

**Fig. S1.** Heatmap analysis of the correlation between short-chain fatty acids and the relative abundance of core gut microbiota genera.

**Fig. S2.** Comparison of *Pseudomonas* relative abundance in the Ascending Colon (AC), Transverse Colon (TC), and Descending Colon (DC). CTL: the end of basal period; Yod-15d: the end of astaxanthin yogurt treatment.

**Fig. S3.** The impact of astaxanthin yogurt on microbiota function. A02: End of the ascending colon basal period, T02: End of the transverse colon, D02: End of the descending colon basal period; A152: End of the ascending colon treatment period, T152: End of the transverse colon treatment period, D152: End of the descending colon treatment period.

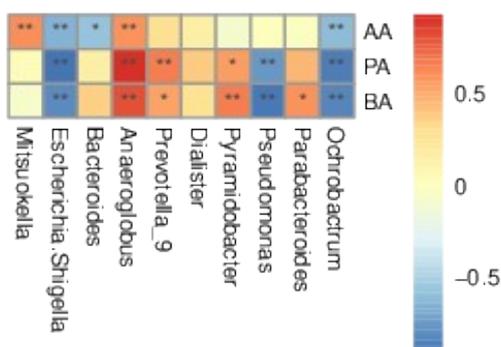


Figure. S1. Heatmap analysis of the correlation between short-chain fatty acids and the relative abundance of core gut microbiota genera.

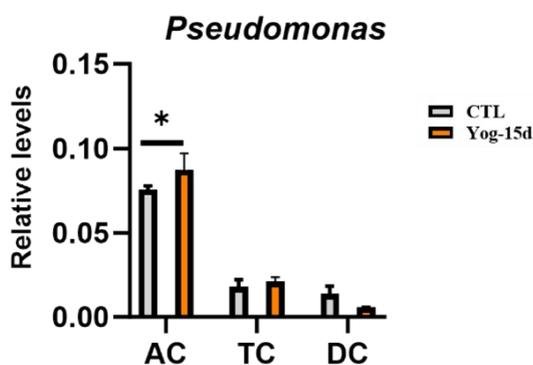


Figure. S2. Comparison of *Pseudomonas* relative abundance in the Ascending Colon (AC), Transverse Colon (TC), and Descending Colon (DC). CTL: the end of basal period; Yod-15d: the end of astaxanthin yogurt treatment. \*  $p < 0.05$ , compared with CTL.

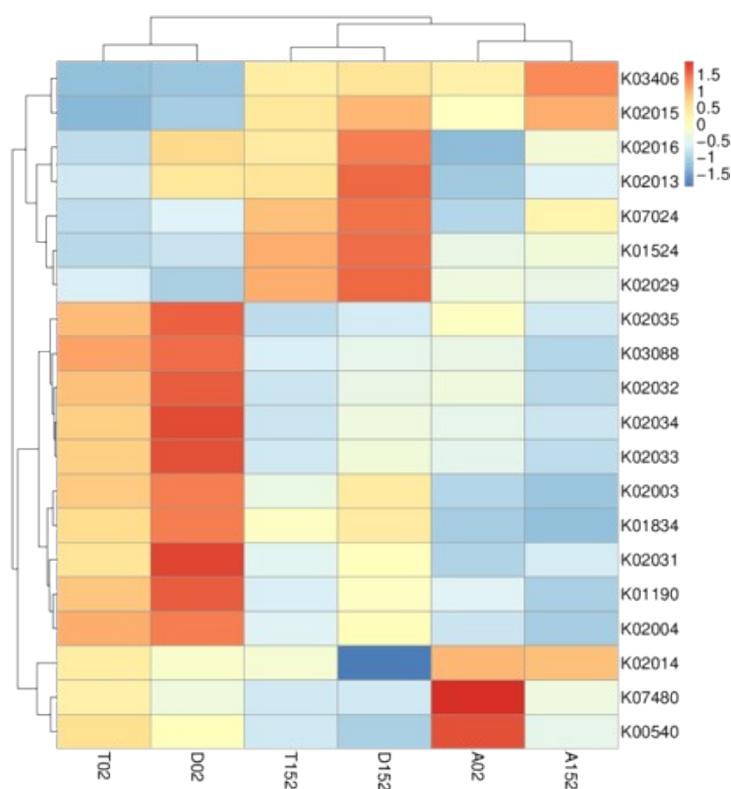


Figure. S3. The impact of astaxanthin yogurt on microbiota function. A02: End of the ascending colon basal period, T02: End of the transverse colon, D02: End of the descending colon basal period; A152: End of the ascending colon treatment period, T152: End of the transverse colon treatment period, D152: End of the descending colon treatment period.

Table S1. The operation procedure of SHIME®

Start Time	End Time	Action
00:00:00	23:59:59	Fixed pH (Controller AC 5.6/5.9)
00:00:00	23:59:59	Fixed pH (Controller TC 6.15/6.4)
00:00:00	23:59:59	Fixed pH (Controller DC 6.6/6.9)
00:00:00	00:04:10	Flow Verification Action (ST - SI - Min. Flow: 1.50 mL/min)
00:00:00	00:11:00	Flush Action (ST - SI)
00:18:00	00:18:10	Flow Verification Action (AC - TC - DC Min. Flow: 1.50 mL/min)
00:12:00	00:19:00	Flush Action (AC - TC - DC)
08:00:00	8:30:00	Pump Action (Feed 3.73 mL/min)
09:30:00	9:45:00	Pump Action (PJ 4.00 mL/min)
09:30:00	10:45:00	Pump Action (ST - SI 3.50 mL/min)

11:00:00	12:15:00	Pump Action (SI - AC 3.50 mL/min)
11:00:00	12:25:00	Pump Action (AC - TC 3.50 mL/min)
11:00:00	12:35:00	Pump Action (TC - DC 3.50 mL/min)
11:00:00	12:45:00	Pump Action (DC - W 3.50 mL/min)
13:00:00	13:30:30	Pump Action (Feed 3.73 mL/min)
14:30:00	14:45:00	Pump Action (PJ 4.00 mL/min)
14:30:00	15:45:00	Pump Action (ST - SI 3.50 mL/min)
16:00:00	17:15:00	Pump Action (SI - AC 3.50 mL/min)
16:00:00	17:25:00	Pump Action (AC - TC 3.50 mL/min)
16:00:00	17:35:00	Pump Action (TC - DC 3.50 mL/min)
16:00:00	17:45:00	Pump Action (DC - W 3.50 mL/min)
19:00:00	19:30:00	Pump Action (Feed 3.73 mL/min)
20:30:00	20:45:00	Pump Action (PJ 4.00 mL/min)
20:30:00	21:45:00	Pump Action (ST - SI 3.5 mL/min)
22:00:00	23:15:00	Pump Action (SI - AC 3.5 mL/min)

22:00:00	23:25:00	Pump Action (AC - TC 3.5 mL/min)
22:00:00	23:35:00	Pump Action (TC - DC 3.5 mL/min)
22:00:00	23:45:00	Pump Action (DC - W 3.5 mL/min)

Table S2. The basal medium formulation for SHIME®

Reagent	Composition (g/L)
Arabinogalactan	1.2
Pectin	2
Xylan	0.5
Gluconate	0.4
Yeast Extract	3
Peptone	1
Mucin	3
L-Cysteine Hydrochloride	0.4
Starch	4
Total	15.6

Table S3. Gastric Juice Formula

Reagent	Composition (g/L)
KCl	0.49
NaCl	2.684
Lectin	0.049
Pepsin	1.29

Table S4. Pancreatic Juice Formula

Reagent	Composition (g/L)
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NaHCO <sub>3</sub>	12.5
Oxgall	6
Pancreatin	0.9

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