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## Supplementary Materials

### 2 1. Materials and methods

#### 3 1.1 Isolation and identification of *Lactiplantibacillus plantarum* strains

4 Pickle and faeces samples were collected and mixed with 30% sterile glycerinum. Then samples  
5 were transported to laboratory as soon as possible and were kept in ultra-low temperature freezer  
6 (-80°C) for later use. Samples were unfrozen and homogenized at low temperatures. Gradient  
7 dilution was performed and the diluent was spread using *Lactobacillus* selective (LBS) agar  
8 (Haibo, Qingdao). Then the LBS plates were incubated at 37°C under anaerobic conditions until  
9 bacterial colonies grew. Plate streaking were performed twice to obtain single strains. Genome of  
10 these strains were extracted with TIANamp Bacteria DNA Kit (TIANGEN, Beijing). Bacterial  
11 16S rDNA was amplified with universal primers (27F and 1492R) and sequenced by Sangon  
12 Biotech, Shanghai. The species of the strains were identified by aligning to the 16S rDNA  
13 sequence entries using Basic Local Alignment Search Tool (BLAST) of the National Center for  
14 Biotechnology Information (NCBI). 16S rDNA sequences of the five strains used in the present  
15 study were listed in section 2.7.

#### 16 1.2 Primers for quantitative reverse transcriptionime PCR

17 Table S1 Primers for rat GPR41, GPR43 and GAPDH

Protein	Primer	
GPR41	Forward	5' - TCTACCTAGGTCCCGTGTGG - 3'
	Reverse	5' - GGTGTAGAGGCAGGAGAGG - 3'
GPR43	Forward	5' - GGCTTCGGCTTCTACAGCAGTATCT - 3'
	Reverse	5' - TCCAAGGCACACCAGGAAATTAAAGA - 3'
GAPDH	Forward	5' - CAGTGCCAGCCTCGTCTCAT - 3'
	Reverse	5' - AGGGGCCATCCACAGTCTTC - 3'

18 GPR: G protein-coupled receptor.

#### 19 1.3 Detection parameters of GC-MS for short-chain fatty acids analysis

20 The initial oven temperature was 100°C and increased to 140°C at a rate of 7.5°C min<sup>-1</sup>. The  
21 temperature was further increased to 200°C at a rate of 60°C min<sup>-1</sup> and remained for 3 min.  
22 Helium was utilized as the carrier gas at a flow rate of 0.89 mL min<sup>-1</sup>, and the column head  
23 pressure was 62.7 kPa. The injector was set at 240°C. The injection mode was split and the ratio  
24 was 10:1. For mass spectrometer, ion source temperature was 220°C, interface temperature was  
25 250°C, and the scan range was from m/z 2 to 100.

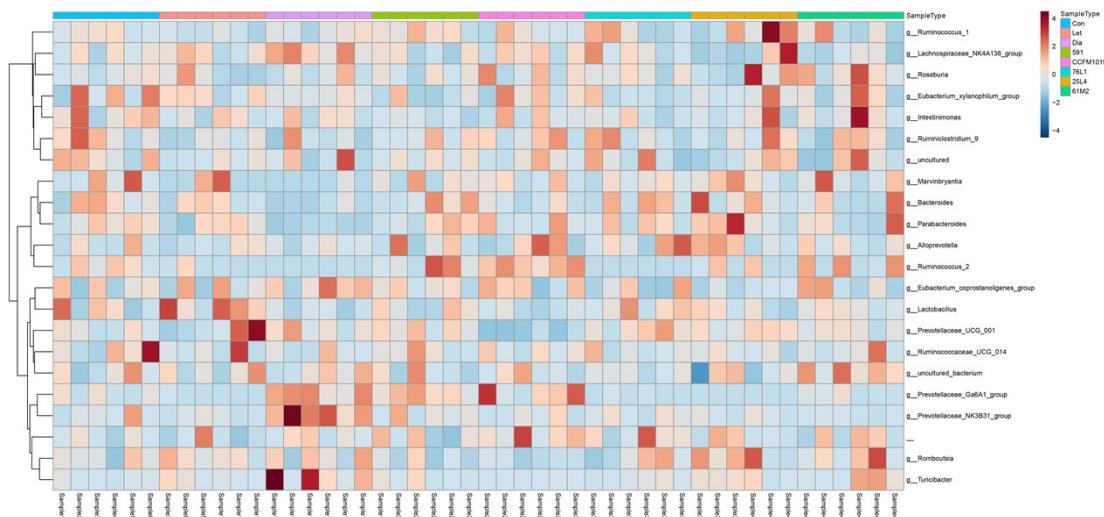
26 **1.4 Morphology and immunohistochemistry**

27 After euthanasia, ovaries and colon samples were immediately removed from the animals and  
28 fixed with 4% paraformaldehyde and embedded in paraffin. The ovaries were sectioned at a  
29 thickness of 4–5 µm and stained with haematoxylin and eosin for microscopic examination. The  
30 thickness of the granulosa cell layers was measured using Image Pro Plus 6.0 software (Media  
31 Cybernetics, Rockville).

32 Deparaffinised colon tissue sections were treated with citrate buffer for antigen retrieval and  
33 blocked with 3% H<sub>2</sub>O<sub>2</sub>. The slides were then blocked using 3% (w/v) bovine serum albumin for  
34 30 min. A rabbit-derived primary antibody, anti-GPR41 (Affinity Biosciences Inc, OH), was used  
35 at a dilution of 1:200. The slides were then incubated with a secondary antibody for 50 min and  
36 stained with diaminobenzidine. They were then counterstained with haematoxylin and cleared  
37 with xylene. Image Pro Plus 6.0 software was used to measure the integrated optical density of the  
38 target protein.

39 **2. Results**

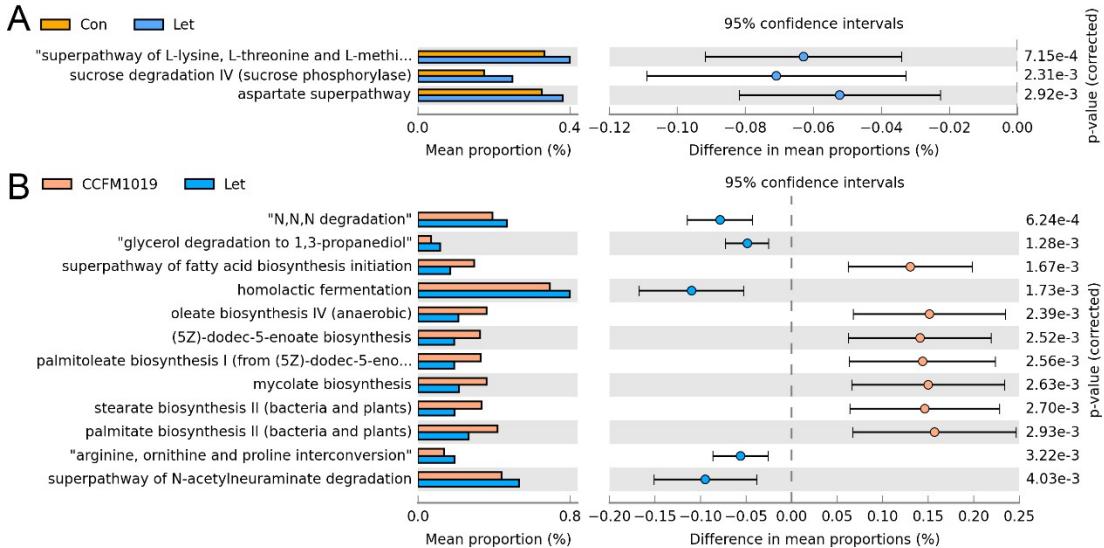
40 **2.1 Overview of top 25 genera**



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42 Figure S1 Heatmap of the top 25 abundant genera of individual rats. Con: control group; Let: letrozole group; Dia:  
43 Diane-35 group.

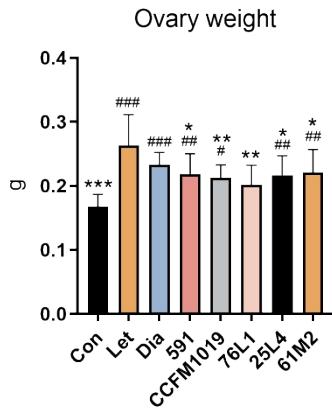
44 **2.2 PICRUSt analysis**



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46 Figure S2 Differential microbial functions between groups. Phylogenetic Investigation of Communities by  
 47 Reconstruction of Unobserved States (PICRUSt) was performed based on the Kyoto Encyclopedia of Genes and  
 48 Genomes (KEGG) database. Con: control group; Let: letrozole group.

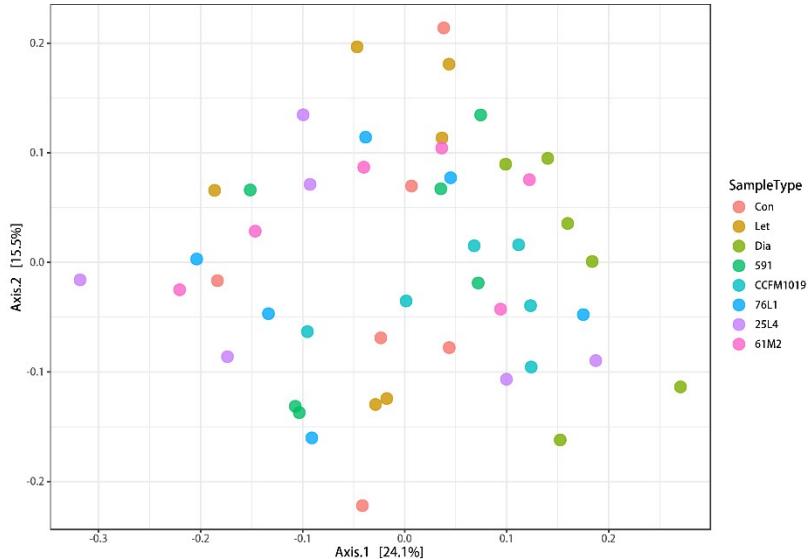
### 49 2.3 Ovary weight



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51 Figure S3 Ovary weight. Data are means with SD. # $p < 0.05$ , ## $p < 0.01$ , ### $p < 0.001$  versus the control group; \* $p <$   
 52 0.05, \*\* $p < 0.01$ , \*\*\* $p < 0.001$  versus the letrozole group using a one-way ANOVA (or Kruskal-Wallis test). Con:  
 53 control group; Let: letrozole group; Dia: Diane-35 group.

### 54 2.4 PCoA analysis



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56 Figure S4 Principal coordinates analysis (PCoA) using the Bray–Curtis distance. Con: control group; Let: letrozole  
57 group; Dia: Diane-35 group.

## 58 2.5 One-way ANOSIM test of microbiota between experimental groups

59 Table S2 Detailed results of one-way ANOSIM test between experimental groups in PCoA analysis.

Group	Con	Let	Dia	591	CCFM1019	76L1	25L4	61M2
Con		R=0.11	R=0.64	R=0.02	R=0.52	R=0.26	R=0.27	R=0.29
		p=0.15	p=0.01	p=0.38	p=0.01	p=0.04	p=0.06	p=0.02
Let	R=0.11		R=0.76	R=0.49	R=0.82	R=0.48	R=0.51	R=0.57
	p=0.15		p=0.01	p=0.01	p=0.01	p=0.01	p=0.01	p=0.01
Dia	R=0.64	R=0.76		R=0.45	R=0.42	R=0.46	R=0.43	R=0.39
	p=0.01	p=0.01		p=0.01	p=0.01	p=0.01	p=0.01	p=0.01
591	R=0.02	R=0.49	R=0.45		R=0.29	R=0.08	R=0.14	R=0.11
	p=0.38	p=0.01	p=0.01		p=0.02	p=0.24	p=0.13	p=0.16
CCFM1019	R=0.52	R=0.82	R=0.42	R=0.29		R=0.39	R=0.28	R=0.20
	p=0.01	p=0.01	p=0.01	p=0.02		p=0.02	p=0.04	p=0.06
76L1	R=0.26	R=0.48	R=0.46	R=0.08	R=0.39		R=-0.05	R=0.05
	p=0.04	p=0.01	p=0.01	p=0.24	p=0.02		p=0.57	p=0.34
25L4	R=0.27	R=0.51	R=0.43	R=0.14	R=0.28	R=-0.05		R=-0.05
	p=0.06	p=0.01	p=0.01	p=0.13	p=0.04	p=0.57		p=0.61
61M2	R=0.29	R=0.57	R=0.39	R=0.11	R=0.20	R=0.05	R=-0.05	
	p=0.02	p=0.01	p=0.01	p=0.16	p=0.06	p=0.34	p=0.61	

60 Red number indicate significant difference between experimental groups ( $p < 0.05$ ). Con: control group; Let:  
61 letrozole group; Dia: Diane-35 group.

## 62 2.6 16S rDNA sequences of five *Lp. plantarum* strains

63 *Lp. plantarum* 591 (Preservation number: CCFM591)

64 CTATAATGCAGTCGACGAACCTGGTATTGGTGGCTGCATCATGATTACATT

65 GAGTGAGTGGCGAACCTGGTGGTAGTAACACGTGGAAACCTGCCAGAAGCGGGGGAT

66 AACACCTGGAAACAGATGCTAATACCGCATAACAACCTGGACCGCATGGTCCGAGCT  
67 TGAAAGATGGCTTCGGCTATCACTTTGGATGGTCCCGCGCGTATTAGCTAGATGGT  
68 GGGGTAACGGCTACCAGGCAATGATACGTAGCCGACCTGAGAGGGTAATCGGCCA  
69 CATTGGGACTGAGACACGGCCAAACTCCTACGGGAGGCAGCAGTAGGAAATCTTCC  
70 ACAATGGACGAAAGTCTGATGGAGCAACGCCCGTGAGTGAAGAAGGGTTCGGCTC  
71 GTAAAACCTGTTAAAGAACATATCTGAGAGTAACGTTCAGGTATTGACG  
72 GTATTAAACCAGAAAGCCACGGCTAACTACGTGCCAGCAGCCCGGTAATACGTAGG  
73 TGGCAAGCGTTGCCGGATTATTGGCGTAAAGCGAGCGCAGGCCGGTTAAAGTC  
74 TGATGTGAAAGCCTCGGCTAACCGAAGAAGTGCATCGAAACTGGAAACTTGAG  
75 TGCAGAACAGGACAGTGGAACTCCATGTGTAGCGGTGAAATGCGTAGATATGGAA  
76 GAACACCAGTGGCGAAGGCGGCTGTCTGGTCTGTAACGTGAGCTGAGGCTCGAAAGT  
77 ATGGGTAGCAAACAGGATTAGATACCGTGGTAGTCCATACCGTAAACGATGAATGCT  
78 AAGTGGTGGAGGGTTCCGCCCTCAGTGCAGCTAACGCATTAAGCATTCCGCCT  
79 GGGGAGTACGCCGCAAGGCTGAAACTCAAAGGAATTGACGGGGCCCGACAAGC  
80 GGTGGAGCATGTGGTTAACCGTACGCGAAGAACCTTACCAAGGTCTGACAT  
81 ACTATGCAAATCTAAGAGATTAGACGTTCCCTCGGGACATGGATACAGGTGGTGC  
82 ATGGTTGTCGTCAGCTCGTGTGAGATGTTGGGTTAAGTCCCAGCTGGCAACGAGCGCAAC  
83 CCTTATTATCAGTTGCCAGCATTAAGTTGGCACTCTGGTGAAGACTGCCGGTACAAA  
84 CCGGAGGAAGGTGGGATGACGTCAAATCATCATGCCCTTATGACCTGGCTACAC  
85 ACGTGCTACAATGGATGGTACAACGAGTTGCGAACTCGCGAGAGTAAGCTAATCTCT  
86 TAAAGCCATTCTCAGTCGGATTGTAGGCTGCAACTCGCCTACATGAAGTCGGAATCG  
87 CTAGTAATCGCGGATCAGCATGCCCGGTGAATACGTTCCGGCCTTGTACACACC  
88 GCCCGTCACACCATGAGAGTTGTAACACCCAAAGTCGGTGGGTAACCTTAGAAC  
89 CAGCCGCTA  
90 *Lp. plantarum* CCFM1019 (Preservation number: CCFM1019)  
91 CTTAGCGGCTGGTCTAAAGGTTACCCACCGACTTGGGTGTTACAAACTCTCATGG  
92 TGTGACGGCGGTGTACAAGGCCGGAACGTATTCACCGCGGCATGCTGATCCG  
93 CGATTACTAGCGATTCCGACTTCATGTAGCGAGTTGCAGCCTACAATCGAAGTGA  
94 AATGGCTTAAGAGATTAGCTTACTCTCGCGAGTCGCAACTCGTTGACCATCCATT  
95 GTAGCACGTGTAGCCCAGGTCTAAAGGGCATGATGATTGACGTCACTCCCCACCT

96 TCCTCCGGTTGTCACCGCAGTCTCACCAAGAGTGCCAACTTAATGCTGGCAACTGA  
97 TAATAAGGGTTGCGCTCGTGCAGGACTTAACCCAACATCTCACGACACGAGCTGAC  
98 GACAACCATGCACCACCTGTATCCATGTCCCCGAAGGAAACGTCTAATCTTAGATT  
99 TGCATAGTATGTCAAGACCTGGTAAGGTTCTCGCGTAGCTCGAATTAAACCACATG  
100 CTCCACCGCTTGTGCAGGCCCCGTCAATTCTTGAGTTCAGCCTGCGGCCGTACT  
101 CCCCAGGCGGAATGCTTAATGCCTAGCTGCAGCACTGAAGGGCGAAACCCCTCAA  
102 CACTTAGCATTCATCGTTACGGTATGGACTACCAGGGTATCTAATCCTGTTGCTAC  
103 CCATACTTCGAGCCTCAGCGTCAGTTACAGACCAGACAGCCGCCTCGCCACTGGT  
104 TTCTTCCATATATCTACGCATTCACCGCTACACATGGAGTTCCACTGTCCTCTG  
105 ACTCAAGTTCCCAGTTCCGATGCACCTCTCGTTGAGCCGAAGGCTTCACATCA  
106 GACTAAAAAACGCCTGCGCTCGCTTACGCCAATAATCCGGACAACGCTTGCC  
107 ACCTACGTATTACCGCGCTGCTGGCACGTAGTTAGCCGTGGCTTCTGGTTAAATAC  
108 CGTCAATACTGAACAGTTACTCTCAGATATGTTCTTAAACAACAGAGTTTACG  
109 AGCCGAAACCCCTCTTCACTCACCGCGTTGCTCCATCAGACTTCGTCCATTGTGG  
110 AAGATTCCCTACTGCTGCCTCCCGTAGGAGTTGGGCCGTCTCAGTCCAATGTGG  
111 CCGATTACCCTCTCAGGTCGGCTACGTATGCCATTGGTGAGCCATTACCCACCA  
112 TCTAGCTAATACGCCGGGACCATCCAAAAGTGATAGCCGAAGCCATTTCAAAC  
113 TCGGACCATGCGGTCCAAGTTGTTAGCGGTATTAGCATCTGTTCCAGGTGTTATCC  
114 CCCGCTTCTGGCAGGTTCCCACGTGTTACTCACCAAGTTCGCCACTCACTCAAATGT  
115 AAATCATGATGCAAGCACCAATCAATACCAGAGTTCGTCAGTGCATGATAGA  
116 *Lp. plantarum* 76L1(Preservation number: FSCDJY76L1)  
117 CGGCTGGTTCTAAAAGGTTACCCACCGACTTGGGTGTTACAAACTCTCATGGTGT  
118 GACGGCGGTGTACAAGGCCGGAACGTATTACCGCGCATGCTGATCCCGCGA  
119 TTACTAGCGATTCCGACTTCATGTAGGCGAGTTGCAGCCTACAATCGAACTGAGAAT  
120 GGCTTAAGAGATTAGCTTACTCTCGCGAGTCGAACTCGTTGACCATCCATTGTA  
121 GCACGTGTAGCCCAGGTATAAGGGCATGATGATTGACGTACCCACCTTC  
122 TCCGGTTGTCACCGCAGTCTCACCAAGAGTGCCAACTTAATGCTGGCAACTGATAA  
123 TAAGGGTTGCCTCGTGCAGGACTTAACCCAACATCTCACGACACGAGCTGACGAC  
124 AACCATGCACCACCTGTATCCATGTCCCCGAAGGAAACGTCTAATCTTAGATTAC  
125 ATAGTATGTCAAGACCTGGTAAGGTTCTCGCGTAGCTCGAATTAAACCACATGCTC

126 CACCGCTTGTGCGGGCCCCGTCATTGAGTTCAGCCTGCGGCCGTACTCC  
127 CCAGGCGGAATGCTTAATGCGTTAGCTGCAGCACTGAAGGGCGAAACCCTCCAACA  
128 CTTAGCATTCATCGTTACGGTATGGACTACCAGGGTATCTAATCCTGTTGCTACCC  
129 ATACTTCGAGCCTCAGCGTCAGTTACAGACCAGACAGCCGCTCGCCACTGGTGT  
130 CTTCCATATATCTACGCATTCACCGCTACACATGGAGTTCCACTGTCCTCTGCAC  
131 TCAAGTTCCCAGTTCCGATGCACTTCTCGGTTGAGCGAAGGCTTCACATCAGA  
132 CTTAAAAAACCGCCTGCGCTCGCTTACGCCAATAAACCGGACAACGCTGCCACC  
133 TACGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTGGCTTCTGGTTAAATACCGT  
134 CAATACCTGAACAGTTACTCTCAGATATGTTCTTAAACAACAGAGTTTACGAGC  
135 CGAAACCCCTTCTCACTCACGCCGTTGCTCCATCAGACTTCGTCCATTGTGGAAG  
136 ATTCCCTACTGCTGCCTCCGTAGGAGTTGGCCGTGTCTCAGTCCAATGTGGCCG  
137 ATTACCCCTCTCAGGTCGGCTACGTATCATTGCCATGGTAGCCGTTACCTCACCATCT  
138 AGCTAATACGCCCGGGACCATCCAGAAGTGATAGCCGAAGCCATTTCAAACACTCG  
139 GACCATGCGGTCCAAGTTGTTATGCGGTATTAGCATCTGTTCCAGGTGTTATCCCCC  
140 GCTTCTGGCAGGTTCCCACGTGTTACTCACCAGTTGCCACTCACTCAAATGTAAA  
141 TCATGATGCAAGCACCAATCAATACCAGAGTTCGTTGACTGC  
142 *Lp. plantarum* 25L4 (Preservation number: FCQHC25L4)  
143 GGCTGGTCTAAAGGTTACCCACCGACTTGGGTGTTACAAACTCTCATGGTGTG  
144 ACGGGCGGTGTACAAGGCCGGAACGTATTACCGCCATGCTGATCCGCGAT  
145 TACTAGCGATTCCGACTTCATGTAGGCGAGTTGCAGCCTACAATCCGAACTGAGAAT  
146 GGCTTAAGAGATTAGCTTACTCTCGCAGTCGAACCTGTTACCATCCATTGTA  
147 GCACGTGTAGCCCAGGTATAAGGGCATGATGATTGACGTATCCCCACCTTCC  
148 TCCGGTTGTCACCGCAGTCTCACCAGAGTGCCAACTTAATGCTGGCAACTGATAA  
149 TAAG  
150 GGTTGCGCTCGTTGCGGGACTTAACCCAACATCTCACGACACGAGCTGACGACAACC  
151 ATGCACCACCTGTATCCATGTCCCCGAAGGGAACGTCTAATCTTAGATTGCATAG  
152 TATGTCAAGACCTGGTAAGGTTCTCGCGTAGCTCGAATTAAACCACATGCTCCACC  
153 GCTTGTGCGGGCCCCCGTCATTGAGTTCAGCCTGCGGCCGTACTCCCCAG  
154 GCGGAATGCTTAATGCGTTAGCTGCAGCACTGAAGGGCGAAACCCTCAAACACTTA  
155 GCATTCATCGTTACGGTATGGACTACCAGGGTATCTAATCCTGTTGCTACCCATAC

156 TTTCGAGCCTCAGCGTCAGTTACAGACCAGACAGCCGCCTCGCCACTGGTGTCTTC  
157 CATATATCTACGCATTCAACCGCTACACATGGAGTTCCACTGTCCTCTGCACTCAA  
158 GTTTCCCAGTTCCGATGCACCTCTCGGTTGAGCGAAGGCTTCACATCAGACTTA  
159 AAAAACCGCCTGCGCTCGCTTACGCCAATAAATCCGGACAACGCTGCCACCTAC  
160 GTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTGGCTTCTGGTTAAATACCGTCAA  
161 TACCTGAACAGTTACTCTCAGATATGTTCTTAAACAACAGAGTTTACGAGCCGA  
162 AACCCCTCTTCACTCACGCCGCGTTGCTCCATCAGACTTCGTCCATTGTGGAAGATT  
163 CCCTACTGCTGCCCTCCGTAGGAGTTGGGCCGTCTCAGTCCAATGTGGCGATT  
164 ACCCTCTCAGGTCGGTACGTATCATTGCCATGGTGAGCCGTACCCACCACATAGC  
165 TAATACGCCGCCGGGACCATCCAAAAGTGTAGCCGAAGCCATCTTCAAGCTCGGAC  
166 CATGCGGTCCAAGTTGTTATGCGGTATTAGCATCTGTTCCAGGTGTTATCCCCGCTT  
167 CTGGGCAGGTTCCCACGTGTTACTCACCAGTCGCCACTCACTCAAATGTAATCAT  
168 GATGCAAGCACCAATCAATACCAGAGTCGTTGACTTG  
169 *Lp. plantarum* 61M2 (Preservation number: FZJTZ76L161M2)  
170 GCTGGTCCTAAAAGGTTACCCACCGACTTGGGTGTTACAAACTCTCATGGTGTGA  
171 CGGGCGGTGTGTACAAGGCCGGAACGTATTACCGCGCATGCTGATCCCGATT  
172 ACTAGCGATTCCGACTTCATGTAGGCGAGTTGCAGCCTACAATCCGAACTGAGAATG  
173 GCTTAAGAGATTAGCTTACTCTCGCGAGTCGCAACTCGTTGACGTACCCACCTCCT  
174 CACGTGTGTAGCCCAGGTATAAGGGCATGATGATTGACGTACCCACCTCCT  
175 CCGGTTGTCACCGCAGTCTCACAGAGTGCCAACTTAATGCTGGCAACTGATAAT  
176 AAGGGTTGCGCTCGTGCAGGACTTAACCAACATCTCACGACACGAGCTGACGACA  
177 ACCATGCACCACCTGTATCCATGTCCCCGAAGGGAACGTCTAATCTTAGATTGCA  
178 TAGTATGTCAAGACCTGTAAGGTTCTCGCGTAGCTCGAATTAAACCACATGCTCC  
179 ACCGCTTGTGCGGGCCCCGTCAATTCTTGAGTTCAGCCTGCGGCCGTACTCCC  
180 CAGGCAGGAATGCTTAATGCGTTAGCTGCAGCACTGAAGGGCGGAAACCCCTCCAACAC  
181 TTAGCATTCATCGTTACGGTATGGACTACCAGGGTATCTAATCCTGTTGCTACCCAT  
182 ACTTCGAGCCTCAGCGTCAGTTACAGACCAGACAGCCGCCTCGCCACTGGTGTCT  
183 TCCATATATCTACGCATTCAACCGCTACACATGGAGTTCCACTGTCCTCTGCACTC  
184 AAGTTCCCAGTTCCGATGCACCTCTCGGTTGAGCGAAGGCTTCACATCAGACT  
185 TAAAAAACCGCCTGCGCTCGCTTACGCCAATAAATCCGGACAACGCTGCCACCTA

186 CGTATTACCGCGGCTGCTGGCACGTAGTTAGCCGTGGCTTCTGGTTAAATACCGTCA  
187 ATACCTGAACAGTTACTCTCAGATATGTTCTTAAACAACAGAGTTTACGAGCCG  
188 AAACCCTTCTTCACTCACGC GGCGTTGCTCCATCAGACTTCGTCCATTGTGGAAGAT  
189 TCCCTACTGCTGCCTCCCGTAGGAGTTGGGCCGTCTCAGTCCAATGTGGCCGAT  
190 TACCCTCTCAGGT CGGCTACGTATCATTGCCATGGTGAGCCGTTACCCCACCATCTAG  
191 CTAATACGCCGCGGGACCATCCAAAAGTGATAGCCGAAGCCATCTTCAAGCTCGGA  
192 CCATGCGGTCCAAGTTGTTATGCGGTATTAGCATCTGTTCCAGGTGTTATCCCCGCT  
193 TCTGGCAGGTTCCCACGTGTTACTCACCAGTTCTCCACTCACTCAAATGTAAATCA  
194 TGATGCAAGCACCAATCAATACCAGAGTTCGTTCGACTT