

Red Beetroots fermentation with different microbial consortia to develop foods with improved aromatic features

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Supplementary Materials

Figure S1. Quantification heatmap of significant variables of the volatilome (ANOVA $P < 0.05$).

Figure S2. Texture analysis.

Figure S3. Significance of Spearman rank correlations.

Table S1. pH measurements.

Table S2. MANOVA categorical descriptors for the volatilome, categorized for the type of matrix.

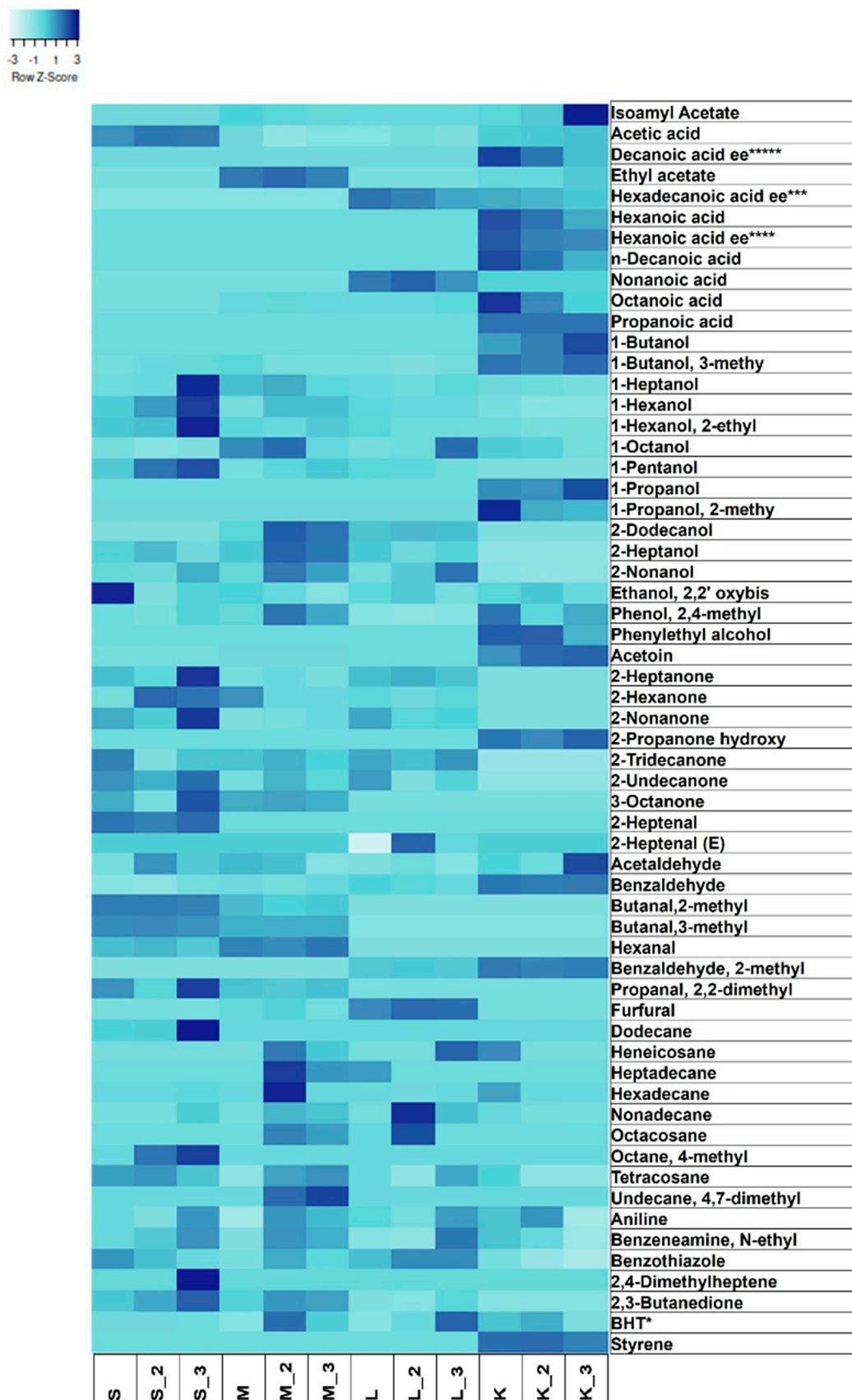


Figure S1. Quantification heatmap of significant variables of the volatilome (ANOVA $P < 0.05$).

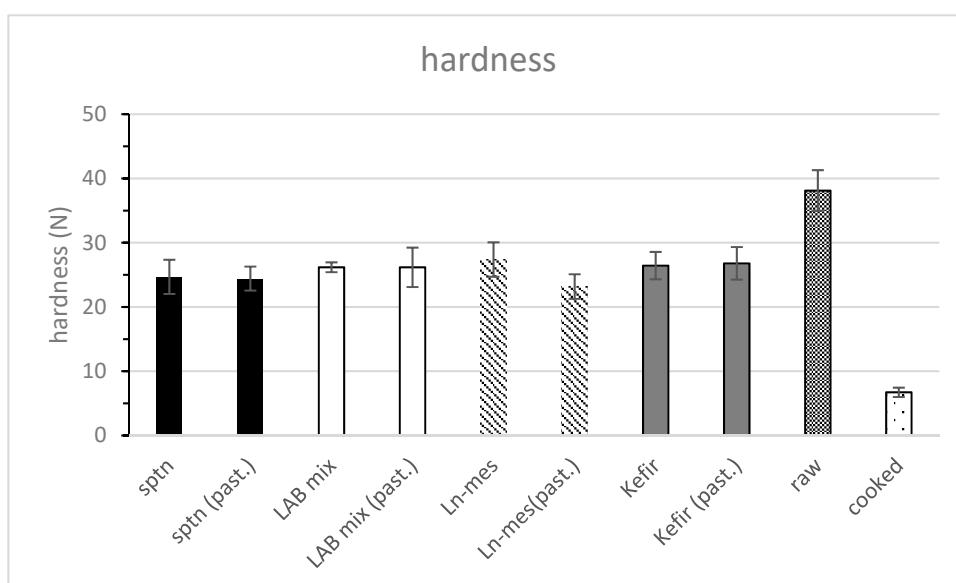


Figure S2: Texture results of beetroot samples fermented, fermented and pasteurized (past), compared to the raw and the cooked samples. Amounts reported are the average value of the replicates, the error bars representing the standard deviation “sptn”: spontaneous fermentation; “LAB mix”: fermentation after inoculum with mixed lactic acid bacteria starter culture; “Ln-mes”: fermentation after inoculum with single-strain *Ln. mesenteroides* starter culture; “Kefir”: fermentation after inoculum of LAB and yeasts water kefir starter. For this samples measurement was taken on five samples for each of the three fermentation replicates. For raw and cooked beetroot measurement was taken on five samples of one product.

[illegible]

Figure S3. Significance of Spearman rank correlations

Table S2. pH measurements during lactic fermentation expressed as means of three technical replicates plus standard deviation.

	1 st day	13 th day	20 th day
Spontaneous	6.07 ± 0.26 ^a	3.65 ± 0.04 ^b	3.68 ± 0.04 ^b
LAB mix	6.30 ± 0.21 ^a	3.58 ± 0.04 ^b	3.65 ± 0.05 ^b
<i>Ln mesenteroides</i>	6.17 ± 0.15 ^a	3.67 ± 0.04 ^b	3.69 ± 0.03 ^b
Kefir	6.17 ± 0.04 ^a	3.55 ± 0.03 ^b	3.63 ± 0.01 ^c

^{abc} Different letters indicate statistical significance by ANOVA followed by Tukey's HSD (Honestly Significant Difference) *post hoc* test ($P < 0.05$).

Table S2. MANOVA categorical descriptors for the volatilome, categorized for the type of matrix. % of contribution of VOCs descriptors significant among the food matrices.

Volatile Organic Compounds	% of contribution of VOCs descriptors				MANOVA
	Spontaneous	Mix	<i>Ln. mes</i> [*]	Kefir	<i>P</i> value
Isoamyl acetate	0.00	18.18	3.93	77.89	0.20373
Acetic acid	38.37 ^a	16.99 ^b	17.64 ^b	27.00 ^{ab}	0.00001
Decanoic acid, ethyl ester	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00351
Ethyl acetate	1.92 ^c	76.35 ^a	1.45 ^c	20.29 ^b	<0.00001
Hexadecanoic acid, ethyl ester	0.00 ^c	0.00 ^c	61.03 ^a	38.97 ^b	0.00001
Hexanoic acid	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00037
Hexanoic acid, ethyl ester	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00001
n-Decanoic acid	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00099
Nonanoic acid	0.00 ^c	0.00 ^c	76.09 ^a	23.91 ^b	<0.00001
Octanoic acid	0.00 ^c	11.24 ^b	13.71 ^b	75.05 ^a	0.02334
Propanoic acid	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00051
1-Butanol	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00021
1-Butanol, 3-methyl-	12.58 ^b	10.50 ^b	4.79 ^c	72.13 ^a	<0.00001
1-Heptanol	48.20	34.81	12.34	4.65	0.44823
1-Hexanol	50.27 ^a	24.88 ^b	18.48 ^b	6.38 ^c	0.03072
1-Hexanol, 2-ethyl-	63.70	20.69	12.42	3.20	0.09269
1-Octanol	7.28	42.73	28.78	21.21	0.18809
1-Pentanol	60.77 ^a	18.63 ^b	17.71 ^b	2.89 ^c	0.01085
1-Propanol	0.00	0.00	0.00	100.00 ^a	0.00007
1-Propanol, 2-methyl-	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.02325
2-Dodecanol	0.00 ^c	64.86 ^a	35.14 ^b	0.00 ^c	0.00638
2-Heptanol	23.73 ^b	53.78 ^a	22.49 ^b	0.00 ^c	0.00422
2-Nonanol	24.88	35.69	31.26	8.17	0.09163
Ethanol, 2,2'-oxybis-	38.14	17.53	21.03	23.29	0.61613
Phenol, 2,4-bis(1,1-dme)-*	20.98 ^{ab}	31.99 ^a	14.91 ^b	32.13 ^a	0.03854
Phenylethyl alcohol	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	0.00080
2-Butanone, 3-hydroxy-	0.00 ^c	4.81 ^b	2.09 ^b	93.10 ^a	<0.00001
2-Heptanone	50.65	9.42	36.40	3.52	0.07820
2-Hexanone	53.94	28.75	17.31	0.00	0.13754
2-Nonanone	61.88 ^a	5.84 ^c	32.28 ^b	0.00 ^d	0.03272
2-Propanone, 1-hydroxy-	0.00 ^b	0.00 ^b	0.00 ^b	100.00 ^a	<0.00001
2-Tridecanone	30.59 ^a	30.66 ^a	38.75 ^a	0.00 ^b	0.01377

2-Undecanone	50.14 ^a	23.55 ^b	26.31 ^b	0.00 ^c	0.01097
2-Octanone	49.51 ^a	50.49 ^a	0.00 ^b	0.00 ^b	0.04905
2,3-Butanedione	49.01	50.99	0.00	0.00	0.05003
2-Heptenal	100.00 ^a	0.00 ^b	0.00 ^b	0.00 ^b	<0.00001
2-Heptenal, (E)-	0.00	0.00	100.00	0.00	0.94485
Acetaldehyde	29.72	24.04	8.41	37.83	0.41336
Benzaldehyde	10.39 ^b	17.23 ^b	22.76 ^{ab}	49.62 ^a	<0.00001
Butanal, 2-methyl-	68.26 ^a	31.74 ^b	0.00 ^c	0.00 ^c	<0.00001
Butanal, 3-methyl-	57.49 ^a	42.51 ^a	0.00 ^b	0.00 ^b	<0.00001
Hexanal	34.94 ^b	65.06 ^a	0.00 ^c	0.00 ^c	<0.00001
Benzaldehyde, 2-methyl-	0.00 ^c	0.00 ^c	30.52 ^b	69.48 ^a	<0.00001
Propanal, 2,2-dimethyl-	66.08 ^a	33.92 ^b	0.00 ^c	0.00 ^c	0.01803
Furfural	0.00 ^c	12.91 ^b	87.09 ^a	0.00 ^c	<0.00001

^{abcd} Different letters indicate statistical significance by MANOVA followed by Tukey's HSD

(Honestly Significant Difference) *post hoc* test ($P < 0.05$). **Ln. mes.* = *Leuconostoc mesenteroides*