

## Supplementary Materials:

**Table S1.** Identification of primarily selected 12 LAB strains showing good acid tolerance (%) based on their 16S rRNA gene sequences.

| Strains | Closest type strain  | Sequence similarity (%) | GenBank accession No. |
|---------|--|-------------------------|-----------------------|
| NKJ81   | <i>Leuconostoc mesenteroides</i> subsp. <i>jonggajibkimchii</i> DRC1506 <sup>T</sup> | 100                     | MZ971173              |
| NKJ96   | <i>Latilactobacillus curvatus</i> JCM1096 <sup>T</sup>                               | 100                     | MZ971174              |
| NKJ170  | <i>Leuconostoc mesenteroides</i> subsp. <i>jonggajibkimchii</i> DRC1506 <sup>T</sup> | 100                     | MZ971175              |
| NKJ198  | <i>Leuconostoc mesenteroides</i> subsp. <i>mesenteroides</i> ATCC8293 <sup>T</sup>   | 100                     | MZ971176              |
| NKJ235  | <i>Latilactobacillus curvatus</i> JCM1096 <sup>T</sup>                               | 100                     | MZ971177              |
| NSMJ15  | <i>Lacticaseibacillus paracasei</i> subsp. <i>tolerans</i> JCM 1171 <sup>T</sup>     | 100                     | MT397048              |
| NSMJ16  | <i>Lentilactobacillus parabuchneri</i> NBRC 107865 <sup>T</sup>                      | 100                     | MT397049              |
| NSMJ23  | <i>Levilactobacillus brevis</i> ATCC 14869 <sup>T</sup>                              | 99.87                   | MT397050              |
| NSMJ27  | <i>Lacticaseibacillus paracasei</i> subsp. <i>paracasei</i> ATCC 25302 <sup>T</sup>  | 100                     | MZ971178              |
| NSMJ42  | <i>Schleiferlactobacillus harbinensis</i> DSM 16991 <sup>T</sup>                     | 99.58                   | MT397051              |
| NSMJ56  | <i>Lacticaseibacillus paracasei</i> subsp. <i>tolerans</i> JCM 1171 <sup>T</sup>     | 100                     | MZ971179              |
| NFFJ04  | <i>Lacticaseibacillus paracasei</i> subsp. <i>tolerans</i> JCM 1171 <sup>T</sup>     | 99.93                   | MT397052              |

**Table S2.** Growth characteristics of five selected LAB strains.

| Characteristic            | NSMJ15           | NSMJ16               | NSMJ23               | NSMJ42               | NFFJ04               |
|---------------------------|------------------|----------------------|----------------------|----------------------|----------------------|
| Growth at                 |                  |                      |                      |                      |                      |
| Temperature (optimum, °C) | 10-45<br>(30-40) | 10-40<br>(30-40)     | 10-40<br>(30-40)     | 10-45<br>(30-40)     | 10-45<br>(30-35)     |
| pH (optimum)              | 4.0-8.0<br>(6.0) | 3.5-8.0<br>(6.0-7.0) | 3.5-8.0<br>(6.0-6.5) | 3.0-9.0<br>(5.5-7.0) | 4.0-8.0<br>(6.0-7.0) |
| NaCl (optimum, %)         | 0-5<br>(0-1)     | 0-7<br>(0-3)         | 0-5<br>(0-2)         | 0-6<br>(0-2)         | 0-6<br>(0-1)         |
| Anaerobic condition       | +                | +                    | +                    | +                    | +                    |

## **Supplementary figure legends**

**Figure S1.** (A) Acid- and (B) bile salt tolerance (%) of primarily selected 12 LAB strains.

**Figure S2.** Cell surface hydrophobicity (%, MATS) and bacterial adhesion to Caco-2 cells (%) of primarily selected 12 LAB strains.

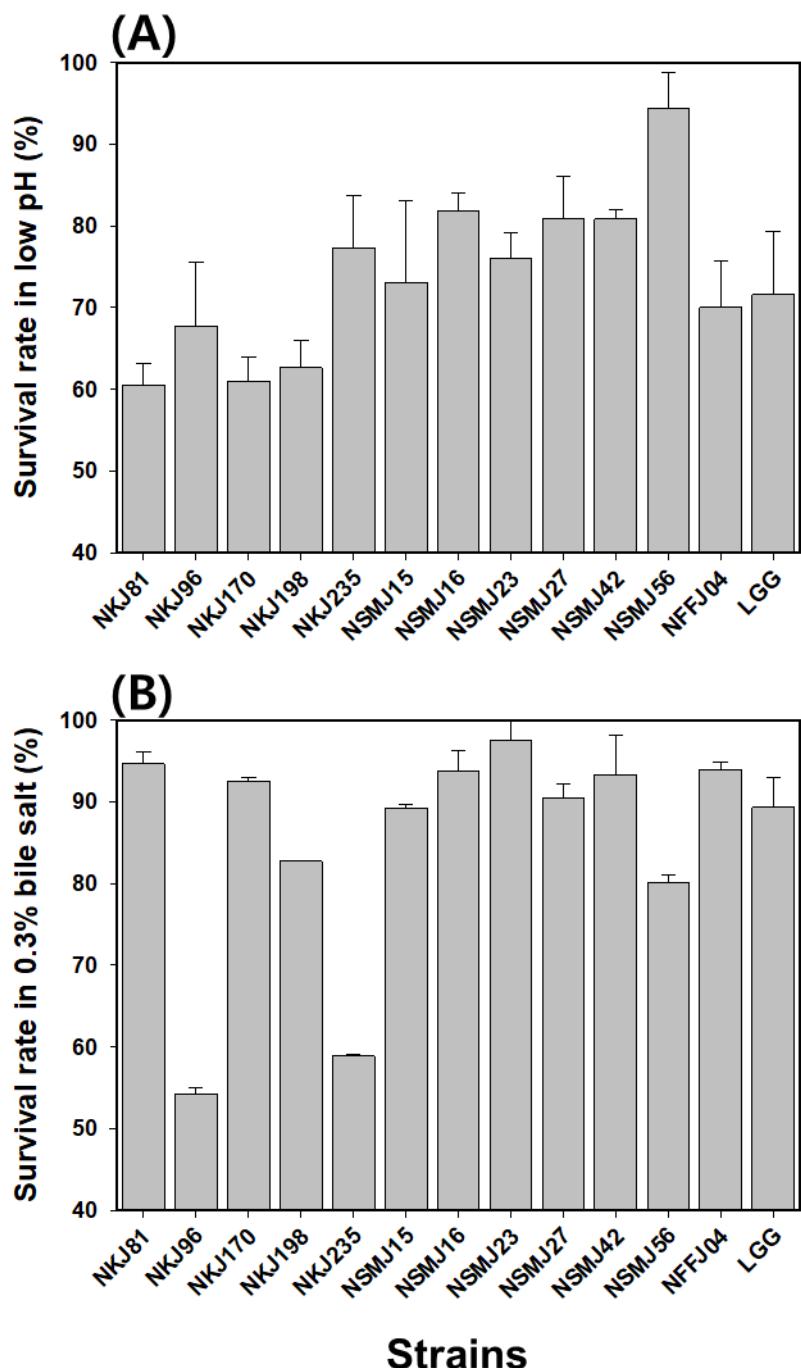
**Figure S3.** Fermentative profiling of five selected LAB strains from API 50 CHL system assay.

**Figure S4.** Growth kinetic curves of fecal microbiome treated with cell-free culture supernatant (CFS) from five LAB strains NSMJ15, NSMJ16, NSMJ23, NSMJ42, and NFFJ04. Data points represent means of triplicate replications and error bars represent standard deviations of means.

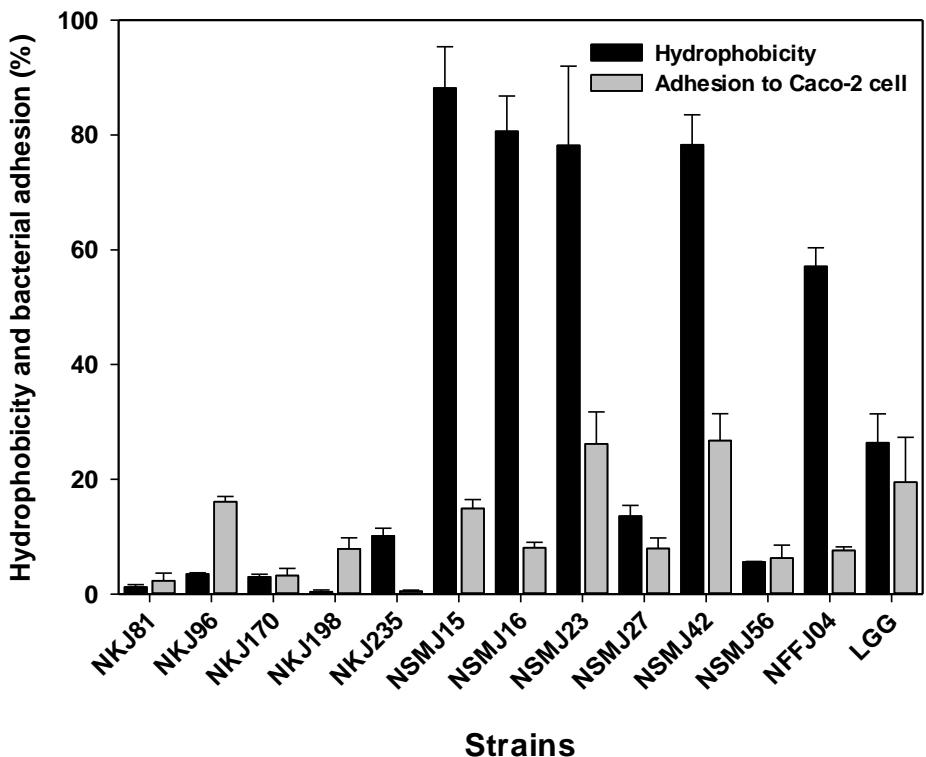
**Figure S5.** Abundance profiling of bacterial communities in original sample (0 h) at the (A) phylum and (B) genus level. Others in B are composed of taxonomic compositions showing less than 0.1% of total reads in genus level analyses.

**Figure S6.** (A) Change in relative abundance (%) of bacterial taxonomic groups in control and five CFS-treated samples at the species-level at 8 and 16 h of incubation. Species composed of taxonomic compositions above 0.2% of the total reads in all respective samples are shown. (B) Heat map showing log2-fold change relative to controls at the species level. Red and blue cells indicate decreased and increased abundance due to treatment, respectively.

**Figure S1.**



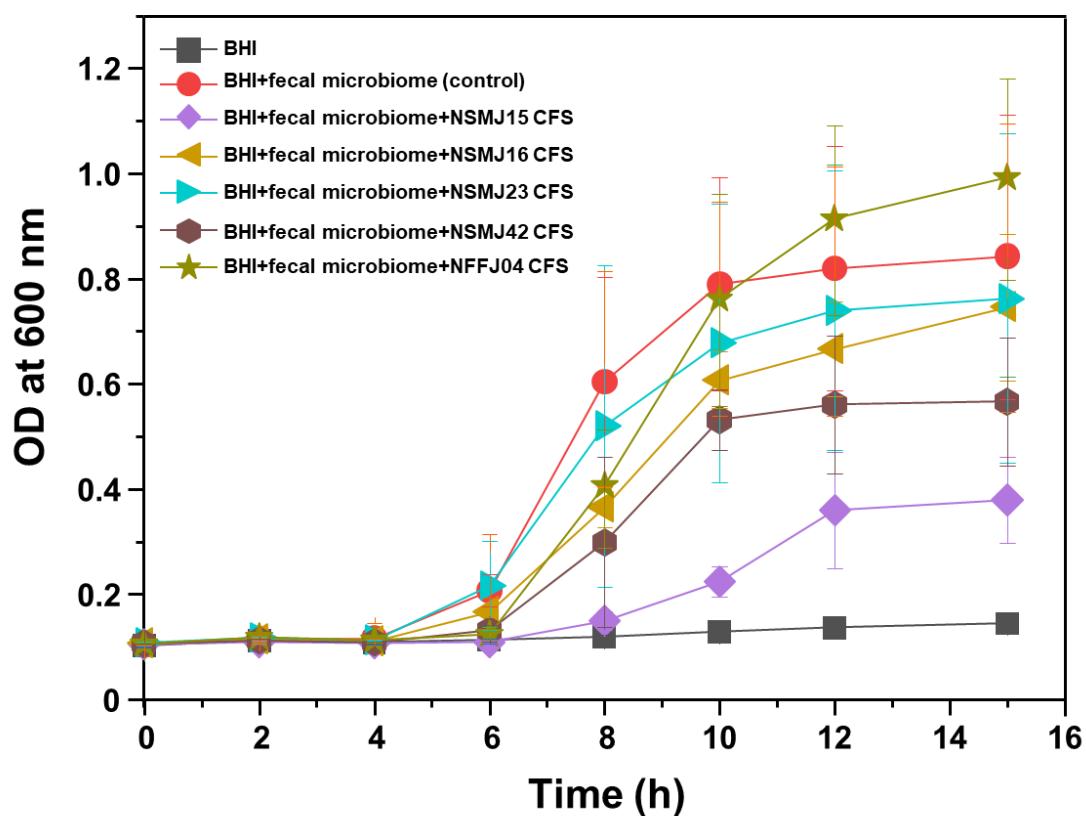
**Figure S2.**



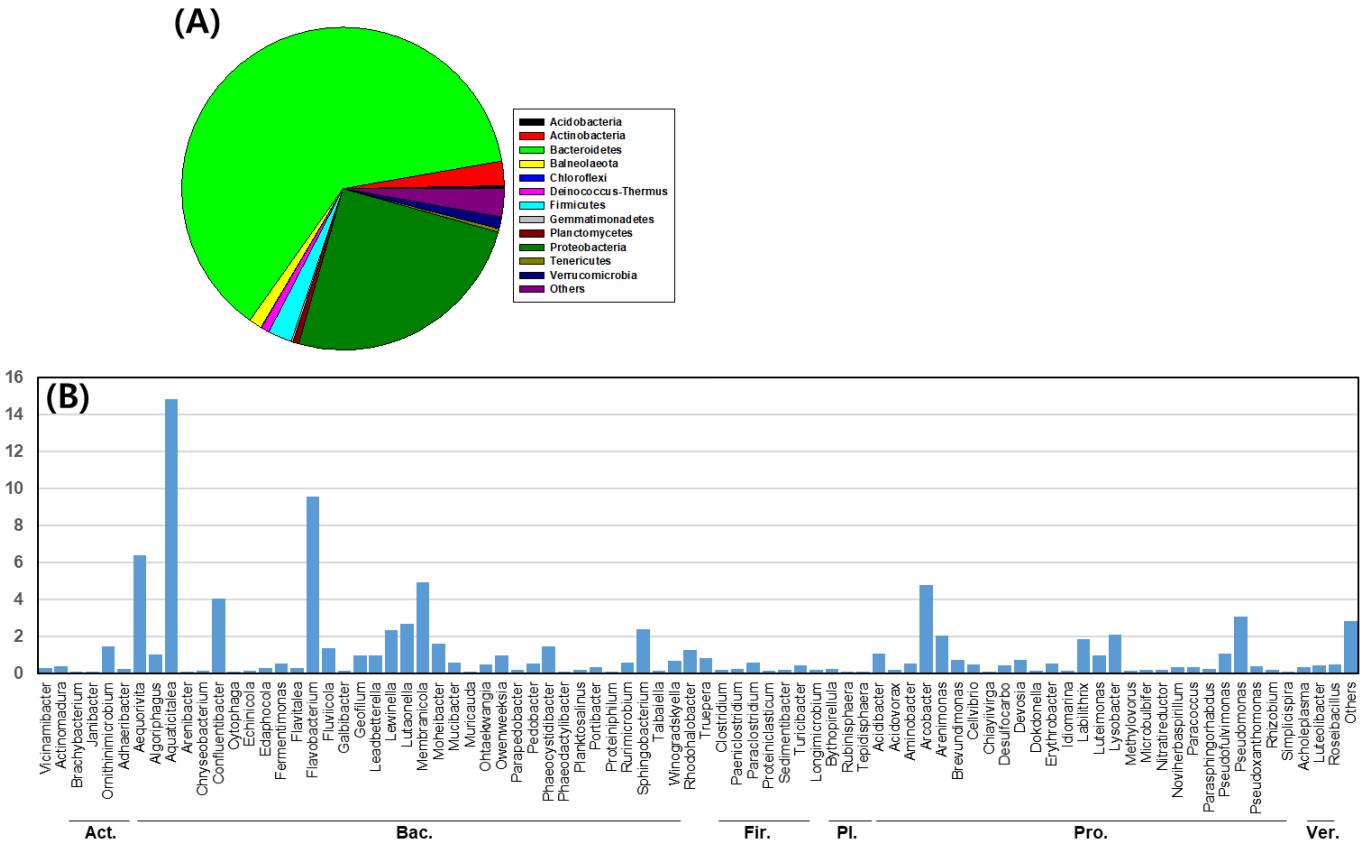
**Figure S3.**

| No. | Utilization of                     | NSM<br>J15 | NSM<br>J16 | NSM<br>J23 | NSM<br>J42 | NFFJ<br>04 | No. | Utilization of            | NSM<br>J15 | NSM<br>J16 | NSM<br>J23 | NSM<br>J27 | NSM<br>J42 | NFFJ<br>04 |
|-----|------------------------------------|------------|------------|------------|------------|------------|-----|---------------------------|------------|------------|------------|------------|------------|------------|
| 0   | Control                            |            |            |            |            |            | 25  | Esculin                   |            | ■          | ■■■        |            |            |            |
| 1   | Glycerol                           |            |            |            |            |            | 26  | Salicin                   |            |            |            | ■■■        |            |            |
| 2   | Erythritol                         |            |            |            |            |            | 27  | D-Cellibiose              |            |            |            |            |            |            |
| 3   | D-arabinose                        |            |            |            |            |            | 28  | D-Maltose                 | ■■■        | ■■■        | ■■■        |            |            |            |
| 4   | L-arabinose                        |            | ■■■        | ■■■        | ■■■        |            | 29  | D-Lactose (bovine origin) |            |            |            | ■■■        |            |            |
| 5   | D-ribose                           | ■■■        | ■■■        | ■■■        | ■■■        |            | 30  | D-Melibiose               |            | ■■■        |            |            | ■■■        |            |
| 6   | D-xylose                           |            | ■■■        | ■■■        | ■■■        |            | 31  | D-Saccharose (sucrose)    |            | ■■■        |            | ■■■        | ■■■        |            |
| 7   | L-xylose                           |            |            |            |            |            | 32  | D-Trehalose               | ■■■        |            |            | ■■■        | ■■■        |            |
| 8   | D-adonitol                         |            |            |            |            |            | 33  | Inulin                    |            |            |            |            |            |            |
| 9   | Methyl- $\beta$ D-xylopyranoside   |            |            |            |            |            | 34  | D-Melezitose              |            | ■■■        |            |            | ■■■        |            |
| 10  | D-galactose                        | ■■■        | ■■■        | ■■■        | ■■■        |            | 35  | D-Raffinose               |            |            |            |            |            |            |
| 11  | D-glucose                          | ■■■        | ■■■        | ■■■        | ■■■        |            | 36  | Amidon (starch)           |            |            |            |            |            |            |
| 12  | D-fructose                         | ■■■        | ■■■        | ■■■        | ■■■        |            | 37  | Glycogen                  |            |            |            |            |            |            |
| 13  | D-mannose                          | ■■■        |            | ■■■        | ■■■        |            | 38  | Xylitol                   |            |            |            |            |            |            |
| 14  | L-sorbose                          |            |            |            |            |            | 39  | Gentibiose                |            |            |            |            |            |            |
| 15  | L-rhamnose                         |            |            |            |            |            | 40  | D-Turanose                |            | ■■■        |            | ■■■        | ■■■        |            |
| 16  | Dulcitol                           | ■■■        |            |            |            |            | 41  | D-Lyxose                  |            |            |            |            |            |            |
| 17  | Inositol                           |            |            |            |            |            | 42  | D-Tagatose                | ■■■        |            |            | ■■■        | ■■■        |            |
| 18  | D-mannitol                         | ■■■        |            |            |            |            | 43  | D-Fucose                  |            |            |            |            |            |            |
| 19  | D-sorbitol                         | ■■■        |            |            |            |            | 44  | L-Fucose                  |            |            |            |            |            |            |
| 20  | Methyl- $\alpha$ D-mannopyranoside |            |            |            |            |            | 45  | D-arabitol                |            |            |            |            |            |            |
| 21  | Methyl- $\alpha$ D-glucopyranoside |            | ■■■        | ■■■        | ■■■        |            | 46  | L-arabitol                |            |            |            |            |            |            |
| 22  | N-acetylglucosamine                | ■■■        |            | ■■■        | ■■■        |            | 47  | Potassium gluconate       | ■■■        | ■■■        | ■■■        | ■■■        | ■■■        |            |
| 23  | Amygdalin                          |            |            |            |            |            | 48  | Potassium 2 ketogluconate |            |            | ■■■        |            |            |            |
| 24  | Arbutin                            |            |            |            |            |            | 49  | Potassium 5 ketogluconate |            | ■■■        | ■■■        |            |            |            |

**Figure S4.**



**Figure S5.**



**Figure S6.**

