Supplementary materials

Table S1. Statistical summary of antioxidant activity and selected-wavelength absorbance measurements.

Outcome	MRP-D-Glu (mean ± SD)	MRP-L-Glu (mean ± SD)	Overall ANOVA	Effect size, R^2/η^2	Mean difference	95% CI	Adjusted p
ABTS	60.350 ± 2.695	65.786 ± 8.988	F(3,8)=173.1, p<0.0001	0.9848	-5.435	-17.71 to 6.841	0.5233
FRAP	158.949 ± 3.035	206.964 ± 19.576	F(3,8)=313.6, p<0.0001	0.9916	-48.01	-74.41 to -21.62	0.0018
DPPH	16.567 ± 4.524	18.533 ± 4.497	F(3,8)=30.47, p<0.0001	0.9195	-1.967	-10.31 to 6.372	0.8720
A420	0.806 ± 0.020	0.859 ± 0.027	F(3,8)=2191, p<0.0001	0.9988	-0.05333	-0.09980 to -0.006872	0.0259
A280	0.682 ± 0.079	0.855 ± 0.100	F(3,8)=154.0, p<0.0001	0.9830	-0.1730	-0.3331 to -0.01290	0.0348
A294	0.713 ± 0.081	0.878 ± 0.115	F(3,8)=124.9, p<0.0001	0.9791	-0.1647	-0.3488 to 0.01942	0.0805

ABTS activity was expressed as vitamin C equivalent antioxidant capacity. FRAP activity was expressed as Fe^{2+} equivalents. DPPH radical-scavenging activity was expressed as the percentage decrease in absorbance relative to the assay control. A420 was measured using undiluted samples and used as the browning index. A280 and A294 were measured after 30-fold dilution with H_2O to provide preliminary information on UV-absorbing reaction products. For ABTS, FRAP, and DPPH, the main comparison shown is MRP-D-Glu versus MRP-L-Glu. For A420, A280, and A294, the comparison shown is heated D-glucose/L-lysine MRP versus heated L-glucose/L-lysine MRP. Mean difference was calculated as MRP-D-Glu minus MRP-L-Glu; therefore, negative values indicate higher values for MRP-L-Glu. Confidence intervals indicate 95% confidence intervals, and adjusted p values were obtained using Tukey's multiple-comparison test. The overall one-way ANOVA included the two heated MRP preparations and their corresponding non-heated precursor-mixture controls, whereas the pairwise comparison shown in the table focuses on MRP-D-Glu

versus MRP-L-Glu. Abbreviations: Maillard reaction products prepared from D-glucose and L-lysine (MRP-D-Glu); Maillard reaction products prepared from L-glucose and L-lysine (MRP-L-Glu); vitamin C equivalents (VCE); analysis of variance (ANOVA); confidence interval (CI); standard deviation (SD).

Table S2. Statistical summary of two-way repeated-measures ANOVA and selected post hoc comparisons for growth-kinetic assays against *L. monocytogenes* ATCC 19111.

(a) Overall two-way repeated-measures ANOVA for the final 50% (v/v) reaction-mixture proportion.

Source	F value	df	p value
Time × treatment	F(20,50)=548.1	20, 50	p<0.0001
Time	F(1.141,11.41)=3081	1.141, 11.41	p<0.0001
Treatment	F(4,10)=27.62	4, 10	p<0.0001

(b) Selected 16 h post hoc comparisons for the final 50% (v/v) reaction-mixture proportion.

Time	Comparison	Mean difference	95% CI	Adjusted p
16 h	D-Glu vs L-Glu	-0.02967	-0.06413 to 0.004795	0.0762
16 h	D-Glu vs PB/vehicle	-0.2750	-0.3186 to -0.2314	0.0002
16 h	L-Glu vs PB/vehicle	-0.2453	-0.2878 to -0.2029	0.0001

(c) Overall two-way repeated-measures ANOVA for the final 25% (v/v) reaction-mixture proportion.

Source	F value	df	p value
Time × treatment	F(20,50)=23.38	20, 50	p<0.0001
Time	F(1.004,10.04)=99.38	1.004, 10.04	p<0.0001
Treatment	F(4,10)=35.01	4, 10	p<0.0001

(d) Selected 12 h and 16 h post hoc comparisons for the final 25% (v/v) reaction-mixture proportion.

Time	Comparison	Mean difference	95% CI	Adjusted p
12 h	D-Glu vs L-Glu	0.01600	-0.01388 to 0.04588	0.2177
12 h	D-Glu vs PB/vehicle	-0.2093	-0.2387 to -0.1799	<0.0001
12 h	L-Glu vs PB/vehicle	-0.2253	-0.2406 to -0.2100	<0.0001
16 h	D-Glu vs L-Glu	0.2363	0.02349 to 0.4492	0.0405
16 h	D-Glu vs PB/vehicle	-0.009000	-0.2112 to 0.1932	0.9968

16 h	L-Glu vs PB/vehicle	-0.2453	-0.2872 to -0.2035	0.0002

Growth-kinetic assays were performed by monitoring OD_{600} over 16 h in tryptic soy broth. The final reaction-mixture proportions indicate the proportion of heated MRP preparation present in each well after mixing with the bacterial inoculum. Two-way repeated-measures ANOVA was performed separately for the final 50% (v/v) and 25% (v/v) reaction-mixture proportions. The factors were treatment, time, and their interaction. Selected post hoc comparisons at 12 h and/or 16 h are shown because these time points directly reflect the persistence of growth inhibition during later incubation. Mean differences are expressed as the first-listed group minus the second-listed group. PB/vehicle denotes phosphate buffer containing 0.1% peptone but no MRPs. Adjusted p values were obtained using Tukey's multiple-comparison test. At the final 50% (v/v) reaction-mixture proportion, both MRP-D-Glu and MRP-L-Glu significantly suppressed *L. monocytogenes* growth compared with the PB/vehicle control at 16 h, whereas the difference between MRP-D-Glu and MRP-L-Glu was not statistically significant. At the final 25% (v/v) reaction-mixture proportion, MRP-L-Glu maintained significantly lower OD_{600} than both MRP-D-Glu and the PB/vehicle control at 16 h, whereas MRP-D-Glu was not significantly different from the PB/vehicle control. Abbreviations: Maillard reaction products prepared from D-glucose and L-lysine (MRP-D-Glu); Maillard reaction products prepared from L-glucose and L-lysine (MRP-L-Glu); non-heated D-glucose/L-lysine control (D-Glu C); non-heated L-glucose/L-lysine control (L-Glu C); standard deviation (SD).

Table S3. Growth response of *E. coli* ATCC 25922 exposed to glucose-lysine MRPs and control treatments.

Treatment		MRP-D-Glu		MRP-L-Glu	
		Mean	SD	Mean	SD
Concentration (MRPs)	50%(v/v)	0.825	0.065	0.904	0.096
	25%(v/v)	0.852	0.070	0.870	0.020
	12.5%(v/v)	0.778	0.087	0.889	0.050
	6.2%(v/v)	0.871	0.052	0.852	0.061
	3.1%(v/v)	0.819	0.060	0.872	0.171
	1.6%(v/v)	0.790	0.052	0.821	0.093
	0.8%(v/v)	0.846	0.003	0.760	0.081
Control	PB	0.905	0.129	/	/
	PB(0.1% peptone)	0.952	0.069	/	/
	MRP-D-Glu C	0.967	0.097	/	/
	MRP-L-Glu C	0.931	0.141	/	/

Data are presented as mean ± SD (n = 3) of OD_{600} values after 16 h incubation at 37 °C. MRP-D-Glu and MRP-L-Glu denote heated Maillard reaction products prepared from D-glucose or L-glucose with L-lysine, respectively. The tested MRP levels are expressed as final reaction-mixture proportions in the wells after mixing the MRP preparation with the bacterial inoculum. PB was used as the buffer control, and PB supplemented with 0.1% peptone was used as the vehicle control. MRP-D-Glu C and MRP-L-Glu C denote the corresponding non-heated D-glucose/L-lysine and L-glucose/L-lysine precursor-mixture controls, respectively. No obvious growth inhibition was observed for either MRP-D-Glu or MRP-L-Glu against *E. coli* ATCC 25922 under the tested conditions. Abbreviations: Maillard reaction products prepared from D-glucose and L-lysine (MRP-D-Glu); Maillard reaction products prepared from L-glucose and L-lysine (MRP-L-Glu); non-heated D-glucose/L-lysine control (D-Glu C); non-heated L-glucose/L-lysine control (L-Glu C); standard deviation (SD).

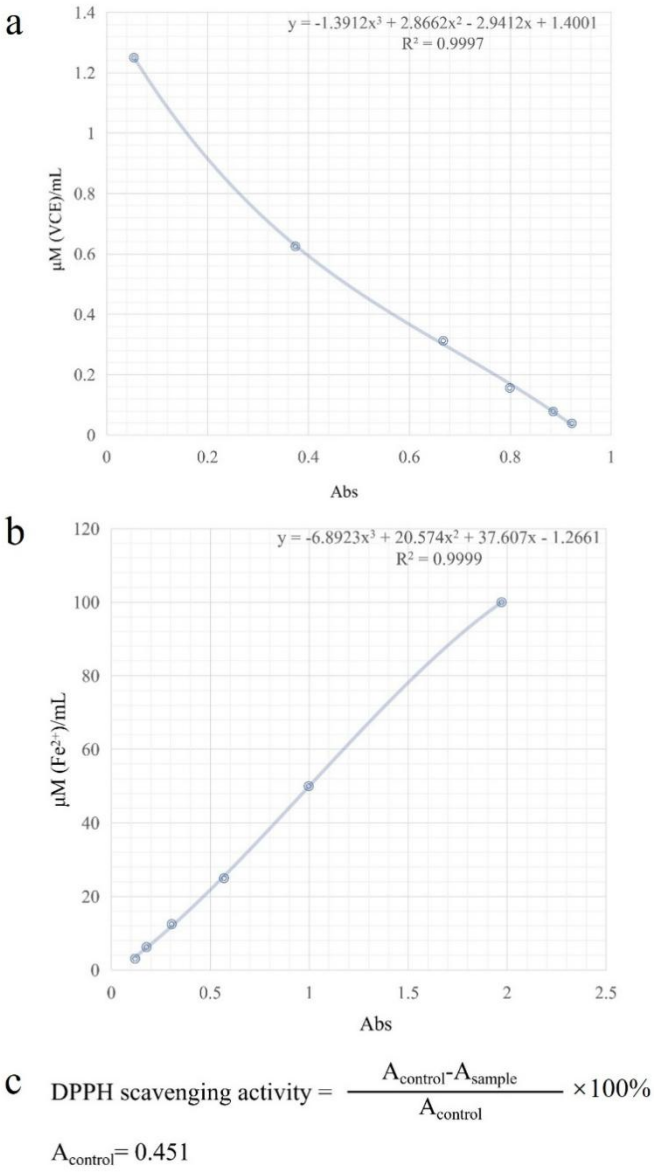

Figure S1. Calibration curves and calculation method used for antioxidant activity assays. (a) Calibration curve for the ABTS assay using vitamin C as the standard. ABTS antioxidant capacity was calculated from the vitamin C calibration curve and expressed as vitamin C equivalents (VCE). (b) Calibration curve for the FRAP assay using Fe^{2+} as the standard. FRAP values were calculated from the Fe^{2+} calibration curve and expressed as Fe^{2+} equivalents. (c) Calculation formula for DPPH radical-scavenging activity. DPPH activity was calculated as the percentage decrease in absorbance of the sample relative to the assay control. Because DPPH activity was expressed as percentage radical-scavenging activity, no external calibration curve was used for this endpoint.