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Supplementary information

2 **Table S1.** Outcome measures by treatment group and within participants taking metformin.

Parameter	Time-point	All Participants		Participants on metformin	
		Probiotic (N=30)	Placebo (N=30)	Probiotic (N=14)	Placebo (N=14)
Weight (kg)	Baseline	100.1±20.4	101.7±21.9	97.6±21.9	101.0±20.6
	Week 12	97.5±21.2	100.8±22.8	91.7±23.9	99.5±22.2
BMI (kg/m ²)	Baseline	35.5±6.20	36.3±7.5	35.0±6.1	35.6±8.2
	Week 12	34.5±6.3	36.0±7.8	32.3±6.5	35.1±8.8
Waist (cm)	Baseline	114.7±12.9	114.3±14.7	113.7±13.6	113.4±12.8
	Week 12	114.3±16.0	116.0±17.1	109.4±18.0	116.1±16.2
Waist:Hip	Baseline	0.97±0.06	0.95±0.07	1.0±0.1	1.0±0.1
	Week 12	0.97±0.06	0.98±0.72	0.9±0.1	1.0±0.1
Body fat (%)	Baseline	37.7±8.2	41.8±7.9	39.5±9.1	40.3±7.8
	Week 12	38.1±7.8	40.9±8.4	37.3±8.5	38.9±8.7
Systolic BP (mmHg)	Baseline	133.0±10.8	127.8±12.5	134.5±14.4	130.4±12.3
	Week 12	128.5±12.5	127.0±13.1	129.0±17.9	127.5±11.3
Diastolic BP (mmHg)	Baseline	79.8±7.3	81.6±6.3	79.4±6.5	83.7±5.8
	Week 12	78.5±5.8	81.6±7.3	78.0±6.6	82.6±6.1
TC (mmol/L)	Baseline	4.9±1.1	5.4±1.3	4.7±1.0	5.1±1.1
	Week 12	4.9±1.1	5.3±1.4	4.4±0.9	4.7±0.8
HDL-c (mmol/L)	Baseline	1.2±0.3	1.3±0.2	1.3±0.3	1.3±0.2
	Week 12	1.2±0.3	1.2±0.2	1.2±0.3	1.2±0.2
LDL-c (mmol/L)	Baseline	2.8±1.1	3.2±1.0	2.7±0.9	3.0±1.1
	Week 12	2.9±1.1	3.2±1.1	2.4±1.0	2.7±0.8
Triglycerides (mmol/L)	Baseline	1.8±0.9	1.9±1.2	1.7±0.8	1.6±0.8
	Week 12	1.7±0.7	2.1±1.3	1.6±0.9	1.6±0.6
FFA (µmol/L)	Baseline	608.5±296.4	647.8±234.9	687.1±345.8	651.1±248.4
	Week 12	618.0±219.1	642.0±183.2	714.6±195.2	621.6±229.3
hs-CRP (mg/L)	Baseline	3.9±4.1	3.0±2.4	4.7±4.1	5.5±9.1
	Week 12	4.1±4.7	4.3±6.2	5.4±5.8	5.5±10.3
LPS (EU/mL)	Baseline	0.5±0.2	0.6±0.3	0.5±0.3	0.5±0.3
	Week 12	0.5 ± 0.2	0.5±0.2	0.5±0.2	0.5±0.2
Zonulin (mg/dL)	Baseline	203.6±171.9	207.8±172.9	291.0±211.3	233.9±239.0
	Week 12	166.7 ± 112.6	136.3±79.9	197.9±119.3 ^{a*}	151.6±71.8

3 Data are means ± SD or median (IQR). Difference between baseline and endpoint. P value obtained
4 from repeated measure ANOVA^a or Wilcoxon matched-pairs signed rank test^b for the within-group
5 comparisons. **p* < 0.05. BMI: body mass index; BP: blood pressure; TC: total cholesterol; HDL-c: high-
6 density lipoprotein cholesterol; LDL: low-density lipoprotein cholesterol; FFA: free fatty acids; hs-CRP:
7 high-sensitive C-reactive protein; LPS: lipopolysaccharide.

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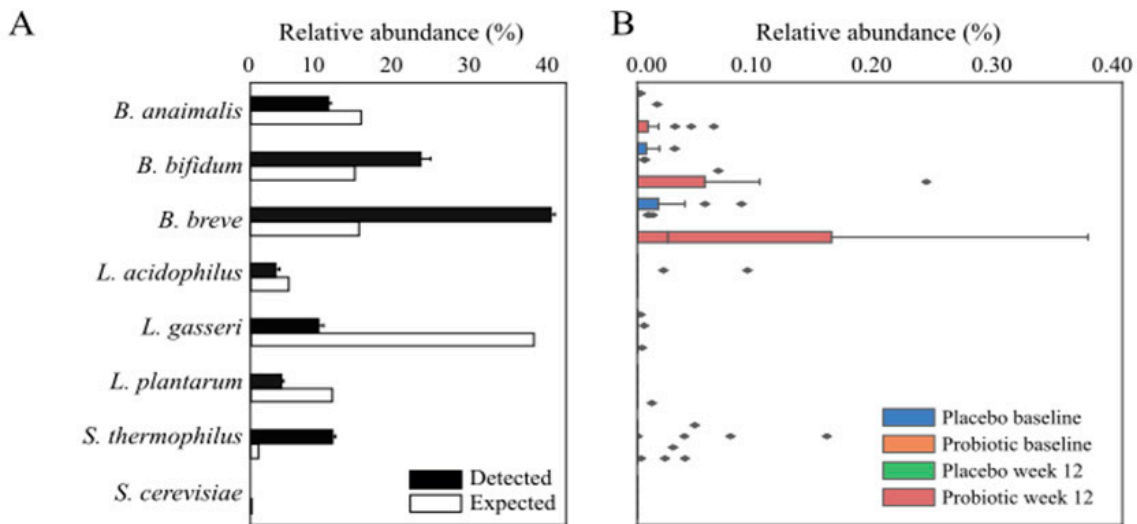
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11 **Table S2.** Plasma SCFA concentrations by treatment group within the participants on metformin
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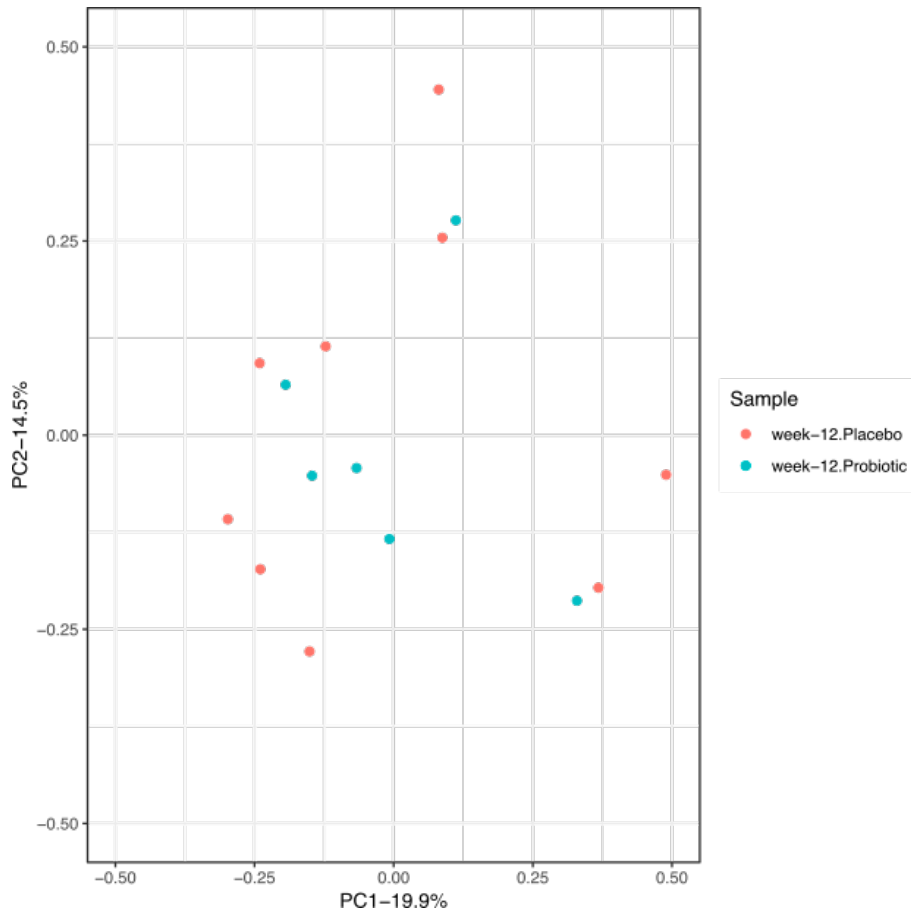
		All participants		Participants on metformin	
SCFA (μM)	Time-point	Probiotic (N=30)	Placebo (N=30)	Probiotic (N=13)	Placebo (N=14)
Propionate	Baseline	60.7 (70.0)	56.6 (85.2)	50.2 (57.4)	56.6 (83.8)
	Week 12	89.2 (79.8)	99.6 (80.1)	85.3 (80.3)	99.6 (81.6)
Isobutyrate	Baseline	6.1 (8.4)	6.0 (11.2)	5.4 (6.9)	6.0 (6.0)
	Week 12	6.9 (17.0)	7.0 (11.7)	6.6 (9.8)	7.0 (7.1)
Butyrate	Baseline	4.3 (4.9)	3.5 (7.3)	3.2 (4.3)	3.5 (5.3)
	Week 12	5.8 (8.3) ^{a*}	6.5 (7.8)	6.3 (9.1) ^{a*}	6.9 (4.6)
Isovalerate	Baseline	0.4 (2.2)	0.1 (2.1)	0.0 (1.1)	0.1 (1.6)
	Week 12	0.9 (4.7)	1.2 (3.6)	1.4 (3.0)	1.1 (5.8)
Total	Baseline	72.3 (86.6)	62.9 (111.1)	60.2 (67.3)	62.9 (95.6)
	Week 12	103.3 (113.3)	120.4 (99.3)	100.0 (102.4)	114.5 (98.2)

13 Data are median (IQR). ^aDifference between baseline and endpoint. P value obtained from Wilcoxon
 14 matched-pairs signed rank test for the within-group comparisons. * $p < 0.05$

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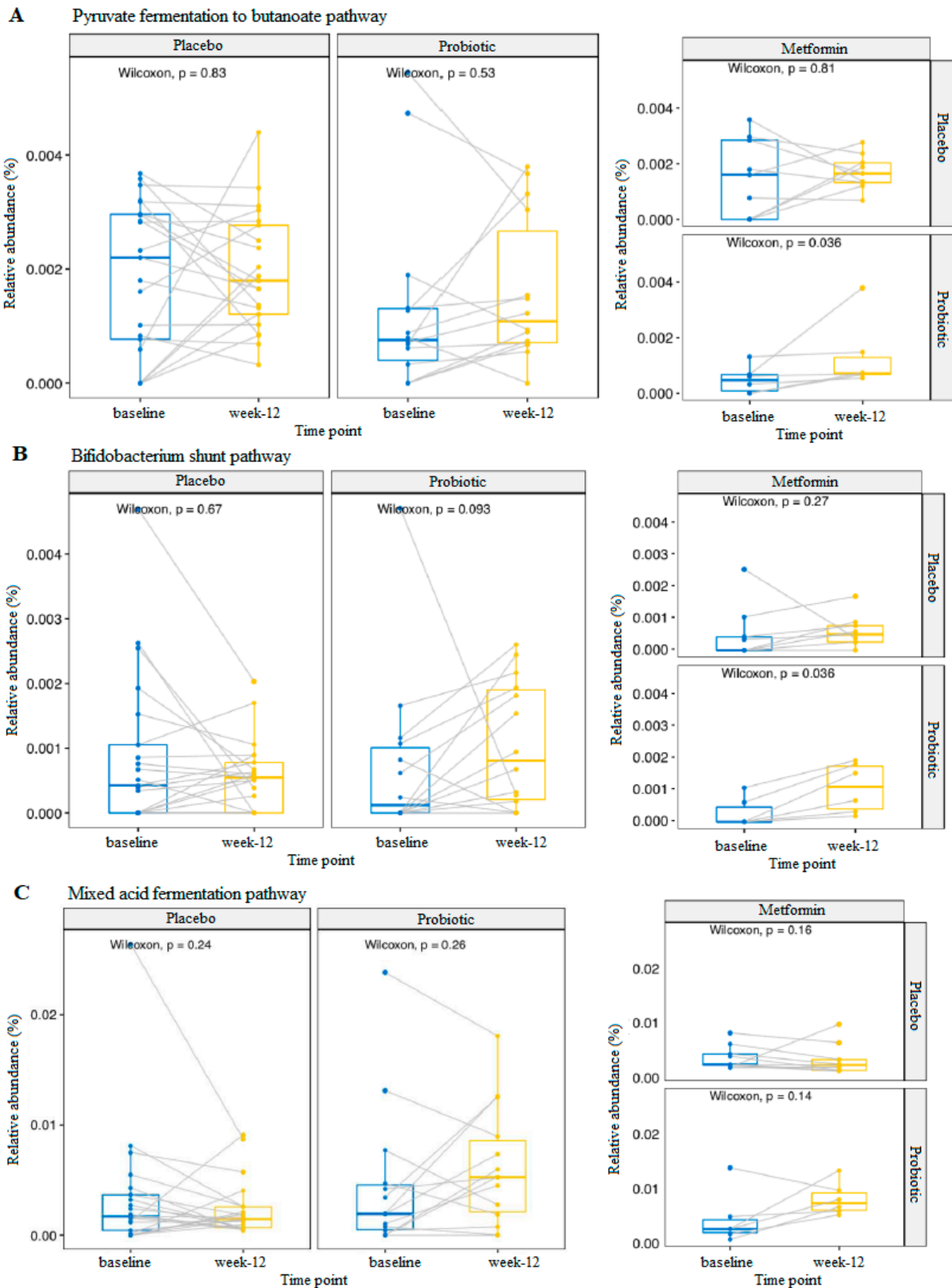


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 20 **Figure S1.** Probiotic detection and quality control. **A.** Comparison of the relative abundance of species
 21 in the capsule between the target formulation (Expected) and shotgun metagenomic sequencing
 22 (Detected, n=2). **B.** Relative abundance of probiotic species found in the study groups at baseline and
 23 after the 12-week intervention.
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26 **Figure S2.** PCoA of Bray-Curtis distances between intestinal microbial communities of probiotics and
 27 placebo groups in Metformin treated group after 12 weeks of intervention.



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29 **Figure S3.** Relative abundance of SCFA-producing pathways in the faecal microbiota of participants in the intervention and metformin groups.
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