Oat protein isolate-*Pleurotus ostreatus* β-glucan conjugate nanoparticles bound to β-carotene effectively alleviate immunosuppression by regulating gut microbiota

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Figure S1. TEM images of β-carotene nanoparticles stabilized by OPI, OPI-POG

mixture and OPI-POG conjugate before digestion (the scale bar represents 200 nm).

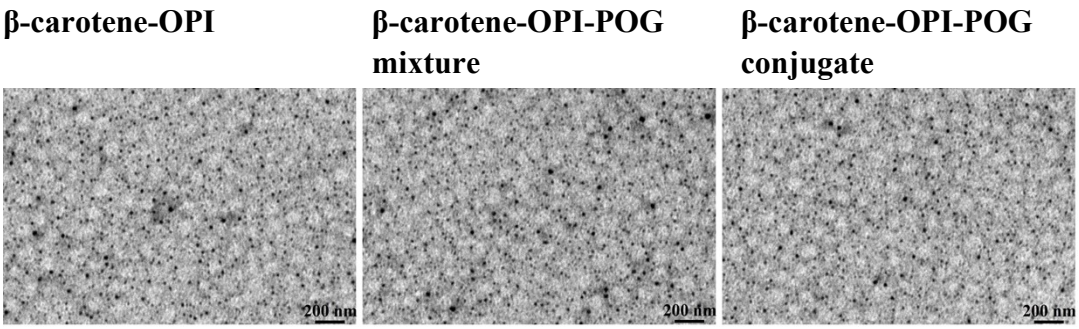

Figure S2. Venn diagrams of 80 OTUs altered by β-carotene, OPI-POG conjugate nanoparticles, and β-carotene-OPI-POG conjugate nanoparticles. ↑ indicates increased by β-carotene, OPI-POG conjugate nanoparticles, and β-carotene-OPI-POG conjugate nanoparticles. ↓ indicates decreased by β-carotene, OPI-POG conjugate nanoparticles, and β-carotene-OPI-POG conjugate nanoparticles. Red font: β-carotene, OPI-POG conjugate nanoparticles, and β-carotene-OPI-POG conjugate nanoparticles reversed OTU whose abundance was changed by CTX.

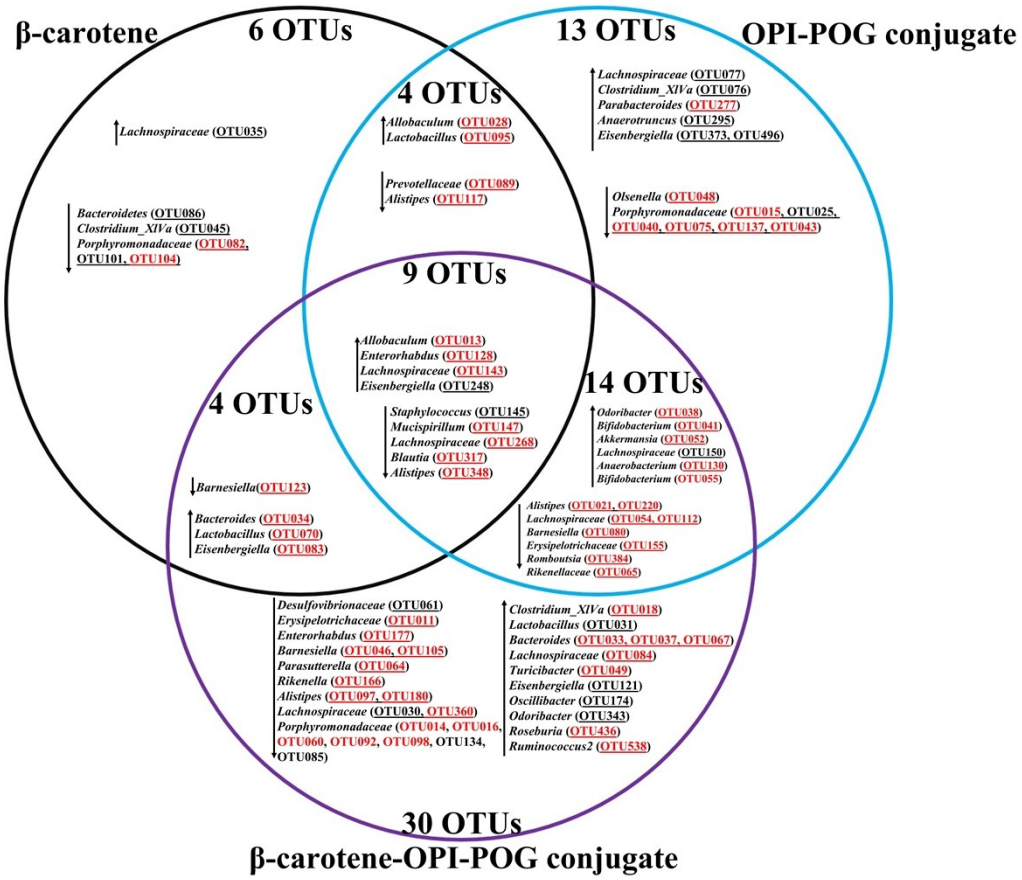
β-carotene
6 OTUs
13 OTUs
OPI-POG conjugate
4 OTUs
9 OTUs
4 OTUs
14 OTUs
30 OTUs
β-carotene-OPI-POG conjugate
↑Lachnospiraceae (OTU035)
↑Allobaculum (OTU028)
Lactobacillus (OTU095)
↓Prevotellaceae (OTU089)
Alistipes (OTU117)
↓Bacteroidetes (OTU086)
Clostridium_XlVa (OTU045)
Porphyromonadaceae (OTU082, OTU101, OTU104)
↑Lachnospiraceae (OTU077)
Clostridium_XlVa (OTU076)
Parabacteroides (OTU277)
Anaerotruncus (OTU295)
Eisenbergiella (OTU373, OTU496)
↓Olsenella (OTU048)
Porphyromonadaceae (OTU015, OTU025, OTU040, OTU075, OTU137, OTU043)
↑Allobaculum (OTU013)
Enterorhabdus (OTU128)
Lachnospiraceae (OTU143)
Eisenbergiella (OTU248)
↓Staphylococcus (OTU145)
Mucispirillum (OTU147)
Lachnospiraceae (OTU268)
Blautia (OTU317)
Alistipes (OTU348)
↓Barnesiella(OTU123)
↑Bacteroides (OTU034)
Lactobacillus (OTU070)
Eisenbergiella (OTU083)
↑Odoribacter (OTU038)
Bifidobacterium (OTU041)
Akkermansia (OTU052)
Lachnospiraceae (OTU150)
Anaerobacterium (OTU130)
Bifidobacterium (OTU055)
↓Alistipes (OTU021, OTU220)
Lachnospiraceae (OTU054, OTU112)
Barnesiella (OTU080)
Erysipelotrichaceae (OTU155)
Romboutsia (OTU384)
Rikenellaceae (OTU065)
↓Desulfovibrionaceae (OTU061)
Erysipelotrichaceae (OTU011)
Enterorhabdus (OTU177)
Barnesiella (OTU046, OTU105)
Parasutterella (OTU064)
Rikenella (OTU166)
Alistipes (OTU097, OTU180)
Lachnospiraceae (OTU030, OTU360)
Porphyromonadaceae (OTU014, OTU016, OTU060, OTU092, OTU098, OTU134, OTU085)
↑Clostridium_XlVa (OTU018)
Lactobacillus (OTU031)
Bacteroides (OTU033, OTU037, OTU067)
Lachnospiraceae (OTU084)
Turicibacter (OTU049)
Eisenbergiella (OTU121)
Oscillibacter (OTU174)
Odoribacter (OTU343)
Roseburia (OTU436)
Ruminococcus2 (OTU538)

Table S1. Procedure of reversed phase HPLC for determining β-carotene and retinoids content

Equipment	(1) Alliance HPLC System equipped with 2998 PDA Detector (E2695, Waters, Milford, MA) (2) A COSMOSIL Cholester packed column (250 × 4.6 mm ID, 5 μm) with a Cholester guard column (10 × 4.6 mm ID, 5 μm)
Mobile phase	(1) Solvent A: 84% methanol: 14% acetonitrile: 2% ultra-pure grade water, v/v/v (2) Solvent B: dichloromethane
Gradient program	Solvent A: 80%-45% in 15 min, 45% for 5 min, 45%-80% in 5min, held at 80% for 3 min until injection of the next sample.
Injection volume	20 μL
Flow rate	1 mL/min
Column temperature	10 °C
Detection wavelength	PDA detector, β-carotene (450 nm), retinol and retinyl palmitate (340 nm).

Table S2. Procedure of gas chromatography for determining SCFAs content

Equipment	Agilent HP-INNOWAX capillary column (30 m × 0.25 mm × 0.25 μm) a flame ionization detector
Procedure	
Flow rate of nitrogen	19 mL/min
Program	① at 100°C for 1 min ② at 180°C (5 °C/min) for 4 min
Injection volume	1.0 μL
Makeup gas	air: 260 mL/min hydrogen: 30 mL/min nitrogen: 30 mL/min