petioles											
0 P	97.62 a	261.14	5.60	175.38	2.68	39.63	185.69	648.34	2.09	37.77	0.373
1 P	63.68 a	233.25	4.68	156.78	1.83	36.52	131.78	553.88	1.99	34.56	0.382
5 P	64.15 a	220.03	4.18	161.32	3.55	37.96	134.75	558.47	1.82	36.29	0.390
Pr > F	0.365	0.219	0.232	0.626	0.089	0.877	0.546	0.555	0.343	0.931	0.796
Significant	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Alcohols, norisoprenoids, and miscellaneous compounds											
Leaf or petiole level (% w/w)	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate
Leaves											
0 L	160.41	277.09	1669.8	167.94	38.58	52.67	10 108.7	4.12	0.475	0.230	2.68
0.5 L	153.71	283.52	2891.9	153.05	38.96	53.89	8886.9	5.98	0.745	0.363	3.97
2 L	155.13	280.98	4860.0	162.10	42.49	55.71	9836.9	7.04	1.572	0.877	3.62
Pr > F	0.945	0.966	0.0002	0.878	0.615	0.662	0.894	0.012	<0.0001	<0.0001	0.445
Significant	NS	NS	***L	NS	NS	NS	NS	*L	****L	****L	NS
Petioles											
0 P	160.41	277.09	1669.8	167.94	38.58	52.67	10 108.7	4.12	0.475	0.230	2.68
1 P	107.99	209.52	1375.4	113.69	30.22	45.65	9495.2	5.48	0.505	0.215	4.98
5 P	130.79	254.58	1580.8	123.98	34.52	53.61	9121.5	4.75	0.542	0.217	12.01
Pr > F	0.754	0.999	0.968	0.014	0.751	0.621	0.633	0.848	0.445	0.795	<0.0001
Significant	NS	NS	NS	*Q	NS	NS	NS	NS	NS	NS	****L

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Supplemental Table 2 continued Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2018. Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Terpenes												
Leaf or petiole level (% w/w)	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
Leaves												
0 L	0.763	1.26	0.397	9.82	7.03	0.205	0.220	6.69	2.54	3.41	0.415	0.160
0.5 L	1.16	8.37	1.03	15.86	15.13	0.180	0.270	11.19	2.39	3.43	0.352	0.127
2 L	2.03	26.96	1.72	29.72	28.62	0.313	0.462	15.42	2.48	3.93	0.583	0.175
Pr > F	<0.0001	<0.0001	0.0006	0.0009	<0.0001	0.016	0.0003	<0.0001	0.615	0.546	0.306	0.870
Significant	****L	****L	***L	***L	****L	*L	***L	****L	NS	NS	NS	NS
Petioles												
0 P	0.763	1.26	0.397	9.82	7.03	0.205	0.220	6.69	2.54	3.41	0.415	0.160
1 P	1.53	1.90	1.52	17.02	13.41	0.188	0.233	18.30	2.17	2.95	0.473	0.175
5 P	4.86	2.87	7.55	47.78	37.96	0.175	0.470	54.23	2.29	4.49	2.14	0.835
Pr > F	<0.0001	0.187	0.0003	0.0001	<0.0001	0.494	0.0002	<0.0001	0.737	0.066	0.008	0.013
Significant	****L	NS	***L	***L	****L	NS	***L	****L	NS	NS	**L	*L
Leaf or petiole level (% w/w)	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP^d (ng/L)	IBMP^d (ng/L)	SBMP^d (ng/L)			
Leaves												
0 L	14.40	0.015	0.005	0.092	2.39	0.127	2.08	3.12	1.25			
0.5 L	33.93	0.020	0.015	0.123	4.42	0.558	4.03	3.10	1.42			
2 L	117.23	0.028	0.015	0.162	5.18	4.24	1.47	2.90	1.85			
Pr > F	<0.0001	0.007	0.058	0.006	0.157	<0.0001	<0.0001	0.176	0.010			
Significant	****L	**L	NS	**L	NS	****L	****Q	NS	**L			
Petioles												
0 P	14.40	0.015	0.005	0.092	2.39	0.127	2.08	3.12	1.25			
1 P	16.71	0.020	0.018	0.133	3.07	1.18	1.93	2.80	1.28			
5 P	32.09	0.048	0.022	0.212	11.12	3.97	1.98	2.55	1.17			
Pr > F	<0.0001	0.003	0.106	0.053	0.037	0.011	<0.0001	0.176	0.010			
Significant	****L	**L	NS	NS	*L	*L	****Q	NS	**L			

^a0 L, 0.5 L, or 2 L: 0, 0.5%, or 2% (w/w) leaves, respectively; 0 P, 1 P, or 5 P: 0, 1%, or 5% (w/w) petioles, respectively.

^b, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively.

^cL: linear trend; Q: quadratic trend.

^dIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, SBMP: sec-butylmethoxypyrazine. IPMP, IBMP, and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

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Supplemental Table 3 Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2019. Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Esters												
Leaf or petiole level (% w/w)	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
Leaves												
0 L ^a	197.14	1192.4	6.45	355.57	3.17	73.30	238.96	1687.8	3.95	55.71	1.07	
0.5 L	430.78	2217.6	14.26	563.27	5.94	93.12	500.06	3760.5	6.38	115.59	1.76	
2 L	731.61	3302.0	32.34	775.10	6.03	111.85	979.49	6427.6	10.44	170.69	4.13	
Pr > F	0.112	0.039	0.031	0.097	0.181	0.222	0.078	0.064	0.041	0.029	0.016	
Significant	NS ^b	*L ^c	*L	NS	NS	NS	NS	NS	*L	*L	*L	
Petioles												
0 P	197.14	1192.4	6.45	355.57	3.17	73.30	238.96	1687.75	3.95	55.71	1.07	
1 P	488.47	1750.8	15.34	507.28	2.64	89.56	594.86	3109.46	4.75	78.31	1.71	
5 P	334.52	3087.6	23.50	933.12	7.62	186.01	473.86	3718.35	8.49	143.56	2.58	
Pr > F	0.853	0.110	0.123	0.098	0.109	0.059	0.664	0.285	0.153	0.101	0.172	
Significant	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Leaf or petiole level (% w/w)	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
Leaves												
0 L	510.65	2407.9	15 137.9	458.78	170.09	189.93	9828.3	14.20	1.71	0.390	12.02	0.370
0.5 L	916.88	4358.4	21 727.6	612.64	282.89	366.70	8622.6	22.58	6.26	1.58	18.97	0.720
2 L	1663.70	6771.2	33 899.2	1163.2	492.83	476.06	8209.9	35.28	17.37	4.37	36.77	1.75
Pr > F	0.086	0.065	0.069	0.028	0.014	0.059	0.831	0.024	0.001	0.0007	0.008	0.003
Significant	NS	NS	NS	*L	*L	NS	NS	*L	***L	***L	**L	**L
Petioles												
0 P	510.65	2407.9	15 137.9	458.78	170.09	189.93	9828.3	14.20	1.71	0.390	12.02	0.370
1 P	1047.5	3594.8	14 676.6	509.97	169.82	219.07	8153.5	17.24	1.67	0.490	34.05	1.95
5 P	1019.9	5354.0	31 972.3	1551.6	599.06	452.12	23 401.7	38.87	5.38	0.730	127.23	9.47
Pr > F	0.499	0.198	0.155	0.023	0.023	0.114	0.231	0.053	0.034	0.196	0.004	0.0001
Significant	NS	NS	NS	*L	*L	NS	NS	NS	*L	NS	**L	****L

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Supplemental Table 3 continued Impact of leaf and petiole additions to Ontario Cabernet franc fermentations on aroma compounds across three yeast strains in 2019. Yellow-highlighted columns are compounds with significant trends for leaf or petiole levels. Green-highlighted cells are those leaf or petiole levels whose concentrations are likely above their aroma threshold.

Terpenes												
Leaf or petiole level (% w/w)	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
Leaves												
0 L	6.72	8.60	4.43	21.68	13.88	0.25	0.33	30.94	5.58	3.13	0.300	0.07
0.5 L	15.11	20.93	13.54	48.50	30.88	0.51	0.95	57.66	9.03	3.32	1.55	0.37
2 L	30.14	98.15	40.05	103.12	572.32	0.83	5.01	89.29	15.45	21.86	5.72	1.47
Pr > F	0.025	0.016	0.0006	0.025	0.041	0.011	0.002	0.004	0.005	0.044	<0.0001	0.0001
Significant	*L	*L	***L	*L	*L	*L	**L	**L	**L	*L	****L	****L
Petioles												
0 P	6.72	8.60	4.43	21.68	13.88	0.250	0.330	30.94	5.58	3.13	0.300	0.070
1 P	11.97	22.72	34.85	38.70	18.00	0.410	2.56	30.00	6.01	3.48	5.26	1.28
5 P	41.07	190.47	888.46	90.46	61.57	0.640	28.79	119.74	16.61	12.00	39.16	10.36
Pr > F	0.016	0.013	0.021	0.029	0.013	0.044	0.002	0.032	0.016	0.012	0.0008	0.0007
Significant	*L	*L	*L	*L	*L	*L	**L	*L	*L	*L	***L	***L
Leaf or petiole level (% w/w)												
Leaves												
0 L	68.51	0.030	0.020	0.160	3.20	2.09						
0.5 L	531.23	0.070	0.050	0.350	5.08	11.81						
2 L	2334.79	0.120	0.150	0.860	10.98	43.34						
Pr > F	0.002	0.024	0.0008	0.005	0.080	0.0001						
Significant	**L	*L	***L	**L	NS	****L						
Petioles												
0 P	68.51	0.030	0.020	0.160	3.20	2.09						
1 P	124.24	0.050	0.020	0.220	4.61	7.33						
5 P	482.65	0.120	0.040	0.420	8.00	38.55						
Pr > F	0.010	0.034	0.117	0.161	0.163	0.0006						
Significant	**L	*L	NS	NS	NS	***L						

^a0 L, 0.5 L, or 2 L: 0, 0.5%, or 2% (w/w) leaves, respectively; 0 P, 1 P, or 5 P: 0, 1%, or 5% (w/w) petioles, respectively.

^b*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively.

^cL: linear trend.

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Supplemental Table 4 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2017, with no leaf or petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	492.55	968.00	8.37 a	625.26	2.05 b	176.71	492.55	90.80	15.66 a	75.30 a	1.22	
EC 1118	241.72	741.70	5.92 ab	502.57	12.83 a	127.38	241.72	36.48	4.72 b	62.66 ab	0.663	
FX10	408.74	761.69	2.42 b	395.39	5.65 b	102.72	408.74	56.07	5.54 b	26.57 b	0.780	
Pr > F	0.529	0.678	0.031	0.370	0.005	0.213	0.529	0.144	0.050	0.031	0.312	
Significant	NS ^a	NS	*	NS	**	NS	NS	NS	NS	*	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	534.82	1444.5	8511.6	160.53	44.47	183.69	21 333.8	21.66	0.767 a	0.603 a	33.42	1.26
EC 1118	221.60	1008.1	8998.4	151.67	60.39	211.11	16 602.1	14.72	0.743 a	0.463 a	29.43	1.19
FX10	348.98	1195.2	7560.0	168.06	39.87	91.59	13 942.2	11.07	0.540 a	0.370 a	15.38	0.507
Pr > F	0.376	0.634	0.821	0.923	0.135	0.086	0.625	0.136	0.409	0.202	0.324	0.291
Significant	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	10.63 a	3.00 ab	0.517	43.67 a	7.58	0.593	0.307 a	14.95 b	4.23	0.000	0.267	0.040
EC 1118	6.41 ab	5.62 a	0.000	25.60 ab	5.14	0.060	0.173 b	45.58 a	3.87	1.05	0.360	0.447
FX10	2.79 b	2.59 b	0.000	7.29 b	2.58	2.07	0.133 b	11.48 b	4.03	1.21	0.200	2.21
Pr > F	0.012	0.031	0.422	0.043	0.330	0.483	0.050	0.002	0.962	0.103	0.141	0.421
Significance	*	*	NS	*	NS	NS	*	**	NS	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	20.79	0.120	0.020	0.513 b	1.11	4.49 a						
EC 1118	16.06	0.077	0.003	0.350 b	0.170	4.35 a						
FX10	8.55	0.083	0.030	2.51 a	1.31	1.72 b						
Pr > F	0.083	0.152	0.221	<0.0001	0.484	0.025						
Significance	NS	NS	NS	****	NS	*						

^a, ^{**}, ^{****}, or NS: significant at $p \leq 0.05$, 0.01, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 5 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2017, with 0.5% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Yeast strain	Esters											
	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	640.51	1017.8	8.29 a	559.73	8.45	151.13	88.98	1472.8 a	10.33	62.34	0.947	
EC 1118	203.49	741.32	5.94 ab	447.35	11.57	101.68	24.94	633.76 b	6.35	56.36	0.647	
FX10	720.01	967.83	3.39 b	568.67	12.70	144.15	88.32	1256.6 ab	11.26	61.85	1.18	
Pr > F	0.181	0.262	0.005	0.685	0.540	0.576	0.072	0.027	0.236	0.946	0.130	
Significant	NS ^a	NS	**	NS	NS	NS	NS	*	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	716.28	1537.6	9319.8 b	149.33 b	59.88	157.72	18 177.9	23.26	1.273 a	0.953	33.35	1.39
EC 1118	171.24	871.99	9897.5 b	148.07 b	57.37	190.95	17 301.8	15.46	0.977 a	0.763	28.62	1.58
FX10	544.50	1689.4	16 977.7 a	379.21 a	88.33	212.21	25 626.9	17.70	1.340 a	0.783	25.92	0.817
Pr > F	0.093	0.129	0.048	0.032	0.281	0.570	0.404	0.619	0.650	0.715	0.776	0.266
Significant	NS	NS	*	*	NS	NS	NS	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	12.09	2.54	—	50.06	11.39	1.00	0.497	16.74	4.03	0.530	0.447	0.070
EC 1118	8.13	7.10	—	29.41	9.83	1.39	0.283	45.89	4.48	0.000	0.457	0.927
FX10	8.97	10.73	—	21.76	7.14	1.98	0.453	30.74	3.84	0.000	0.517	0.093
Pr > F	0.572	0.267	—	0.103	0.487	0.439	0.216	0.130	0.957	0.422	0.896	0.170
Significance	NS	NS	—	NS	NS	NS	NS	NS	NS	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	51.87	0.183	0.040	0.777	2.25	9.55						
EC 1118	37.36	0.123	0.010	0.570	1.08	10.30						
FX10	46.96	0.140	0.033	1.38	0.687	11.59						
Pr > F	0.704	0.696	0.436	0.056	0.139	0.905						
Significance	NS	NS	NS	NS	NS	NS						

^a, **, or NS: significant at $p \leq 0.05$, 0.01, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 6 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2017 with 2% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Yeast strain	Esters											
	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	609.89 a	780.38	8.25 a	366.88	9.69	93.37 b	93.80 a	1346.9 a	9.94	62.49	0.880	
EC 1118	334.91 ab	738.46	5.19 ab	313.00	13.23	69.23 b	39.24 b	698.87 ab	6.41	53.38	0.640	
FX10	208.02 b	522.48	2.07 b	517.75	13.35	186.57 a	27.09 b	525.70 b	4.15	56.89	1.490	
Pr > F	0.050	0.475	0.015	0.085	0.580	0.004	0.007	0.033	0.179	0.766	0.390	
Significant	*a	NS	*	NS	NS	**	**	*	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	569.91	1231.7	10 562.5	157.07	76.29	144.09	15 474.2 b	25.82 a	2.73 a	2.17 a	41.67 a	1.98 a
EC 1118	362.12	1271.4	16 213.9	123.91	48.15	228.11	15 219.0 b	9.24 b	1.03 b	0.973 b	22.34 b	0.853 b
FX10	373.39	1079.5	8948.4	242.24	50.11	235.34	37 446.4 a	12.81 b	0.663 b	0.357 b	36.39 ab	0.823 b
Pr > F	0.273	0.923	0.485	0.374	0.231	0.435	0.009	<0.0001	0.001	0.001	0.040	0.036
Significant	NS	NS	NS	NS	NS	NS	**	****	***	***	*	*
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	18.61 a	5.83 a	—	97.92 a	26.67 a	9.14 a	1.39 a	29.64	6.65 a	0.747	1.05	0.287
EC 1118	6.89 b	13.67 a	—	32.61 b	11.99 b	3.98 ab	0.523 b	38.31	4.09 b	0.627	0.907	0.257
FX10	4.62 b	4.75 a	—	16.74 b	7.16 b	0.00 b	0.410 b	24.30	6.48 a	0.000	0.493	0.093
Pr > F	0.002	0.190	—	<0.0001	<0.0001	0.027	0.002	0.180	0.027	0.626	0.345	0.173
Significance	**	NS	—	****	****	*	**	NS	*	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	145.12 a	0.290	0.043	1.55	3.50 a	38.54 a						
EC 1118	73.61 b	0.120	0.043	0.530	1.07 b	18.41 b						
FX10	4.50 b	0.073	0.027	1.12	0.763 b	3.39 c						
Pr > F	0.003	0.054	0.664	0.466	0.017	0.001						
Significance	**	NS	NS	NS	*	***						

a, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 7 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2017 with 1% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	576.34 a	487.09	4.32	327.99	5.91 b	79.49	70.64	881.15	5.78	34.96	0.370 b	
EC 1118	263.92 ab	1048.5	6.99	777.53	18.01 a	188.41	35.04	687.67	9.21	76.67	1.29 ab	
FX10	157.55 b	695.99	2.74	524.16	13.31 ab	186.82	32.08	652.07	5.49	58.12	2.17 a	
Pr > F	0.021	0.215	0.097	0.154	0.050	0.119	0.055	0.503	0.291	0.254	0.017	
Significant	* ^a	NS	NS	NS	*	NS	NS	NS	NS	NS	*	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	479.53	908.92	4632.1	85.86 b	28.07	91.64 b	11 670.7 b	8.32	0.470	0.293	18.85	0.830
EC 1118	307.83	1472.1	13 672.0	195.54 ab	63.62	296.86 a	29 940.9 ab	16.75	0.690	0.410	49.69	2.07
FX10	371.76	1438.4	11 920.6	319.41 a	66.10	229.65 ab	37 994.9 a	12.59	0.673	0.370	36.81	1.16
Pr > F	0.432	0.344	0.087	0.037	0.160	0.037	0.042	0.427	0.504	0.651	0.297	0.227
Significant	NS	NS	NS	*	NS	*	*	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	5.28	3.96	—	24.34	4.57	0.027	0.197	9.84	1.79	0.940 a	0.327	0.090
EC 1118	9.07	11.28	—	28.26	6.89	0.510	0.490	48.38	4.83	0.000 b	0.847	0.167
FX10	6.51	6.48	—	16.90	7.34	0.000	0.407	24.31	6.85	0.000 b	0.680	0.120
Pr > F	0.470	0.117	—	0.483	0.431	0.063	0.183	0.102	0.093	0.002	0.265	0.374
Significance	NS	NS	—	NS	NS	NS	NS	NS	NS	***	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	11.72	0.043	0.000	0.527	0.297	3.65						
EC 1118	25.08	0.133	0.037	0.550	2.40	6.15						
FX10	4.43	0.047	0.027	0.293	0.980	4.90						
Pr > F	0.124	0.113	0.405	0.281	0.076	0.469						
Significance	NS	NS	NS	NS	NS	NS						

*^a, ***, or NS: significant at $p \leq 0.05$, 0.001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 8 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2017 with 5% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	268.91	829.82	9.85 a	639.96	9.42	142.26	61.32	1089.7 a	8.16	71.49	0.830 b	
EC 1118	179.37	644.26	4.93 b	451.22	11.09	112.03	28.00	651.12 b	7.05	56.21	0.827 b	
FX10	217.84	740.82	3.16 b	512.29	15.28	152.22	45.36	716.89 b	6.44	59.29	2.13 a	
Pr > F	0.557	0.319	0.010	0.143	0.309	0.322	0.254	0.005	0.706	0.312	0.001	
Significant	NS ^a	NS	**	NS	NS	NS	NS	**	NS	NS	***	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	295.42	1031.2 ab	7359.8	135.59 b	73.77	132.66	22 414.7	25.92	0.993	0.663	93.35	10.86
EC 1118	220.17	910.71 b	7785.1	116.13 b	48.79	175.03	17 964.6	13.65	0.693	0.430	70.71	8.10
FX10	344.28	1560.9 a	12 222.4	300.21 a	72.02	263.25	36 769.5	13.61	0.750	0.377	93.98	8.84
Pr > F	0.136	0.040	0.109	0.008	0.266	0.184	0.176	0.255	0.490	0.297	0.468	0.195
Significant	NS	*	NS	**	NS	NS	NS	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	32.48	21.29	0.000 b	102.18 a	31.42	0.270	1.53	84.80	5.60	6.53 a	4.03	1.02
EC 1118	15.22	15.20	0.000 b	50.17 b	23.75	0.260	1.17	112.99	3.48	0.913 b	3.30	0.85
FX10	18.73	21.19	58.98 a	52.24 b	24.16	0.177	1.30	99.18	6.20	1.72 b	3.49	0.90
Pr > F	0.075	0.513	< 0.0001	0.019	0.317	0.723	0.510	0.445	0.192	0.044	0.612	0.744
Significance	NS	NS	****	*	NS	NS	NS	NS	NS	*	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	75.60	0.690	0.150	2.28	14.75	3.65						
EC 1118	45.14	0.307	0.077	1.11	4.30	6.15						
FX10	40.21	0.243	0.083	1.14	2.87	4.90						
Pr > F	0.128	0.334	0.252	0.468	0.331	0.469						
Significance	NS	NS	NS	NS	NS	NS						

* , ** , *** , **** , or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 9 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2018, with no leaf or petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	161.80	282.88	7.24	187.68	2.05 b	42.66	322.67	802.95	2.51	42.98	0.420	
EC 1118	77.09	267.97	6.21	155.89	4.49 a	33.22	109.63	580.74	1.89	37.89	0.355	
FX10	53.97	232.57	3.37	182.58	1.51 b	43.03	124.78	561.35	1.89	32.44	0.345	
Pr > F	0.095	0.803	0.204	0.783	0.022	0.672	0.127	0.398	0.649	0.635	0.742	
Significant	NS ^a	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	256.55	304.37	1793.9	168.42	36.58	53.73	6757.9	5.64	0.675	0.305	2.47	0.390
EC 1118	93.37	261.19	1499.5	162.75	34.78	53.98	12 627.4	5.02	0.395	0.240	2.45	0.285
FX10	131.30	265.73	1715.9	172.67	44.37	50.36	10 940.7	1.69	0.355	0.145	3.13	0.350
Pr > F	0.112	0.890	0.909	0.986	0.758	0.976	0.336	0.100	0.252	0.269	0.801	0.758
Significant	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	1.055 a	1.47	0.410	14.94	7.92	0.245	0.220	2.78	1.93	3.63	0.185	0.065
EC 1118	0.665 ab	2.14	0.260	7.96	7.21	0.260	0.165	11.03	2.55	3.44	0.305	0.115
FX10	0.570 b	0.185	0.520	6.56	5.96	0.110	0.275	6.27	3.14	3.16	0.755	0.300
Pr > F	0.065	0.158	0.114	0.146	0.781	0.172	0.490	0.179	0.234	0.955	0.222	0.209
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP ^b (ng/L)	IBMP ^b (ng/L)	SBMP ^b (ng/L)			
CSM	19.93	0.015	0.010	0.085	2.52	0.125 b	2.65 a	3.35	1.25 a			
EC 1118	12.68	0.020	0.005	0.095	2.58	0.155 a	1.55 c	2.75	1.05 b			
FX10	10.61	0.010	0.000	0.095	2.07	0.100 c	2.05 b	3.25	1.45 a			
Pr > F	0.353	0.192	0.604	0.926	0.867	0.006	<0.0001	0.287	0.021			
Significance	NS	NS	NS	NS	NS	**	****	NS	*			

^a, **, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

^bIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, and SBMP: sec-butylmethoxypyrazine. IPMP, IBMP, and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 10 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2018, with 0.5% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	133.41 a	266.09	5.22	155.73	1.74	38.23	277.25 a	715.66	2.99	36.84	0.470	
EC 1118	47.02 b	315.82	6.49	159.77	2.13	33.56	91.09 b	670.03	4.35	47.51	0.545	
FX10	42.46 b	217.55	2.72	147.20	1.23	33.99	98.02 b	470.08	2.95	26.68	0.345	
Pr > F	0.023	0.552	0.146	0.957	0.285	0.825	0.016	0.441	0.472	0.400	0.598	
Significant	* ^a	NS	NS	NS	NS	NS	**	NS	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	255.82	315.83	2560.2	147.83	37.28	52.13	3372.6	6.58	0.780	0.390	3.28	0.415
EC 1118	113.40	335.39	3832.1	183.46	43.00	69.76	14 675.9	5.97	0.845	0.345	4.97	0.700
FX10	91.915	199.35	2283.7	127.85	36.61	39.80	8612.0	5.39	0.610	0.355	3.65	0.405
Pr > F	0.196	0.607	0.589	0.752	0.920	0.561	0.146	0.808	0.759	0.815	0.646	0.387
Significant	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	1.34	6.99	0.770	21.10	13.63	0.160	0.240	4.07	1.74	3.14	0.180	0.060
EC 1118	1.39	11.70	1.47	15.94	20.25	0.225	0.325	20.04	2.65	4.64	0.560	0.205
FX10	0.750	6.41	0.850	10.53	11.50	0.155	0.245	9.47	2.77	2.52	0.315	0.115
Pr > F	0.376	0.591	0.522	0.425	0.590	0.583	0.651	0.140	0.422	0.498	0.261	0.259
Significance	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP ^b (ng/L)	IBMP ^b (ng/L)	SBMP ^b (ng/L)			
CSM	33.96	0.020	0.020	0.100	6.77	0.315 b	3.70 b	2.80	1.25 b			
EC 1118	38.29	0.025	0.015	0.155	3.79	1.08 a	3.45 b	2.95	1.40 b			
FX10	29.54	0.015	0.010	0.115	2.71	0.285 b	4.95 a	3.55	1.60 a			
Pr > F	0.820	0.354	0.192	0.510	0.625	0.001	<0.0001	0.287	0.021			
Significance	NS	*	NS	NS	NS	***	****	NS	*			

^a, ^{**}, ^{***}, ^{****}, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

^bIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, and SBMP: sec-butylmethoxypyrazine. IPMP, IBMP, and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 11 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2018, with 2% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	135.16	287.96	5.98	142.48	1.09	37.36	290.49	767.12	5.73	41.69	0.520	
EC 1118	46.75	351.44	5.83	130.90	1.81	26.07	80.48	593.61	6.84	42.75	0.660	
FX10	42.23	273.18	4.38	142.51	1.91	31.79	102.19	571.27	6.25	34.27	0.520	
Pr > F	0.098	0.501	0.613	0.906	0.715	0.487	0.077	0.475	0.603	0.742	0.434	
Significant	NS ^a	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	240.16	296.54	4179.0	163.88	42.48	55.43	5448.0 b	7.48	1.45	0.895	3.02	0.520
EC 1118	92.57	278.77	5693.2	149.12	39.49	64.32	12 267.3 a	7.21	1.76	0.855	3.73	0.755
FX10	110.20	254.28	4707.9	173.30	45.52	47.40	11 795.7 ab	6.43	1.51	0.880	4.13	0.830
Pr > F	0.267	0.920	0.577	0.907	0.910	0.690	0.042	0.786	0.716	0.961	0.619	0.414
Significant	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	2.21	22.88	1.15	39.14	23.76	0.290	0.490	5.72 b	1.87 b	3.81	0.325 b	0.035 b
EC 1118	1.89	31.57	1.89	23.23	31.03	0.310	0.435	23.57 a	2.21 ab	3.62	0.705 a	0.250 a
FX10	2.00	26.43	2.12	26.78	31.07	0.340	0.460	16.97 a	3.35 a	4.37	0.720 a	0.240 a
Pr > F	0.817	0.696	0.149	0.528	0.522	0.886	0.912	0.013	0.049	0.845	0.042	0.023
Significance	NS	NS	NS	*	NS	NS	NS	**	*	NS	*	*
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP ^b (ng/L)	IBMP ^b (ng/L)	SBMP ^b (ng/L)			
CSM	128.29	0.025	0.020	0.155	7.99	2.50	1.10 b	3.35	1.40 b			
EC 1118	107.97	0.030	0.025	0.170	3.33	5.53	0.00 b	3.05	2.15 a			
FX10	115.44	0.030	0.000	0.160	4.23	4.68	3.30 a	2.30	2.00 ab			
Pr > F	0.778	0.893	0.368	0.960	0.584	0.211	<0.0001	0.287	0.021			
Significance	NS	NS	NS	NS	NS	NS	****	NS	*			

^a, **, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

^bIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, and SBMP: sec-butylmethoxypyrazine. IPMP, IBMP, and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 12 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2018, with 1% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	105.85 a	244.69 a	5.70 a	171.03	1.64 b	37.16	232.54 a	737.59 a	2.24	39.38 a	0.460	
EC 1118	40.27 b	264.98 a	5.68 a	161.63	2.39 a	37.35	68.15 b	504.09 b	2.13	37.61 a	0.425	
FX10	44.94 b	190.06 b	2.67 b	137.68	1.47 b	35.06	94.65 b	419.95 c	1.59	26.71 b	0.260	
Pr > F	0.015	0.011	0.007	0.388	0.008	0.937	0.023	0.002	0.199	0.001	0.133	
Significant	**a	**	**	NS	**	NS	*	**	NS	***	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	183.72 a	259.22 a	1453.1	112.89	29.43 ab	47.90 a	9564.6 ab	6.32	0.610	0.190	6.00	0.730
EC 1118	65.13 b	205.92 b	1533.1	112.64	28.61 b	51.66 a	11 172.5 a	5.13	0.470	0.235	4.88	0.870
FX10	75.11 b	163.43 b	1140.1	115.53	32.63 a	37.40 b	7748.8 b	4.99	0.435	0.220	4.08	0.845
Pr > F	0.022	0.014	0.155	0.910	0.045	0.004	0.047	0.130	0.133	0.594	0.451	0.328
Significant	*	**	NS	NS	*	**	*	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	2.19 a	3.08 a	2.13	25.65 a	14.10	0.145	0.230	10.52 c	1.69 c	2.91 ab	0.310	0.110
EC 1118	1.33 b	1.47 b	1.39	12.74 b	14.17	0.175	0.240	25.27 a	2.09 b	3.67 a	0.600	0.225
FX10	1.08 b	1.17 b	1.06	12.68 b	11.97	0.245	0.230	19.12 b	2.72 a	2.29 b	0.510	0.190
Pr > F	0.027	0.050	0.562	0.005	0.454	0.181	0.944	0.008	0.005	0.043	0.150	0.138
Significance	*	*	NS	**	NS	NS	NS	**	**	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP ^b (ng/L)	IBMP ^b (ng/L)	SBMP ^b (ng/L)			
CSM	18.11	0.025	0.015	0.110	5.04	1.43	2.00 ab	2.95	1.35 a			
EC 1118	16.58	0.015	0.030	0.190	1.78	1.68	1.25 b	2.65	1.10 ab			
FX10	15.44	0.020	0.010	0.100	2.40	0.445	2.55 a	2.80	1.40 a			
Pr > F	0.529	0.354	0.539	0.554	0.154	0.604	<0.0001	0.287	0.021			
Significance	NS	NS	NS	NS	NS	NS	****	NS	*			

a*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

^bIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, and SBMP: sec-butylmethoxypyrazine. IPMP, IBMP, and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 13 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2018 with 5% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	121.79 a	267.07	5.45	195.37 a	2.79	44.67	268.00 a	851.34 a	2.26 a	44.02	0.515 a	
EC 1118	31.62 b	195.33	4.53	144.84 b	4.11	32.99	56.73 b	440.78 b	1.68 ab	39.76	0.375 ab	
FX10	39.06 b	197.69	2.56	143.77 b	3.74	36.23	79.52 b	383.28 b	1.52 b	25.08	0.280 b	
Pr > F	0.013	0.170	0.816	0.046	0.767	0.290	0.004	0.011	0.041	0.249	0.035	
Significant	** ^a	NS	NS	*	NS	NS	**	**	*	NS	*	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	224.06 a	321.19	1524.8	119.65	32.43	54.59	10 149.3	6.82	0.650	0.230	14.12	3.185
EC 1118	83.17 b	247.76	1769.2	118.42	32.97	62.74	11 997.2	2.80	0.485	0.190	11.07	2.92
FX10	85.15 b	194.79	1448.3	133.88	38.17	43.51	5218.0	4.63	0.490	0.230	10.84	2.98
Pr > F	0.009	0.239	0.857	0.862	0.773	0.581	0.117	0.197	0.490	0.527	0.464	0.783
Significant	**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	6.63	6.27	8.56	75.06 a	42.67	0.210	0.425	41.28 b	1.67	4.63	1.08	0.375
EC 1118	4.42	1.17	9.85	31.35 b	36.68	0.130	0.560	62.99 a	2.43	5.23	3.58	1.45
FX10	3.53	1.18	4.24	36.94 b	34.53	0.185	0.425	58.41 a	2.80	3.61	1.78	0.68
Pr > F	0.265	0.156	0.587	0.015	0.475	0.423	0.697	0.025	0.472	0.697	0.486	0.680
Significance	NS	NS	NS	**	NS	NS	NS	*	NS	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol	IPMP ^b (ng/L)	IBMP ^b (ng/L)	SBMP ^b (ng/L)			
CSM	35.92	0.080	0.040 a	0.360	24.33	8.71 a	1.60 b	2.70	0.950 b			
EC 1118	34.17	0.040	0.015 ab	0.170	5.39	1.85 b	1.85 b	2.35	1.650 a			
FX10	26.18	0.025	0.010 b	0.105	3.63	1.37 b	2.50 a	2.60	0.900 b			
Pr > F	0.648	0.121	0.046	0.240	0.184	0.045	<0.0001	0.287	0.021			
Significance	NS	NS	*	NS	NS	*	****	NS	*			

^a, ^{**}, ^{****}, or NS: significant at $p \leq 0.05$, 0.01, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

^bIPMP: isopropylmethoxypyrazine, IBMP: isobutylmethoxypyrazine, and SBMP: sec-butylmethoxypyrazine. IPMP, IBMP and SBMP thresholds are based on Leffingwell and Leffingwell (1991) and Pickering et al. (2007).

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 14 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2019 with no leaf or petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	452.82 a	1538.8 a	11.01 a	402.49	3.15 b	62.38 b	496.62 a	2480.06 a	3.88 ab	60.17	1.50 a	
EC 1118	137.29 b	1420.9 ab	9.19 b	329.34	4.30 a	55.78 b	146.91 c	1640.36 b	3.61 b	69.55	0.900 b	
FX10	178.02 b	1264.1 b	5.43 c	455.03	3.36 b	102.54 a	245.75 b	1833.30 b	5.33 a	60.76	1.29 ab	
Pr > F	<0.0001	0.041	0.0013	0.219	0.034	0.019	0.0002	0.028	0.048	0.133	0.032	
Significant	****a	*	***	NS	*	**	***	*	*	NS	*	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	739.66 a	2742.8	11 168.8 b	262.87 b	120.04 b	147.86 b	4399.5 b	14.38	1.68	0.420	13.99	0.390
EC 1118	412.74 b	2381.8	14 686.1 ab	368.96 b	143.05 b	264.02 a	1912.9 b	17.04	1.85	0.500	10.38	0.420
FX10	533.32 ab	2725.9	19 345.1 a	653.23 a	227.85 a	201.56 b	15 643.4 a	18.09	2.13	0.450	13.50	0.390
Pr > F	0.027	0.512	0.044	0.006	0.006	0.023	0.009	0.473	0.118	0.256	0.177	0.920
Significant	*	NS	*	**	**	*	**	NS	NS	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	8.71 a	13.28 a	6.76	26.10	13.01	0.260	0.310	17.14 c	4.12 b	3.31	0.280	0.070
EC 1118	7.49 b	11.16 b	4.48	24.53	15.21	0.250	0.330	51.31 a	4.31 b	3.43	0.410	0.100
FX10	7.12 b	8.04 c	3.59	21.40	15.91	0.300	0.380	34.80 b	7.87 a	3.66	0.310	0.060
Pr > F	0.012	0.006	0.221	0.624	0.439	0.675	0.378	0.0003	0.0007	0.840	0.110	0.134
Significance	**	**	NS	NS	NS	NS	NS	***	***	NS	NS	NS
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	85.35	0.020	0.020 ab	0.120 b	3.96	2.15						
EC 1118	85.33	0.030	0.010 b	0.140 b	2.30	2.24						
FX10	78.27	0.040	0.030 a	0.210 a	3.69	2.34						
Pr > F	0.805	0.118	0.044	0.027	0.204	0.697						
Significance	NS	NS	*	*	NS	NS						

a*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 15 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2019 with 0.5% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	484.34 a	1670.4 a	13.43 a	417.27	3.77 ab	57.87 b	547.17 a	3478.8 a	4.69 a	83.75 a	1.47	
EC 1118	118.39 c	1447.5 ab	8.55 b	367.32	4.12 a	57.65 b	129.88 c	1406.3 b	2.99 b	62.66 b	1.16	
FX10	165.88 b	1189.2 b	5.82 b	353.41	3.12 b	89.92 a	268.46 b	1799.6 b	5.25 a	64.54 b	1.18	
Pr > F	<0.0001	0.014	0.002	0.372	0.031	0.043	<0.0001	0.0013	0.004	0.045	0.479	
Significant	****a	**	**	NS	*	*	****	***	**	*	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	829.09 a	3351.0 a	12 649.9	313.98 b	145.53 b	210.70	4217.6	14.90	5.04 a	1.31	13.83	0.510
EC 1118	383.79 b	2148.4 b	13 026.6	322.06 b	173.84 b	260.30	1857.4	13.14	3.13 b	0.92	12.21	0.460
FX10	429.66 b	2340.9 ab	16 026.3	614.09 a	225.51 a	158.46	9708.9	20.07	4.13 ab	0.98	16.16	0.520
Pr > F	0.003	0.048	0.181	0.0004	0.009	0.268	0.168	0.106	0.014	0.103	0.516	0.672
Significant	**	*	NS	***	**	NS	NS	NS	**	NS	NS	NS
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	11.96 a	16.97	8.78	40.86 a	21.79 a	0.340	0.580	25.64 c	5.12 b	1.87	0.770 b	0.180 b
EC 1118	7.92 b	12.89	9.30	24.88 b	18.90 ab	0.310	0.600	48.83 a	4.97 b	2.17	1.15 a	0.290 a
FX10	7.95 b	11.87	11.46	23.59 b	17.73 b	0.380	0.720	36.06 b	8.39 a	2.98	1.18 a	0.260 a
Pr > F	0.004	0.089	0.465	0.0009	0.045	0.654	0.131	0.0001	0.0001	0.281	0.010	0.007
Significance	**	NS	NS	***	NS	NS	NS	****	****	NS	**	**
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	415.01 a	0.050	0.030 b	0.230	4.60	8.27						
EC 1118	290.75 b	0.040	0.030 b	0.260	1.96	7.44						
FX10	326.08 b	0.038	0.040 a	0.270	2.72	7.56						
Pr > F	0.012	0.387	0.005	0.880	0.151	0.280						
Significance	**	NS	**	NS	NS	NS						

a*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 16 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2019 with 2% (w/w) leaf addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	446.02 a	1676.5 a	20.52 a	575.27	2.88 b	98.25	581.24 a	3534.6 a	5.14 a	78.90 a	2.90	
EC 1118	133.46 b	1405.6 b	10.96 b	319.32	4.64 a	49.55	174.61 b	1709.0 b	3.80 b	73.47 a	1.59	
FX10	121.06 b	1000.0 c	5.33 c	231.95	1.26 c	59.36	198.69 b	1456.0 b	3.67 b	55.60 b	1.19	
Pr > F	<0.0001	<0.0001	0.0005	0.217	0.003	0.581	0.0013	0.002	0.014	0.047	0.123	
Significant	****a	****	***	NS	**	NS	***	**	**	*	*	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	932.73 a	3404.5 a	15 282.1	473.62	205.79	208.60 ab	4154.6 a	15.34	7.90	1.88	15.84	0.850 a
EC 1118	504.84 ab	2644.6 ab	16 363.9	476.43	205.04	278.70 a	2172.8 b	13.90	6.82	1.77	16.23	0.720 b
FX10	373.91 b	1987.0 b	13 138.5	626.18	254.74	161.46 b	2788.7 ab	15.08	6.80	1.70	16.58	0.660 b
Pr > F	0.049	0.045	0.577	0.349	0.309	0.046	0.023	0.603	0.153	0.713	0.965	0.008
Significant	*	NS	NS	NS	NS	*	*	NS	NS	NS	NS	**
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	15.25 a	46.55	18.46	55.38 a	34.63 a	0.240	2.32	30.96 b	5.81 b	11.48	2.27 b	0.430
EC 1118	10.90 ab	21.87	16.51	32.94 b	28.60 b	0.470	1.70	60.11 a	5.81 b	2.76	3.19 a	0.850
FX10	7.51 b	20.76	18.89	27.52 b	21.87 c	0.260	1.83	38.98 b	10.42 a	1.85	2.38 b	0.570
Pr > F	0.024	0.194	0.534	0.015	0.007	0.444	0.180	0.0005	<0.0001	0.074	0.008	0.309
Significance	*	NS	NS	**	**	NS	NS	***	****	NS	**	*
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	1139.1 a	0.062 a	0.070	0.420	6.03 a	18.10						
EC 1118	884.96 ab	0.064 a	0.070	0.450	3.43 ab	19.45						
FX10	667.47 b	0.020 b	0.060	0.280	1.87 b	18.71						
Pr > F	0.026	<0.0001	0.683	0.223	0.042	0.610						
Significance	*	****	NS	NS	*	NS						

*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 17 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2019, with 1% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Yeast strain	Esters											
	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate		
CSM	481.51 a	1532.3 a	13.89 a	456.93 a	2.07 b	73.87	590.07 a	2942.5 a	4.01 a	66.15	1.55 a	
EC 1118	121.93 b	1224.8 b	9.44 b	338.78 ab	3.64 a	68.81	141.73 b	1306.3 b	3.17 b	59.75	1.05 b	
FX10	145.26 b	967.51 c	3.90 c	246.42 b	0.72 c	68.53	177.45 b	1485.0 b	3.27 ab	56.40	0.760 b	
Pr > F	<0.0001	0.00018	0.002	0.035	0.002	0.915	<0.0001	0.0002	0.044	0.212	0.0095	
Significant	****a	***	**	*	**	NS	****	***	*	NS	**	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	1014.1 a	3266.3 a	11 648.9	399.34 ab	129.34 b	169.44 b	7596.4	13.77	1.22	0.420	31.75 a	1.90 a
EC 1118	342.55 b	1891.9 b	12 220.4	376.25 b	136.44 b	215.83 a	5967.1	15.55	1.86	0.410	19.79 ab	0.870 b
FX10	393.46 b	2114.3 b	11 997.9	504.47 a	233.16 a	203.28 ab	2733.6	13.15	1.84	0.390	11.53 b	0.780 b
Pr > F	0.0011	0.007	0.855	0.046	0.003	0.047	0.344	0.915	0.101	0.858	0.041	0.012
Significant	***	**	NS	*	**	NS	NS	NS	NS	NS	*	**
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	10.12 a	18.02 ab	17.21	35.25 a	15.29	0.330	1.90 c	18.88 c	4.63 b	2.96 a	4.56 a	1.12 a
EC 1118	8.25 b	22.23 a	70.75	23.98 b	15.87	0.320	2.97 a	45.55 a	4.27 b	3.87 a	3.49 b	0.880 ab
FX10	7.86 b	11.77 b	33.42	22.73 b	16.26	0.550	2.30 b	33.04 b	7.79 a	0.00 b	3.00 b	0.710 b
Pr > F	0.038	0.040	0.274	0.002	0.906	0.190	<0.0001	<0.0001	0.00097	0.034	0.015	0.030
Significance	*	*	NS	**	NS	NS	****	****	***	*	**	*
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	97.98 b	0.04 a	0.020	0.170	4.97 a	6.47 a						
EC 1118	111.36 a	0.03 b	0.020	0.110	1.95 b	4.90 b						
FX10	98.53 b	0.03 b	0.010	0.120	2.47 b	5.24 ab						
Pr > F	0.024	0.049	0.270	0.273	0.023	0.041						
Significance	*	*	NS	NS	*	*						

*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 18 Impact of yeast strain on Ontario Cabernet franc aroma compounds in 2019, with 5% (w/w) petiole addition. Concentrations are in µg/L unless otherwise specified. Yellow-highlighted columns are compounds with significant differences between yeasts. Green-highlighted cells are those yeast treatments whose concentrations are likely above their aroma threshold.

Esters												
Yeast strain	Ethyl isobutyrate	Ethyl hexanoate	Ethyl heptanoate	Ethyl octanoate	Ethyl nonanoate	Ethyl decanoate	Isobutyl acetate	Isoamyl acetate	Hexyl acetate	Phenylethyl acetate	Isoamyl hexanoate	
CSM	405.60 a	1760.5 a	21.15 a	518.67 a	1.83 b	84.18	569.65 a	3127.4 a	4.58 a	71.04	1.45	
EC 1118	116.35 b	1285.0 b	10.35 b	381.82 ab	3.96 a	76.66	155.91 b	1420.4 b	3.28 b	63.46	1.05	
FX10	128.43 b	1064.5 b	4.95 c	346.81 b	2.37 ab	93.49	200.57 b	1577.6 b	3.62 ab	58.73	0.970	
Pr > F	<0.0001	0.021	<0.0001	0.042	0.049	0.398	<0.0001	<0.0001	0.047	0.112	0.086	
Significant	****a	*	****	*	*	NS	****	****	*	NS	NS	
Alcohols, norisoprenoids, and miscellaneous compounds												
Yeast strain	Isobutanol (mg/L)	Isoamyl alcohol (mg/L)	Hexanol	Heptanol	Octanol	Phenylethyl alcohol (mg/L)	Diethyl succinate	β-Damascenone	α-Ionone	β-Ionone	Methyl salicylate	Ethyl salicylate
CSM	822.61 a	2976.6 a	11 465.1	831.37	235.01	153.52 b	4167.1	15.52	2.09	0.390	142.14 a	12.86 a
EC 1118	395.58 b	2253.1 b	13 497.6	610.66	219.37	214.57 a	9619.0	17.37	2.33	0.340	44.27 b	3.27 b
FX10	439.14 b	2300.0 ab	13 287.6	799.14	342.48	172.92 ab	3528.7	18.34	2.47	0.350	46.68 b	3.30 b
Pr > F	0.004	0.044	0.577	0.129	0.180	0.040	0.302	0.455	0.374	0.584	0.010	0.002
Significant	**	*	NS	NS	NS	*	NS	NS	NS	NS	**	**
Terpenes												
Yeast strain	Linalool	cis-Linalool oxide	trans-Linalool oxide	Geraniol	Nerol	Nerolidol	Nerol oxide	Citronellol	α-Citral	β-Citral	cis-Rose oxide	trans-Rose oxide
CSM	18.39	53.28	141.33	52.35 a	28.91	0.420	10.93 b	31.77 c	8.36 b	8.45 a	25.46 a	6.99 a
EC 1118	17.46	85.46	392.56	37.72 b	26.02	0.300	13.13 a	58.14 a	6.13 c	4.62 b	16.46 b	4.41 b
FX10	17.62	72.60	353.19	39.88 b	29.21	0.340	13.27 a	45.82 b	10.37 a	6.23 ab	16.55 b	4.34 b
Pr > F	0.857	0.111	0.113	0.019	0.469	0.462	0.002	0.002	0.001	0.029	0.017	0.016
Significance	NS	NS	NS	**	NS	NS	**	**	***	*	**	**
Yeast strain	α-Terpineol	Terpinolene	γ-Terpinene	Limonene	Myrcene	Eugenol						
CSM	179.17	0.052	0.023	0.170	5.55	31.70 a						
EC 1118	201.60	0.050	0.020	0.210	3.57	15.36 b						
FX10	235.58	0.047	0.016	0.150	3.23	16.85 b						
Pr > F	0.138	0.583	0.303	0.325	0.397	0.0008						
Significance	NS	NS	NS	NS	NS	***						

a*, **, ***, ****, or NS: significant at $p \leq 0.05$, 0.01, 0.001, 0.0001, or not significant, respectively. Means followed by different letters are significantly different at $p < 0.05$ by Duncan's multiple range test.

Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 19 The basic wine composition variables of Ontario Cabernet franc wines with materials other than grapes (MOG) treatments, 2017 to 2019. For leaf and petiole levels, * or ** mean significant at $p < 0.05$ or 0.01 ; otherwise, not significant. TA, titratable acidity.

Vintage	Wine samples	TA (g/L)	pH	Color	Anthocyanins (mg/L)	Total phenols (mg/L)	Ethanol (%)
2017	CSM-Control	6.79	3.66	0.38	741.42	890.07	12.42
	EC 1118-Control	5.76	3.74	0.40	561.12	710.20	12.37
	FX10-Control	6.18	3.66	0.36	775.18	1032.08	12.68
	CSM-0.5L	6.21	3.73	0.32	615.42	1006.83	12.73
	EC 1118-0.5L	5.82	3.79	0.30	605.10	1164.62	12.64
	FX10-0.5L	6.72	3.55	0.43	839.20	1177.24	12.01
	CSM-2L	6.16	3.79	0.24	537.33	1028.92	12.02
	EC 1118-2L	6.01	3.84	0.35	595.22	1142.53	12.73
	FX10-2L	6.26	3.68	0.30	477.74	880.61	11.88
	Leaf level r^2	0.019	0.206	0.385	0.389	0.051	0.151
	CSM-Control	6.79	3.66	0.38	741.42	890.07	12.42
	EC 1118-Control	5.76	3.74	0.40	561.12	710.20	12.37
	FX10-Control	6.18	3.66	0.36	775.18	1032.08	12.68
	CSM-1P	6.43	3.66	0.33	818.06	905.85	12.32
	EC 1118-1P	6.03	3.71	0.35	740.23	1167.77	12.10
	FX10-1P	6.07	3.68	0.35	691.97	1000.52	12.73
	CSM-5P	5.17	3.80	0.31	596.41	681.80	11.16
	EC 1118-5P	5.50	3.90	0.36	699.31	1047.86	11.52
	FX10-5P	5.84	3.83	0.33	806.21	1221.42	12.19
	Petiole level r^2	0.553	0.788 **	0.384	0.004	0.023	0.621 *

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Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 19 *continued* The basic wine composition variables of Ontario Cabernet franc wines with materials other than grapes (MOG) treatments, 2017 to 2019.
For leaf and petiole levels, * or ** mean significant at $p < 0.05$ or 0.01 ; otherwise, not significant. TA, titratable acidity.

Vintage	Wine samples	TA (g/L)	pH	Color	Anthocyanins (mg/L)	Total phenols (mg/L)	Ethanol (%)
2018	CSM-Control	4.44	4.22	0.07	52.83	230.69	—
	EC 1118-Control	4.69	4.32	0.08	51.70	290.35	—
	FX10-Control	4.23	4.37	0.16	48.31	181.92	—
	CSM-0.5L	4.34	4.29	0.09	33.30	231.63	—
	EC 1118-0.5L	4.39	4.28	0.13	48.42	238.74	—
	FX10-0.5L	3.99	4.38	0.13	79.24	178.13	—
	CSM-2L	4.83	4.29	0.14	84.32	282.77	—
	EC 1118-2L	4.46	4.30	0.19	85.67	368.00	—
	FX10-2L	4.15	4.33	0.13	31.15	187.60	—
	Leaf level r^2	0.027	0.000	0.335	0.127	0.155	—
	CSM-Control	4.44	4.22	0.07	52.83	230.69	—
	EC 1118-Control	4.69	4.32	0.08	51.70	290.35	—
	FX10-Control	4.23	4.37	0.16	48.31	181.92	—
	CSM-1P	4.26	4.24	0.14	67.84	223.58	—
	EC 1118-1P	4.24	4.34	0.10	43.46	226.90	—
	FX10-1P	4.26	4.36	0.11	42.78	220.74	—
	CSM-5P	4.01	4.35	0.09	18.96	210.33	—
	EC 1118-5P	4.18	4.39	0.16	69.08	224.06	—
	FX10-5P	4.03	4.34	0.11	30.59	195.17	—
	Petiole level r^2	0.556	0.205	0.033	0.124	0.117	—

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Supplemental Data for:

Lan Y, Wang J, Aubie E, Crombleholme M and Reynolds A. 2022. Effects of frozen materials other than grapes on red wine volatiles. Mitigation of floral taints by yeast strains. Am J Enol Vitic 73:117-133. doi: 10.5344/ajev.2022.22005.

Supplemental Table 19 continued The basic wine composition variables of Ontario Cabernet franc wines with materials other than grapes (MOG) treatments, 2017 to 2019. For leaf and petiole levels, * or ** mean significant at $p < 0.05$ or 0.01 ; otherwise, not significant. TA, titratable acidity.

Vintage	Wine samples	TA (g/L)	pH	Color	Anthocyanins (mg/L)	Total phenols (mg/L)	Ethanol (%)
2019	CSM-Control	6.07	3.90	0.65	104.43	1392.00	—
	EC 1118-Control	5.76	3.96	0.57	198.80	1439.35	—
	FX10-Control	5.67	3.82	0.41	149.74	1521.42	—
	CSM-0.5L	6.42	3.87	0.56	178.26	1275.20	—
	EC 1118-0.5L	5.83	3.98	0.57	150.72	1486.70	—
	FX10-0.5L	5.95	3.80	0.51	91.30	1052.66	—
	CSM-2L	6.43	3.98	0.47	96.67	1470.91	—
	EC 1118-2L	6.11	4.00	0.51	97.78	1603.49	—
	FX10-2L	6.13	3.92	0.44	78.64	1393.58	—
	Leaf level r^2	0.341	0.259	0.212	0.413	0.073	—
	CSM-Control	6.07	3.90	0.65	104.43	1392.00	—
	EC 1118-Control	5.76	3.96	0.57	198.80	1439.35	—
	FX10-Control	5.67	3.82	0.41	149.74	1521.42	—
	CSM-1P	5.86	4.00	0.59	190.19	1398.31	—
	EC 1118-1P	5.70	3.95	0.63	116.45	1189.97	—
	FX10-1P	6.24	3.86	0.67	183.50	1696.62	—
	CSM-5P	5.67	4.12	0.67	146.80	1676.10	—
	EC 1118-5P	5.52	4.00	0.48	147.48	1600.34	—
	FX10-5P	5.91	3.94	0.53	149.61	1526.16	—
	Petiole level r^2	0.133	0.394	0.004	0.012	0.237	—