Supplementary Materials

Supplementary Table S1. RAPD grouping and representative isolate selection of 74 lactate acid bacteria isolates recovered from approximately 280 presumptive isolates obtained from traditional Korean fermented onion samples

Isolate ID	Sample	Colony morphology (Gram/Cat/Ox)	Acid tolerance (pH 3.0, 2 h, %)	Bile tolerance (0.3% oxgall, 4 h, %)	RAPD cluster	Selected
Isolate-01	FO-2	Round, white, smooth, +/–/–	73.9	84.7	A	Yes (FO-L1)
Isolate-02	FO-4	Round, cream, mucoid, +/–/–	80.6	75.5	B	Yes (FO-L2)
Isolate-03	FO-4	Irregular, white, rough, +/–/–	74.1	92.4	C	Yes (FO-L3)
Isolate-04	FO-6	Round, ivory, smooth, +/–/–	82.0	97.6	D	Yes (FO-L4)
Isolate-05	FO-7	Round, white, mucoid, +/–/–	95.3	89.1	E	Yes (FO-L5)
Isolate-06	FO-7	Round, cream, raised, +/–/–	78.4	91.4	F	Yes (FO-L6)
Isolate-07	FO-8	Oval, white, smooth, +/–/–	88.2	90.8	G	Yes (FO-L7)
Isolate-08	FO-9	Round, cream, flat, +/–/–	71.4	83.5	H	Yes (FO-L8)
Isolate-09	FO-9	Round, ivory, smooth,	79.2	87.1	I	Yes (FO-L9)

Isolate ID	Sample	Colony morphology (Gram/Cat/Ox)	Acid tolerance (pH 3.0, 2 h, %)	Bile tolerance (0.3% oxgall, 4 h, %)	RAPD cluster	Selected
		+/−/−				
Isolate-10	FO-9	Round, white, convex, +/−/−	84.6	91.2	J	Yes (FO-L10)
Isolate-11	FO-10	Round, white, mucoid, +/−/−	70.3	71.2	K	Yes (FO-L11)
Isolate-12	FO-10	Round, cream, smooth, +/−/−	92.1	93.3	L	Yes (FO-L12)
Isolate-13	FO-1	Round/oval, +/−/−	38.2	42.1	A	No
Isolate-14	FO-1	Round/oval, +/−/−	45.3	38.7	A	No
Isolate-15	FO-1	Round/oval, +/−/−	29.6	51.2	B	No
Isolate-16	FO-1	Round/oval, +/−/−	62.1	44.3	B	No
Isolate-17	FO-1	Round/oval, +/−/−	55.4	39.8	C	No
Isolate-18	FO-1	Round/oval, +/−/−	41.2	48.6	C	No
Isolate-19	FO-1	Round/oval, +/−/−	33.5	55.1	D	No
Isolate-20	FO-2	Round/oval, +/−/−	28.4	61.3	E	No
Isolate-21	FO-2	Round/oval, +/−/−	49.7	35.2	E	No
Isolate-22	FO-2	Round/oval, +/−/−	37.8	42.9	F	No
Isolate-23	FO-2	Round/oval, +/−/−	44.1	58.3	G	No
Isolate-24	FO-2	Round/oval, +/−/−	31.6	46.7	H	No
Isolate-25	FO-3	Round/oval, +/−/−	52.3	38.4	I	No

Isolate ID	Sample	Colony morphology (Gram/Cat/Ox)	Acid tolerance (pH 3.0, 2 h, %)	Bile tolerance (0.3% oxgall, 4 h, %)	RAPD cluster	Selected
Isolate-26	FO-3	Round/oval, +/−/−	46.8	41.2	J	No
Isolate-27	FO-3	Round/oval, +/−/−	39.4	55.8	K	No
Isolate-28	FO-3	Round/oval, +/−/−	61.2	48.3	L	No
Isolate-29	FO-3	Round/oval, +/−/−	43.7	36.9	M	No
Isolate-30	FO-3	Round/oval, +/−/−	35.1	62.4	N	No
Isolate-31	FO-4	Round/oval, +/−/−	47.6	39.8	O	No
Isolate-32	FO-4	Round/oval, +/−/−	55.3	43.1	P	No
Isolate-33	FO-4	Round/oval, +/−/−	38.9	51.6	Q	No
Isolate-34	FO-4	Round/oval, +/−/−	42.7	36.4	R	No
Isolate-35	FO-4	Round/oval, +/−/−	60.4	48.7	S	No
Isolate-36	FO-4	Round/oval, +/−/−	34.2	57.3	T	No
Isolate-37	FO-5	Round/oval, +/−/−	51.8	40.2	U	No
Isolate-38	FO-5	Round/oval, +/−/−	39.3	47.6	V	No
Isolate-39	FO-5	Round/oval, +/−/−	44.6	35.9	W	No
Isolate-40	FO-5	Round/oval, +/−/−	63.2	52.4	X	No
Isolate-41	FO-5	Round/oval, +/−/−	36.8	44.1	Y	No
Isolate-42	FO-5	Round/oval, +/−/−	49.1	38.7	Z	No
Isolate-43	FO-6	Round/oval, +/−/−	41.5	53.2	AA	No
Isolate-44	FO-6	Round/oval, +/−/−	57.3	42.8	AB	No

Isolate ID	Sample	Colony morphology (Gram/Cat/Ox)	Acid tolerance (pH 3.0, 2 h, %)	Bile tolerance (0.3% oxgall, 4 h, %)	RAPD cluster	Selected
Isolate-45	FO-6	Round/oval, +/−/−	33.9	48.5	AC	No
Isolate-46	FO-6	Round/oval, +/−/−	48.6	36.1	AD	No
Isolate-47	FO-6	Round/oval, +/−/−	62.4	55.7	AE	No
Isolate-48	FO-7	Round/oval, +/−/−	38.1	44.9	AF	No
Isolate-49	FO-7	Round/oval, +/−/−	53.7	39.2	AG	No
Isolate-50	FO-7	Round/oval, +/−/−	46.2	61.3	AH	No
Isolate-51	FO-7	Round/oval, +/−/−	31.4	48.7	AI	No
Isolate-52	FO-7	Round/oval, +/−/−	59.8	43.1	AJ	No
Isolate-53	FO-7	Round/oval, +/−/−	42.3	35.6	AK	No
Isolate-54	FO-8	Round/oval, +/−/−	55.1	40.8	AL	No
Isolate-55	FO-8	Round/oval, +/−/−	37.6	52.4	AM	No
Isolate-56	FO-8	Round/oval, +/−/−	48.9	38.1	AN	No
Isolate-57	FO-8	Round/oval, +/−/−	64.3	46.7	AO	No
Isolate-58	FO-8	Round/oval, +/−/−	41.7	55.2	AP	No
Isolate-59	FO-8	Round/oval, +/−/−	33.2	43.9	AQ	No
Isolate-60	FO-9	Round/oval, +/−/−	39.5	47.3	AR	No
Isolate-61	FO-9	Round/oval, +/−/−	53.8	36.4	AS	No
Isolate-62	FO-9	Round/oval, +/−/−	46.1	58.9	AT	No
Isolate-63	FO-9	Round/oval, +/−/−	62.7	42.5	AU	No

Isolate ID	Sample	Colony morphology (Gram/Cat/Ox)	Acid tolerance (pH 3.0, 2 h, %)	Bile tolerance (0.3% oxgall, 4 h, %)	RAPD cluster	Selected
Isolate-64	FO-9	Round/oval, +/−/−	35.4	51.8	AV	No
Isolate-65	FO-9	Round/oval, +/−/−	48.3	39.7	AW	No
Isolate-66	FO-10	Round/oval, +/−/−	57.2	44.6	AX	No
Isolate-67	FO-10	Round/oval, +/−/−	40.8	53.1	AY	No
Isolate-68	FO-10	Round/oval, +/−/−	33.7	46.8	AZ	No
Isolate-69	FO-10	Round/oval, +/−/−	51.4	38.3	BA	No
Isolate-70	FO-10	Round/oval, +/−/−	44.9	60.2	BB	No
Isolate-71	FO-10	Round/oval, +/−/−	63.1	47.5	BC	No
Isolate-72	FO-10	Round/oval, +/−/−	37.3	52.7	BD	No
Isolate-73	FO-10	Round/oval, +/−/−	48.5	43.2	BE	No
Isolate-74	FO-10	Round/oval, +/−/−	56.8	39.6	BF	No

Blue highlighted rows indicate the 12 representative strains selected for comprehensive characterization.

Cat, catalase; Ox, oxidase; RAPD, randomly amplified polymorphic DNA.

Supplementary Table 2. Cell surface hydrophobicity and adhesion capacity of lactic acid bacteria strains isolated from Korean fermented onion *jangajji* and Pearson's correlation analysis

Strain	Hydrophobicity (%)	Cell Surface Adhesion (%)
FO-L1	40.5±3.3^{g}	20.5±4.0^{de}
FO-L2	39.4±2.8^{g}	24.0±2.2^{cd}
FO-L3	43.2±3.1^{f}	18.0±5.0^{ef}
FO-L4	52.9±2.7^{cd}	27.0±2.7^{bc}
FO-L5	55.7±4.9^{bc}	24.5±3.1^{cd}
FO-L6	42.2±3.0^{f}	14.7±0.8^{f}
FO-L7	46.3±1.9^{e}	26.0±3.8^{bc}
FO-L8	50.7±2.8^{d}	22.0±2.6^{de}
FO-L9	53.1±0.4^{c}	31.0±6.0^{ab}
FO-L10	44.4±5.0^{ef}	21.5±4.2^{de}
FO-L11	59.9±3.2^{ab}	29.0±0.9^{ab}
FO-L12	62.4±5.3^{a}	34.0±2.5^{a}
Pearson correlation: r = 0.780, R^2 = 0.608, p = 0.003 (p < 0.01); n = 12 strains		

Values are presented as mean ± SD (n = 3). Different superscript letters within the same column indicate statistically significant differences among the strains ($p<0.05$) according to Duncan's multiple range test. The Pearson's correlation coefficient (r) and coefficient of determination (R^2) were calculated using the mean values for all 12 strains.

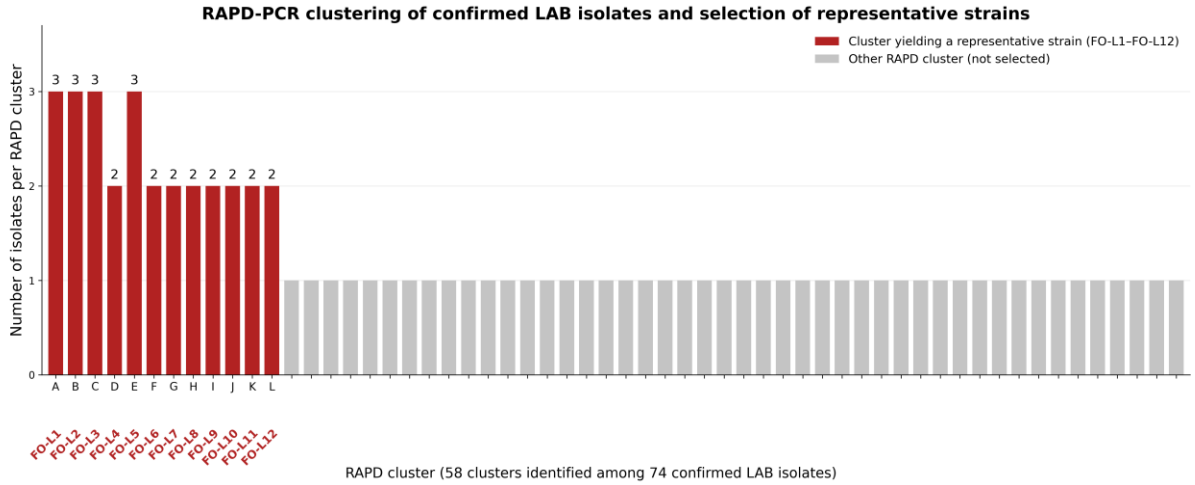
Supplementary Table 3. Antioxidant activity of the three selected LAB strains and Pearson's correlation with EPS production

Antioxidant assay	*W. confusa* FO-L5	*Leu. citreum* FO-L9	*P. acidilactici* FO-L10
EPS yield (mg/L)	89.4±1.4^{c}	164.2±2.5^{a}	138.5±3.3^{b}
DPPH radical scavenging (%)	50.9±1.7^{c}	76.8±4.7^{a}	61.4±3.4^{b}
ABTS radical scavenging (%)	43.8±1.6^{c}	68.2±0.9^{a}	59.0±3.3^{b}
FRAP (µmol Fe^{2+} equivalents/OD_{600} unit)	0.86±0.03^{c}	1.31±0.07^{a}	1.18±0.10^{b}
TBARS inhibition (%)	36.5±1.9^{c}	52.2±0.6^{a}	45.0±2.9^{b}
Pearson correlation coefficients (EPS yield vs. antioxidant activity, n = 3)			
Antioxidant assay	**r value**	**p value**	**Significance**
DPPH radical scavenging (%)	0.959	0.1830	NS
ABTS radical scavenging (%)	0.999	0.0240	* ($p<0.05$)
FRAP (µmol Fe^{2+} equivalents/OD_{600} unit)	0.998	0.0385	* ($p<0.05$)
TBARS inhibition (%)	0.991	0.0833	NS
** $p<0.05$; NS, not significant. Pearson correlation performed using strain mean values (n = 3 strains). Note: statistical power is limited due to small sample size (n = 3); results should be interpreted with caution.*			

Values are presented as mean ± SD (n = 3 independent experiments). Different superscript letters

within each row indicate significant differences among the strains ($p < 0.05$) according to Duncan's multiple range test. Pearson's correlation analysis was performed between EPS yield (mg/L) and each antioxidant indicator using the mean values of the three representative LAB strains. Although strong positive correlations were observed between EPS production and antioxidant activity, the statistical power of the analysis was limited by the small sample size ($n = 3$ strains). Therefore, these correlation results should be interpreted with caution.

EPS, exopolysaccharide; LAB, lactic acid bacteria



Supplementary Fig. S1. RAPD–PCR clustering of the 74 LAB isolates. Bars indicate the number of isolates grouped into each of the 58 RAPD clusters identified using the M13 primer (≥95% banding-pattern similarity). Red bars indicate the 12 clusters from which representative strains (FO-L1 to FO-L12) were selected for further characterization. Per-isolate cluster assignments and selection status are listed in full in Supplementary Table S1.

LAB, lactic acid bacteria; RAPD, randomly amplified polymorphic DNA