

Table S1. Minor volatile compounds (mg/L) identified in low alcohol wines produced by wet or freeze-dried kefir culture at various temperatures (5–30 °C) using the HS-SPME GC/MS analysis. Volatiles were semi-quantified using 4-methyl-2-pentanol as internal standard.

Compounds	30 °C												20 °C						5 °C							
	K1	F values	Free kefir culture		Kefir immob. on apple pieces		Kefir immob. on DCM		Kefir immob. on grape skins		Free kefir culture		Kefir immob. on apple pieces		Kefir immob. on DCM		Kefir immob. on grape skins		Free kefir culture		Kefir immob. on apple pieces		Kefir immob. on DCM		Kefir immob. on grape skins	
			W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd	W	Fd
<i>Esters</i>																										
Ethyl acetate	<700		1.2– 5.1	1.3 –	4.7–6.1 15.5	10.2– 11.5	1.0– 7.5	2.6– 7	2.0 –	4.0 –	3.5– 8.4	2.0– 3.1	3.6– 6.9	1.8– 7.5	4.0– 12.6	1.2– 3.5	6.2– 8.6	5.1– 15.2	4.4–7.7	3.5–11.2	5.3–8.6	5.9–24.3	6.8– 8.8	5.7– 9.0	3.3– 8.8	6.1– 11.9
Ethyl propanoate	707		<0.1– 0.1	0.0 –	<0.1–0.1 0.8	0.0– 0.1	0.0– 0.1	0.1 –	<0. 1	0.2 –	0.2– 0.3	0.0– 0.3	0.0– 0.3	0.0– 0.3	0.0– 0.2	0.0– 0.4	0.2– 0.4	0.1– 0.8	0.2	0.0–0.1	0.1–0.8	0.2–0.6	0.4– 0.5	0.0– 0.2	0.5– 1.3	0.3– 0.7
Isobutyl acetate	745		0.0– <0.1	0.0 –	0.0–0.1 0.2	0.0– 0.2	<0.1– 0.2	<0.1 –0.1	0.1 –	0.2 –	0.0– 0.1	Nd 0.3	0.1– 0.1	0.0– 0.2	0.0– 0.1	0.0– 0.3	0.2– 0.3	0.0– <0.1	0.0– Nd	0.0–0.1	0.0–0.1	0.1	Nd	<0.1 –0.1	0.1	
Ethyl butyrate	803		0.3– 0.4	0.0 –	0.3–0.4 0.2	0.0– 0.6	0.1– –0.3	<0.1 –	0.2 –	0.4 –	0.4– 0.6	0.0– 0.2	0.5– 0.8	0.3– 0.5	0.5– 0.9	0.2– 0.6	0.5– 0.9	0.4– 1.3	0.4–0.5	0.0–0.3	0.3–1.0	0.8–1.9	0.5– 0.8	1.0– 2.0	0.3– 0.7	0.6– 0.7
3-methylbutyl acetate (Isoamyl acetate)	867		0.9– 1.3	0.0 –	3.6–4.8 1.4	0.6– 4.6	1.5– 1.0	0.5– –	2.6 –	6.1 –	3.7– 5.8	0.4– 1.1	7.0– 12.5	1.0– 2.0	4.1– 10.3	0.7– 1.7	5.9– 14.0	5.5– 20.6	1.2–1.6	0.0–0.7	3.6–5.8	0.5–1.3	4.9– 6.8	0.4– 2.3	2.3– 5.7	4.1– 8.7
2-methylbutyl acetate	869		0.0– 0.1	0.0 –	0.3–0.4 0.3	0.0– 0.3	0.1– 0.3	0.0– 0.1	0.2 –	0.4 –	0.0– 0.3	Nd 0.3	0.5– 0.8	0.0– 0.2	0.0– 0.6	0.0– 0.2	0.3– 0.7	0.3– 1.0	0.1	0.0–0.1	0.0–0.3	0.0–0.1	0.3– 0.4	Nd	0.2– 0.3	0.2– 0.4

Ethyl decanoate	1398	9.9– 37.0 6.9	3.7 – 6.9	7.0–11.1	0.1– 2.7	4.9– 9.6	1.6– 5.1	5.2 – 25.9	10. 1– 19.6	6.3– 20.0	1.9– 6.7	1.4– 18.5	4.8– 72.5	1.1– 12.9	4.3– 23.5	1.2– 27.9	8.7– 12.6	1.4–3.4	0.0–4.3	2.9–4.1	8.8–28.0	4.2– 5.0	2.0– 13.6	2.7– 9.0	1.0– 8.6
3-methylbutyl octanoate	1453	0.0– 0.2 <0.1 1	0.0 – <0.1 1	0.1–0.2	Nd 0.1	Nd 0.1	0.0 0.1	0.1 – 0.2 0.4	0.0– 0.2	Nd 0.6	0.0– 0.9	0.0– 0.1	0.0– 0.3	0.0– 0.3	Nd 0.3	Nd	Nd	0.0–0.1	0.0–0.2	0.0– 0.3	Nd 0.3	<0.1 –0.1	0.0– <0.1		
Ethyl dodecanoate	1595	<0.1– 0.3 0.1	0.0 – 0.1	0.1–0.4	0.0– 0.4	0.1– 0.2	0.0– 0.1	0.0 – 0.3 0.4	0.2 0.2	0.0– 0.2	<0.1– 0.9	0.0– 1.5	Nd 1.2	0.1– 0.5	0.2– 3.4	0.2– 3.4	0.0– <0.1	Nd	<0.1–0.1	0.0–1.1	<0.1	Nd	<0.1 –0.1	0.0– 0.1	
Ethyl-9-hexadecanoate	1975	Nd d	N d	Nd	Nd	Nd	N d	Nd d	Nd	Nd	Nd	0.0– 4.3	Nd	0.0– <0.1	Nd	0.0– 1.3	Nd	Nd	Nd	0.0–3.5	Nd	Nd	Nd	0.0– 0.1	
Ethyl hexadecanoate	1995	Nd <0.1 1	0– <0.1 1	Nd	<0.1– 0.2	Nd	Nd	N d 0.1	0.0 – 0.1	Nd	0.0– 0.1	Nd	0.0– 1.7	Nd	0.0– 0.1	Nd	0.0– 0.6	Nd	Nd	Nd	0.0–0.6	Nd	Nd	Nd	0.0– <0.1
Total esters		54.0– 104.6 33.3 3	28. 8– 96.7 28.2 81.8 – 9– 6– 181.9 – 205.1 – – – – – 75.0 73.4	60.6– 19.9– 48.8– 38.1 42. 74. 84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	19.9– 28.2 81.8 – 9– 6– 181.9 – 205.1 – – – – – 75.0 73.4	48.8– 38.1 42. 74. 84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	38.1 42. 74. 84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	42. 74. 84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	74. 84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	84.0– 28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	28.5 60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	60.6– 57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	57.0 36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	36.3 90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	90.7 38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	38.6 67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	67.3 60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	60.3– 16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	16.3–78.8 61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	61.1– 91.5–215.2 93.9– 53.4 58.9 31.8	91.5–215.2 93.9– 53.4 58.9 31.8	93.9– 53.4 58.9 31.8	53.4 58.9 31.8	58.9 31.8	31.8
State of the cells		2.69																							
Nature of kefir culture		3.54*																							
Fermentation temperature		10.20**																							
All interactions		1.40																							
<i>Organic acids</i>																									
Hexanoic acid	1005	Nd d	N d	Nd	Nd	Nd	N d	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	0.0–0.2	Nd	Nd	Nd	0.1– 0.7	Nd	0.0– 0.3	Nd

Octanoic acid	1198	0.4- 2.1 1.2	0.0 - -	2.8-3.2	Nd	0.3- 1.9	0.0- 0.5	0.0 -	1.0 -	0.0- 2.8	Nd	1.1- 3.1	0.0- 3.8	0.0- 3.1	0.0- 0.7	0.1- 4.4	1.2- 2.9	0.9-1.5	0.0-0.3	1.1-2.2	0.0-2.3	4.1- 8.9	Nd	0.4- 3.0	0.0- 1.6	
Decanoic acid	1381	0.0- 3.3 0.4	0.0 - -	0.3-0.6	Nd	<0.1- 0.3	Nd -	0.0 1-	<0. 0.5	0.0- -	Nd	0.0- 1.2	0.0- 1.8	0.0- 0.2	0.0- 0.2	0.0- 1.6	0.0- 1.3	0.0-0.1	Nd	0.0-0.3	0.0-0.4	0.1- 1.5	Nd	0.3- 1.8	0.0- 0.3	
Total organic acids		0.4- 4.4 1.6	0.0 - -	3.2-3.8	Nd	0.3- 2.2	0.0- 0.5	0.0 -	1.0 -	0.0- 3.3	Nd	1.2- 3.4	0.0- 5.6	0.0- 3.1	0.0- 0.9	0.1- 4.9	1.2- 3.5	1.1-1.6	0.0-0.3	1.3-2.5	0.0-2.7	4.8- 10.6	Nd	0.7- 5.1	0.0- 1.9	
State of the cells	18.70**																									
Nature of kefir culture	2.93*																									
Fermentation temperature	0.14																									
All interactions	4.00**																									
<i>Alcohols</i>																										
2-methyl-1-propanol (Isobutanol)	<700	0.3- 0.5 3.0	1.0 - -	0.8-1.6	0.6- 7.4	0.3- 1.3	1.4- 1.8	1.3 -	1.6 -	0.4- 1.5	0.8- 1.6	0.4- 1.6	1.0- 1.6	0.6- 1.6	0.3- 1.4	1.0- 2.7	1.3- 2.4	0.1-0.2	0.0-0.3	0.0-0.4	0.7-2.1	0.4- 0.6	0.5- 1.5	0.2- 0.6	0.9- 1.5	
3-methyl-1-butanol (Isoamyl alcohol)	721	11.0- 24.0 28. 6	22. 9- -	19.8- 45.0	10.8- 71.8	11.5- 37.8	19.9 -	19. 3-	39. 0-	17.6- 37.8	17.8 -	9.9- 40.4	20.7 -	21.7 -	10.1 -	23.8 -	28.4 -	5.1-6.8	5.6-11.4	5.6-22.8	17.6-32.1	12.4- 19.1	16.8 -	6.8- 19.1	15.6 -	
2-methyl-1-butanol (Amyl alcohol)	722	0.0- 3.0 10. 7	6.5 - -	5.1-9.0	4.3- 20.2	2.7- 6.9	5.5- 8.9	2.8 -	6.0 -	5.4- 12.5	4.9- 8.3	2.4- 7.1	4.4- 13.4	4.4- 10.6	1.9- 5.7	5.1- 7.5	5.9- 11.5	1.8-2.4	2.3-4.9	1.3-3.7	4.0-8.4	2.7- 3.9	4.7- 12.3	1.9- 3.6	3.5- 7.0	
2,3-butanediol	756	0.1- 0.3 0.1	0.0 - -	0.0-0.2	0.0- 0.2	<0.1- 0.1	0.0- 0.5	0.0 -	0.0 -	0.0- 0.1	Nd	0.0- 0.3	Nd	0.0- 0.9	Nd	0.0- 0.1	Nd	<0.1- 0.1	Nd	<0.1-0.2	Nd	0.0- 0.1	Nd	<0.1 0.4	0.0- 0.4	

2-phenylethanol	1133	1.1- 11.4 7.1	0.5 -	7.4-13.4	0.2- 2.0	3.7- 8.3	2.2- 3.5	1.3 -	3.3 -	0.6- 8.0	0.8- 2.8	2.8- 10.2	2.2- 4.0	0.0- 6.2	0.5- 2.6	1.5- 7.1	0.9- 3.7	1.4-1.8	0.0-0.6	1.5-2.6	0.0-1.4	1.3- 3.5	0.0- 0.2	0.7- 2.7	0.0- 2.9
3,7-dimethyl-6-octen-1-ol (Citronellol)	1235	0.1- 0.4 0.4	0.1 -	0.1-0.2	Nd 0.1	0.1 0.2	0.0- 0.0	0.0 -	0.2 -	0.0- 0.2	Nd 0.2	<0.1- 0.2	0.0- 0.4	0.0- 0.1	0.0- 0.2	0.0- 0.1	0.0- 0.2	0.4-0.7	0.0-0.1	0.2-0.4	0.0-0.2	0.2- 0.3	0.0- 0.1	0.2- 0.4	0.0- 0.2
2,4-bis(1,1-dimethylethyl)-phenol	1516	0.3- 2.2 3.1	1.2 -	0.5-1.0	1.6- 3.1	0.3- 0.7	0.7- 2.0	0.2 -	1.2 -	0.0- 0.6	0.6- 4.2	0.0- 0.7	1.5- 7.3	0.0- 0.2	1.6- 10.0	0.0- 0.6	0.9- 2.1	0.3-1.6	0.3-17.3	0.2-0.5	1.4-4.5	0.5- 0.7	1.7- 17.9	0.3- 0.8	0.9- 2.3
3,7,11-trimethyl-1,6,10-dodecatrien-3-ol (Nerolidol)	1565	0.0- 0.4 0.4	0.1 -	0.1-0.2	Nd 0.1	<0.1- 0.1	Nd -	0.0 1-	<0.0 0.1	0.0- 0.1	0.0- 0.1	0.0- 0.2	0.0- 11.3	Nd 0.1	0.0- 0.1	Nd 0.1	Nd	0.1	Nd	0.1	Nd	0.1	Nd	<0.1 -0.2	0.0- 0.1
3,7,11-trimethyl-2,6,10-dodecatrien-1-ol	1726	0.0- 0.2 0.3	0.0 -	<0.1-0.1	Nd Nd	0.0- 0.1	0.0 -	0.0 -	0.0 0.3	Nd 0.2	Nd 0.2	0.0- 0.2	0.0- 0.2	Nd 0.3	0.0- 0.3	Nd 0.3	Nd 0.3	Nd	Nd	0.1	0.0-0.1	<0.1 0.1	Nd 0.1	0.0- 0.1	0.0- 0.1
Total alcohols		16.2- 39.4 45. 2	41. 6- 45. 2	40.5- 60.6 102.6	18.9- 54.3	18.7- - 42.7	30.4 1- 52. 0	27. 6- 76. 0	51. 6- 76. 9	28.8- 52.4 43.6	25.9 - 51.1	24.4- - 51.1	32.2 - - 83.4	30.3 - - 53.9	17.6 - - 37.3	34.2 - - 55.9	40.5 - - 68.0	9.7- 13.2	8.9-33.6	10.7- 28.7	25.4-47.1	18.6- 27.8	23.8 - 73.9	10.0 - 26.0	25.9 - 35.3
State of the cells		9.91**																							
Nature of kefir culture		4.91**																							
Fermentation temperature		14.54**																							
All interactions		0.84																							

Carbonyl compounds

1,1-diethoxy-ethane (Acetal)	716	0.8- 2.9 0.9	0.5 -	0.0-0.3	0.7- 1.2	0.1- 0.9	0.3- 1.0	N d	0.3 -	1.1- 4.9	0.1- 0.9	0.0- 1.3	0.1- 2.0	0.0- 1.2	0.1- 1.1	0.2- 1.0	0.2- 0.6	1.0-2.8	0.4-1.8	0.0-0.6	0.6-6.2	0.3- 0.7	1.0- 1.1	0.2- 0.7	0.5- 1.3
Toluene	735	0.0- 0.2 0.1	0.0 -	0.0-0.2	Nd 0.2	0.0- 0.1	0.0- 0.1	N d	0.0 -	0.0- 0.1	Nd 0.1	0.0- 0.1	Nd 0.2	0.0- 0.2	Nd 0.2	0.0- 0.2	0.0- 0.2	0.1-0.2	Nd	0.0-0.1	0.0-0.1	Nd	Nd	0.1- 0.2	Nd
2,4-dimethyl-heptane	815	Nd - 0.1	0.0 -	Nd	Nd	Nd	Nd	N d	0.0 -	Nd	0.0- 0.2	Nd 0.2	0.0- 0.2	Nd 0.2	0.0- 0.2	0.0- 0.3	0.0- <0.1	0.0-0.1	Nd	0.0-0.1	0.0-0.1	Nd	Nd	<0.1 <0.1	0.0- <0.1
1,3,5-trimethyl-benzene (Mesitylene)	956	0.3- 0.6 0.3	0.2 -	0.4-0.7	0.0- 0.1	0.4- 0.5	0.2- 0.3	0.1 -	0.3 -	0.4- 0.5	0.0- 0.4	0.3- 0.6	0.0- 0.6	0.0- 0.4	0.0- 0.4	0.0- 0.5	0.0- 0.4	0.4-0.6	0.0-0.2	0.3-0.5	0.0-0.4	0.3- 0.4	0.0- 0.1	0.3- 0.4	0.0- 0.3
Decane	999	Nd - <0.1 1	0.0 -	Nd	Nd	Nd	Nd	N d	0.0 -	Nd	Nd	Nd	0.0- 0.2	Nd 0.2	0.0- 0.2	Nd 0.4	0.0-0.1	Nd	0.0-0.1	Nd	Nd	Nd	0.0- 0.1	0.0- <0.1	
4-methyl-decane	1023	<0.1- 0.1 0.1	0.0 -	0.0-0.1	Nd 0.1	0.0- 0.1	0.0- 0.1	N d	0.1 -	Nd	0.0- <0.1	0.0- <0.1	0.0- 0.3	Nd 0.2	0.0- 0.1	Nd 0.4	0.0- 0.1	0.0-0.1	Nd	0.0-0.1	Nd	0.0- 0.1	Nd	0.0- <0.1	0.1- 0.5
4,7-dimethyl-undecane	1067	0.0- 0.2 0.2	0.0 -	0.0-0.2	0.0- <0.1	0.2 0.1	0.0- 0.1	0.0 -	0.1 -	0.0- 0.2	0.0- 0.3	0.0- 0.2	Nd 0.2	0.0- 0.1	Nd 0.2	0.0- 0.2	0.0- 0.2	0.1-0.3	0.0-0.1	0.0-0.2	0.0-0.2	0.0- 0.1	Nd	0.0- 0.1	0.0- <0.1
2,6-dimethyl-undecane	1216	0.1- 0.3 0.1	0.0 -	0.0-0.3	Nd 0.2	0.1- 0.1	0.0- 0.1	N d	<0.1 1- 0.4	0.0- 0.1	0.0- 0.4	0.1- 0.3	0.0- 0.5	0.0- 0.1	0.0- 0.2	Nd 0.3	0.0- 0.3	0.1-0.2	0.0-0.1	0.1-0.2	0.0-0.1	0.0- 0.2	Nd	0.1- 0.2	0.0- 0.1
4,8-dimethyl-undecane	1226	<0.1- 0.1 0.1	0.0 -	0.1-0.2	Nd 0.1	0.1 0.1	0.0- 0.1	0.0 -	0.0 -	0.0- 0.1	Nd	Nd	Nd	0.0- 0.1	Nd 0.1	0.0- 0.1	Nd	0.1	Nd	0.1	0.0-0.1	0.1- 0.2	Nd	<0.1 <0.1	0.0- 0.1

State of the cells	0.55
Nature of kefir culture	4.47**
Fermentation temperature	8.72**
All interactions	1.19

W: Wet cells, Fd: Freeze-dried cells; Nd: Not detected; * $p < 0.05$, ** $p < 0.01$.