

Supplementary table S1 Effects of oral administration of a strain (belonging to the *Lactobacillus*) on mice fed a high-fat diet

References	Species	Sex	Age or weight	Probiotic/Potential Probiotic	Resources	Bacterial concentration	Treatment cycle	Body weight and serum biochemical indicators	Liver	Adipose tissue	Intestinal	Gut microbe	SCFA and BA content
Chen et al., 2020 [65]	Kunming mice	Male	6 weeks old, 20 ± 2 g	<i>Lactiplantibacillus plantarum</i> FZU3013	Isolated from the traditional brewing process of Hongqu rice wine	1 × 10 ⁹ CFU/mL	8 weeks	body weights↓ epididymal fat index↓ the size of the adipocytes↓ serum TG, TC and LDL-C levels↓ HDL-C/LDL-C value ↑	the levels of TG, TC, NEFA and BAs↓ the size and number of lipid droplets↓ BSEP, FXR, CYP7A1, NTCP, LDLR and ACOX1 mRNA expression levels ↑ HMGCR, FAS, FATP, ACC1, ACAT2, C/EBP-α, CD36 and SREBP-1c mRNA expression levels ↓ CD36 and SREBP-1C protein expression↓ CYP7A1 protein expression ↑	not found	not found	<i>Flavonifractor</i> , <i>Alistipes</i> , <i>Ruminococcus</i> , <i>Anaerovorax</i> , <i>Helicobacter</i> and <i>Odoribacter</i> ↑ <i>Desulfovibrio</i> ↓	fecal BAs level↑
Sun et al., 2023 [66]	ICR mice	Male	32 ± 4 g	<i>Lactiplantibacillus plantarum</i> NKK20	Zhenjiang Tianyi Biotechnology Co., Ltd. (China)	1 × 10 ⁹ CFU / animal / day	7 weeks	body weights↓ plasma concentrations of TC and TG ↓	the mRNA expression of CYP7A1 ↑, CTGF and TGF-1 ↓ degree of adipose degeneration in hepatocytes ↓	not found	not found	<i>Pseudomonas</i> and <i>Turicibacter</i> ↓ <i>Akkermansia</i> ↑	acetic acid, propionic acid, and butyric acid concentrations ↑ the concentrations of cholic acid, glycinoholic acid, and glycinodeoxycholic acid in the livers ↓ the concentration of aminodeoxycholic acid ↑
Jacouton et al., 2023 [67]	C57BL/6J	Male	6-8 weeks old	<i>Lactiplantibacillus plantarum</i> CGMCC	isolated from the feces of a healthy child and kindly provided by Indigo Therapeutics	1 × 10 ⁹ CFUs / animal / day	12 weeks	fasting glucose levels↓ Serum levels of LDL-c ↓	G6PASE and GLUT-4 mRNA expression levels ↓ FASN mRNA expression levels ↓ PPAR-α mRNA expression levels ↑	not found	the expression of ZO-1 protein↑	ratio of Firmicutes to Bacteroidetes↓ <i>Alloprevotella</i> , <i>Lactobacillus</i> , <i>Parasutterella</i> , and <i>Acinetobacter</i> ↑	concentrations of valerate ↓
Cai et al., 2020	Kunming mice	female	7 weeks old	<i>Lactiplantibacillus plantarum</i>	isolated from Poland	2 × 10 ⁸ CFUs / animal /	8 weeks	body weight↓ lipid accumulation↓	liver weight ↓ TG concentration↓ SREBP-1 and DGAT1	not found	not found	Firmicutes/Bacteroidetes ↓ <i>Bacteroides</i> , <i>Alistipes</i> ,	not found

[68]				FRT10	sour dough	day			mRNA expression levels↓ PPAR-α mRNA expression level↑			<i>Intestinimonas</i> , <i>Butyricicoccus</i> , <i>Odoribacter</i> , <i>Butyricimonas</i> , and <i>Oscillibacter</i> ↑ <i>Roseburia</i> , <i>Blautia</i> , and <i>Lachnoclostridium</i> ↓	
Jang et al., 2024 [69]	C57B-L/6 mice	male	7 weeks old	<i>Lactiplanti-bacillus plantarum</i> NCHBL-004	isolated from honeybees (collected in Gwangju, Republic of Korea)	1 × 10 ⁸ CFU / animal / day	12 weeks	body weight↓ plasma-active GLP-1↑	liver weight ↓ TG and TC concentration↓ lipid accumulation↓ C/EBPα, FABP4, ACC, IL-1β, TNF-α, IL-6 and MCP-1 mRNA expression levels ↓	not found	not found	<i>Lactobacillus</i> ↑	acetic acid and propionic acid concentrations in feces↑ BAs concentration in feces↑
Gan et al., 2020 [70]	C57B-L/6 mice	half male and half female	6 weeks old	<i>Lactiplanti-bacillus plantarum</i> CQPC01	isolated from Sichuan Paocai in Chongqing, China	1 × 10 ⁹ CFU/kg body weight	6 weeks	body weight↓ Serum levels of TG, TC and LDL-c↓ Serum levels of HDL-c↑ serum levels of IL-6, IL-1β, TNF-α and IFN-γ↓ serum levels of IL-4 and IL-10 ↑	Liver index↓ levels of TG, TC and LDL-c↓ levels of HDL-c↑ C/EBP-α and PPAR-γ mRNA expression levels↓ CYP7A1, CPT1, LPL, CAT, SOD1, and SOD2 mRNA expression levels↑	the size of adipocytes↓	not found	not found	not found
Choi et al., 2023 [71]	C57B-L/6J mice	male	6 weeks old	<i>Lactiplanti-bacillus plantarum</i> SKO-001	isolated from Angelica gigas Nakai	5 × 10 ⁹ CFU/day, 1 × 10 ¹⁰ CFU/day and 2 × 10 ¹⁰ CFU/day	12 weeks	body weight↓ Serum levels of adiponectin↑ and leptin↓ Serum levels of TC, LDL-C, FFA and TG↓	lipid accumulation ↓ SREBP-1c and PPARγ mRNA expression and protein levels↓	average adipocyte size in white adipose tissues (subcutaneous, visceral, and epididymal) ↓ UCP-1 mRNA expression level↑ PPARγ, C/EBPα and SREBP-1c mRNA expression levels ↓	not found	not found	not found
Choi et al., 2020 [72]	C57B-L/6-N mice	male	5 weeks old	<i>Lactiplanti-bacillus plantarum</i> LMT1-48	isolated from the traditional Korean fermented food kimchi	1 × 10 ⁹ CFU/day	16 weeks	body weight↓ the plasma levels of leptin↓	liver weight ↓ levels of TG↓ PPARγ, HSL, SCD-1 and CD36 mRNA expression levels ↓	the epididymal fat pad weight↓ the size of visceral adipocytes↓	not found	not found	not found

Gan et al., 2020 [73]	C57BL/6 mice	half male and half female	6 weeks old	<i>Lactiplantibacillus plantarum</i> CQPC03	isolated from Sichuan Paocai in Chongqing, China	1×10^9 CFU/kg body weight	8 weeks	body weight↓ serum IL-10 and IFN- γ ↓, IL-4↑	liver weight ↓ SOD and GSH-Px↑, MDA↓ CPT1, LPL, CAT, and SOD1 mRNA expression levels↑	epididymal fat weight ↓	not found	not found	not found
Yin et al., 2020 [74]	C57BL/6J mice	male	5 weeks old	<i>Lactiplantibacillus plantarum</i> Shinshu N-07	Isolation of lactic acid bacteria from fermented Brassica rapa	1×10^{10} CFU/g	8 weeks	body weight↓	total lipid levels ↓ ACC1 and PPAR γ mRNA expression levels ↓	epididymal adipose tissues↓ cross-sectional area of adipocytes↓ UCP1 mRNA expression levels↑	not found	<i>Lactobacillaceae</i> and <i>f_S24-7</i> ↑	not found
Liu et al., 2020 [75]	C57BL/6 mice	male	6 weeks old	<i>Lactiplantibacillus plantarum</i> Y44	Dalian Probiotics Function Research Key Laboratory	4×10^7 CFU/mL, 4×10^9 CFU/mL	12 weeks	body weight↓ serum TC, TG and LDL-C levels↓ serum HDL-c ↑	liver weight ↓ FAS and ACC protein levels↓	epididymal fat and perirenal fat ↓ epididymal adipocyte area↓	the expression of both p38 and p-p38 in colon↓ the protein expression of occludin and claudin-1↑	the ratio of Firmicutes/Bacteroidetes↓ Bacteroidaceae, Muribaculaceae, Lactobacillaceae and Rikenellaceae↑ Ruminococcaceae and Desulfovibrionaceae ↓	propionic acid, butyric acid, butanoic acid-3-methyl, pentanoic acid and acetic acid↑
Chen et al., 2023 [76]	C57BL/6J mice	male	4 weeks old	<i>Lactiplantibacillus plantarum</i> HF02	isolated and identified from Qula cheese made from yak milk	2×10^8 CFU/mL/day, 2×10^9 CFU/mL/day	8 weeks	body weight↓ serum TG, TC, LDL-C, FFAs levels↓ serum HDL-c level ↑ serum LPS, IL-1 β and TNF- α ↓	liver index↓ TG, TC and FFAs level↓ lipid droplet field↓ cell size of epididymal adipose↓ the mRNA expression levels of AMPK, PPAR α , CPT-1a, and ACOX1↑ the ratio of p-AMPK/AMPK and PPAR α , CPT-1a, and ACOX1 protein levels↑	epididymal and perirenal adipose index↓	not found	Ratio of Bacteroidetes/Firmicutes↓ Muribaculaceae, <i>Rikenellaceae_RC9_gut_group</i> , and <i>Faecalibaculum</i> ↑ <i>Bacteroides</i> , <i>Alistipes</i> , <i>Blautia</i> , and <i>Colidextribacter</i> ↓	SCFAs (acetic acid, pro-pionic acid, and butyric acid) levels↑
Das et al., 2024 [77]	albino mice	male	13.59 ± 0.56 g	<i>Lactiplantibacillus plantarum</i> E2 MCC-KT	isolated from a fermented beverage	1×10^9 CFU/mL	8 weeks	body weight↓ serum TG, TC, LDL-c levels↓ serum HDL-c level ↑	fat deposition and droplets↓ PPAR α , ACO and CPT1 protein levels ↑ SREBP-1c, ACC, FAS mRNA expression levels ↓	PPAR- α and IL10 protein levels ↑ leptin receptor TNF- α and IL-1Ra protein levels ↓	not found	not found	not found
Ghosh et al., 2024 [78]	Swiss albino mice	male	6 weeks old	<i>Lactiplantibacillus plantarum</i> KAD	isolated from ethnic fermented food 'Kinema' found in Darjeeling, India	2×10^{10} CFU/mL	8 weeks	body weight↓ Serum Insulin Level↓ serum TG, TC, LDL-c, VLDL-c levels↓, HDL-C level↑ serum TNF- α and IL-6 protein	liver Co-efficient↓ steatosis, immune infiltration, swollen hepatocytes with distorted histology↓ TNF- α and IL-6 protein levels↓	pgWAT Co-efficient↓ IL-6 protein level↓	Intestine Co-efficient↓ SOD, GSH and CAT enzymes levels↑, MDA level ↓ TNF- α and IL-6 protein	Prevotellaceae, Lactobacillaceae, <i>Prevotella</i> , <i>Lactobacillus</i> , unclassified Lachnospiraceae↑ <i>Unclassified Bacteroidales</i> ↓	not found

								levels↓			levels↓		
Cai et al., 2025 [79]	C57B-L/6J mice	male	4 weeks old	<i>Lactiplanti-bacillus plantarum</i> BXM2	isolated from a naturally fermented passion fruit honey beverage in the Fujian province, China	2×10^9 CFU / animal / day	6 weeks	body weigh not statistically significant	liver index not statistically significant	perirenal fat index↓	villus height to crypt depth↑ the number of goblet cells↑ TNF- α mRNA expression level ↓ , IL-6 level ↑	Firmicutes/Bacteroidota ratio↓ <i>Dubosiella</i> , <i>Romboutsia</i> and <i>Lachnospiraceae_UCG-006</i> ↓ <i>Akkermansia</i> and <i>Lactobacillus</i> ↑	not found
Lee et al., 2024 [80]	C57B-L/6 mice	male	4–6 weeks old	<i>Lactiplanti-bacillus plantarum</i> DSR330	isolated from kimchi in Korea	1×10^8 CFU/animal/day, 1×10^9 CFU/animal/day	7 weeks	body weigh↓ serum TG, TC, LDL-c, AST and ALT↓ serum Insulin and Leptin levels ↓, Adiponectin level ↑	lipid droplets↓ PPAR γ , SREBP-1c and FAS mRNA expression levels ↓ , ACC1, ACO, PPAR α and CPT-1 levels ↑	Subcutaneous fat↓	not found	not found	not found
Sound harraj an et al., 2020 [81]	ICR mice	male	7 weeks old	<i>Lactiplanti-bacillus plantarum</i> KCC48	isolated from alfalfa (Cheonan, South Korea)	1×10^9 CFU/animal/day	8 weeks	body weigh↓ serum ALT, AST, TC, TG and LDL levels↓, HDL, CAT, SOD and GSH levels↑	ALT and AST levels↓	adipose tissue mass↓ adipose tissue IL1 β , IL6, TNF α , and leptin mRNA expression↓ epididymal fat tissues PPAR- γ , C/EBP- α , SREBP-1,ACC, FAS, and aP2 protein levels ↓ , Adiponectin level↑	not found	<i>Lactobacillus</i> ↑	not found
Ondee et al., 2021 [82]	C57B-L/6 mice	male	8 weeks old	<i>Lactiplanti-bacillus plantarum</i> dfa1	Thai-isolated probiotics	1×10^8 CFU	16 weeks	body weigh↓ serum TC and TG levels↓ TNF- α , IL-6 and IL-10 levels ↓	liver weight↓ liver cholesterol↓ GSH level ↑, MDA level ↓	mesentery, peri-renal, retro-peritoneum, peri-gonadal, and subcutaneous fat↓	TNF- α and IL-6 levels↓ enterocyte IL-8 production↓	Bacteroides↑, Proteobacteria ↓	not found
Lee et al., 2018 [83]	C57B-L/6J mice	male	12 weeks old	<i>Lactiplanti-bacillus plantarum</i> strain Ln4	isolated from napa cabbage	5×10^8 CFU /animal/ day	5 weeks	body weigh↓ plasma insulin and TG levels↓ epididymal fat ANGPT-L3, CRP, leptin, lipocalin-2, MCP-1 and IGFBP protein	liver weight ↓ IRS2, Akt2, LPL and AMPK mRNA expression levels↑, CD36 level ↓	lipid accumulation↓ epididymal fat and brown adipose tissue↓	not found	not found	not found

								levels ↓					
Riezu-Boj et al., 2022 [84]	C57B-L/6 mice	male	8 weeks old	<i>Lactiplantibacillus plantarum</i> DSM20174	isolated from a pickled cabbage from the Spanish Collection of Type Cultures	1×10^9 CFU / animal / day	10 weeks	body weigh↓ serum TG, TC, and NEFAs ↓	IL6, TLR4, and MCP1 mRNA expression levels↓	the number of crown-like structures of WAT ↓ F4/80, MCP1, CD11c, CD68 and CD44 mRNA expression levels↓ PPAR γ and SREBP mRNA expression levels ↑	not found	<i>Ruminococcus torques</i> ↓ <i>Lactiplantibacillus plantarum</i> spp. ↑	not found
Huang et al., 2021 [85]	C57B-L/6J mice	male	5 weeks old	<i>Lactiplantibacillus plantarum</i> KC28	isolated from kimchi produced in the Pohang region (South Korea)	5×10^9 CFU / animal / day	12 weeks	body weigh↓ serum TC, TG and LDL-c levels↓	liver weight↓ PPAR- α , PGC1- α , CPT1- α mRNA expression levels↑	adipose tissues weight↓ mesenteric adipose tissue (MAT) ACOX-1、PPAR- γ and FAS mRNA expression levels ↓ , PPAR- α , PGC1- α , CPT1- α mRNA expression levels↑	not found	Desulfovibrionaceae and Lactobacillaceae↑	Butyrate↑
Kuerman et al., 2021 [86]	C57B-L/6J mice	male	4 weeks old	<i>Lactiacasei-bacillus paracasei</i> S0940 <i>Streptococcus thermophilus</i> ldbm1	isolated from a traditional Chinese fermentation isolated from traditional fermented yogurt	1×10^8 CFU/day, 1×10^9 CFU/day, 1×10^{10} CFU/day	6 weeks	body weigh↓ serum TC, TG and LDL-c↓, HDL-c ↑	TC and MDA levels↓ the contents of GSH-PX, CAT and MDA↑	not found	not found	<i>Lactobacillus</i> ↑	not found
Li et al., 2016 [87]	ICR mice	not found	7 weeks old	<i>Lactobacillus casei</i> IBS041 <i>Lactobacillus acidophilus</i> AD031 <i>Bifidobacterium bifidum</i>	Bifido Co., Ltd. (Hongchun, Korea)	5×10^8 CFU/mL	8 weeks	body weigh↓ <i>Lactobacillus acidophilus</i> AD031 and <i>Bifidobacterium bifidum</i> BGN4 serum ALT and AST level↓	<i>Lactobacillus acidophilus</i> AD031 and <i>Bifidobacterium longum</i> BORI liver weight ↓ <i>Lactobacillus acidophilus</i> AD031 and <i>Bifidobacterium bifidum</i> BGN4 TG level ↓ <i>Bifidobacterium longum</i> BORI TC level ↓	adipocyte sizes↓	not found	not found	not found

				BGN4 <i>Bifidobacterium longum</i> BORI									
Liu et al., 2022 [88]	C57BL/6J mice	male	7-8 weeks old	<i>Lactocasei-b acillus paracasei</i> 24	isolated and screened in the intestines of healthy adults	1×10 ⁸ CFU / animal / day	8 weeks	serum TC, TG, LDL-c, ALT, AST, LPS, LEP and NEFA↓, HDL-c↑	TC, TG, NEFA and MDA levels ↓ CAT, SOD and GSH-Px↑	Adipose tissue FAS, ACC, SCD-1 and SREBP-1c expression levels↓, AMPK-α,CPT-1 α, PPARα and HSL levels ↑	not found	Firmicutes/Bacteroidota ratio↓ Proteobacteria ↓ <i>Akkermansia</i> ↑	not found
Miao et al., 2023 [89]	C57BL/6J mice	male	6 weeks old	<i>Lactocasei-b acillus paracasei</i> K56	Yili Industrial Group Co., Ltd	1×10 ⁷ , 1×10 ⁹ , and 1×10 ¹¹ CFU/day	10 weeks	body weigh↓ Fasting plasma glucose, serum insulin↓	FAS protein level↓, PPARγ level ↑	perirenal and epididymal fat mass↓ the fat area of abdominal and subcutaneous adipose tissues↓	not found	<i>Coriobacteriaceae_U-CG-002</i> , <i>Desulfovibrio</i> and <i>Dubosiella</i> ↓	not found
Miao et al., 2022 [90]	BALB /c mice	not found	Neonatal mice	<i>Lactocasei-b acillus paracasei</i> N1115	Shijiazhuang Junlebao Dairy Co. Ltd., Shijiazhuang, China P.R.	1×10 ⁹ CFU	15 weeks	serum levels of insulin and leptin↓	liver weight↓	visceral fat↓	not found	<i>Bilophila</i> , <i>Lachnoclostridium</i> , and <i>Blautia</i> ↑	SCFAs concentration↑
Galin dev et al., 2024 [91]	C57BL/6J mice	male	3 weeks old	<i>Lactocasei-b acillus paracasei</i> X-1 <i>Lactocasei-b acillus paracasei</i> X-17	isolated from Mongolian fermented dairy products	5 × 10 ⁹ CFU/day	6 weeks	body weight↓ Fasting plasma glucose↓ serum TG and LDL levels ↓	not found	epididymal fat index↓	not found	not found	not found
Lee et al., 2024 [92]	C57BL/6J mice	male	6 weeks old	<i>Lactocasei-b acillus paracasei</i> BEPC22 <i>Lactiplantibacillus plantarum</i> BELP53	isolated from Korean faeces	2 × 10 ⁹ CFU / animal / day	10 weeks	body weight↓ Serum Ghrelin level↑	PPARγ and UCP2 mRNA expression levels ↓	adipocyte mean area↓ PPARα mRNA expression level ↑ , UCP2 level↓	not found	<i>Colidextribacter</i> and <i>Tuzzerella</i> ↓ <i>Alistipes</i> ↑	not found
Lv et al., 2021 [93]	Kunming mice	male	6 weeks old	<i>Lactocasei-b acillus paracasei</i> FZU103	isolated from traditional brewing of Wuyi	1 × 10 ⁹ CFU / animal / day	8 weeks	body weight↓ serum TC and LDL-c levels ↓, HDL-c level ↑	accumulation of lipid droplets↓ ACOX1, FXR, NTCP mRNA expression levels↑ FAS, ACAT2, FATP,	epididymal white adipose tissue↓ the size of epididymal	not found	<i>Ruminococcus</i> , <i>Alistipes</i> , <i>Pseudoflavonifractor</i> and <i>Helicobacter</i> ↑ <i>Blautia</i> ,	excretion of BAs through feces↑

					Hong Qu glutinous rice wine				SREBP-1c mRNA expression levels↓	adipocytes↓		<i>Staphylococcus</i> and <i>Tannerella</i> ↓	
Song et al., 2023 [94]	C57BL/6 mice	male	6 weeks old	<i>Lactocasei-bacillus paracasei</i> AO356	isolated from fecal samples of healthy Koreans	5×10^7 CFU/mg	10 weeks	body weight↓ serum glucose, insulin and HOMA-IR levels↓	not found	fat accumulation↓	not found	Bacteroidaceae↓	not found
Novotny et al., 2015 [95]	BALB/c mice	female	5 weeks old	<i>Lactobacillus casei</i> CRL 431	obtained from the CERELA Culture Collection (San Miguel de Tucumán, Argentina)	2×10^8 CFU/mL	8 weeks	not found	CD4+ level ↓, F4/80+ level ↑ IL-6 protein level↑, TNF-α and IL-17 levels ↓	IL-6, IL-10 and MCP-1 protein levels↓	IFN-γ protein level↓, IL-10↑	not found	not found
Nguyen et al., 2022 [96]	mice	not found	not found	<i>Lactobacillus sakei</i> MJM60958	isolated from fermented food	1×10^8 CFU, 1×10^9 CFU	12 weeks	body weight↓ serum TG, leptin, ALT, AST, TNF-α, IL-1β and UA levels ↓, BUN and adiponectin levels↑	Liver weight and liver weight/body weight↓ the fat content↓ FAS, ACC mRNA expression levels↓, PPARα, CPT1A mRNA expression levels ↑ FAS and SREBP-1 protein levels↓, PPARα protein levels↑	not found	not found	Firmicutes, Actinobacteria, <i>Clostridiales vadinBB60 group</i> , <i>Clostridiaceae 1</i> , Atopobiaceae, Lachnospiraceae, and Peptostreptococcaceae ↓ Venrucomicrobia, Tenericutes, Akkermansiaceae and Ruminococcaceae ↑	acetic acid ↑
Chen et al., 2024 [97]	C57BL/6J mice	male	3 weeks old	<i>Latilactobacillus sakei</i> QC9	isolated from traditional Chinese fermented food	1.0×10^9 CFU/mL	12 weeks	body weight↓ Fasting plasma glucose↓ serum TC, TG, LDL-c, TNF-α, IL-1β and IL-6 levels ↓, HDL-c, GSH and IL-10 levels ↑	TC and TG level↓ SOD and CAT ↑, MDA ↓	not found	not found	<i>Lactobacillus</i> and Bacteroidetes↑	butyrate↑
Park et al., 2021 [98]	C57BL/6 mice	male	6 weeks old	<i>Latilactobacillus sakei</i> WIKIM31	isolated from homemade kimchi (Gangwon province, Republic of Korea)	1×10^9 CFU / animal / day	12 weeks	body weight↓ serum TG, TC, glucose, Leptin and resistin levels↓ serum adiponectin level ↑	lipid droplet↓ PPARγ, C/EBPα, FAS and CD36 mRNA expression levels ↓ UCP2 and CPT-1α mRNA expression levels ↑ TNF-α, IL-6, and MCP-1 mRNA expression levels↓	fat mass (epididymal and abdominal adipose tissue)↓ adipocyte size↓ epididymal fat PPARγ, C/EBPα, FAS and CD36 mRNA expression	TNF-α, IL-6, and MCP-1 mRNA expression levels↓	not found	propionate, butyrate, valerate↑

										levels↓ epididymal fat UCP2 and CPT-1α mRNA expression levels↑			
Lim et al., 2016 [99]	C57BL/6J mice	male	5 weeks old	<i>Lactobacillus sakei</i> OK67	isolated from kimchi	1 × 10 ⁹ CFU / animal / day	17 weeks	body weight↓ blood LPS levels ↓	not found	epididymal fat↓ adipose tissue PPARγ, FAS, and αFABP mRNA expression level ↓	TNF-α, IL-1β, IL-6, iNOS, COX-2 and NF-κB protein level ↓ IL-10, Arg1, CD204, tight junction proteins level ↑	not found	not found
Jang et al., 2019 [100]	C57BL/6 mice	male	6 weeks old	<i>Lactobacillus sakei</i> OK67 <i>Lactobacillus sakei</i> PK16	not found	2 × 10 ⁹ CFU / animal / day	9 weeks	body weight↓ serum TG, TC, and LPS levels↓	liver weight↓ serum TG, TC, and LPS levels↓ AMPK protein and SIRT1, PGC-1α, and Fiaf mRNA expression levels↑ SREBP-1c, LPL, G6PD, and FAS mRNA expression↓	epididymal fat pad weight↓	colon shortening↓ TNF-α mRNA expression level↓, IL-10 level↑	Proteobacteria and Firmicutes populations, Proteobacteria/Bacteroidetes↓	not found
Won et al., 2020 [58]	C57BL/6J mice	male	5 weeks old	<i>Lactobacillus sakei</i> ADM14	isolated from Andong sik-hae kimchi	10 ⁸ -10 ⁹ CFU	10 weeks	body weight↓ fasting blood glucose↓ serum TC, LDL-c and HDL-c levels↓	not found	epididymal fat mass↓ epididymal fat pad PPARγ, C/EBPα, CD36 and MCP-1 mRNA expression levels↓	not found	Bacteroidetes, Deferribacteres, Bacteroidia, Clostridia, Deferribacteres, Bacteroidaceae, Lachnospiraceae, and Muribaculaceae↑ Verrucomicrobia, Erysipelotrichia↓	butyrate↑
Ji et al., 2019 [101]	C57BL/6 mice	male	4 weeks old	<i>Lactobacillus sakei</i> CJLS03	isolated from Korean fermented kimchi	1 × 10 ⁹ CFU / animal / day	8 weeks	body weight↓ serum TG, FFA and leptin level↓	not found	mesenteric, epididymal and subcutaneous adipose tissues↓ Subcutaneous and mesenteric adipose tissue sizes↓ epididymal adipose tissue MCP1, IL-1β, SREBP-1c, FAS and SCD1 mRNA expression levels ↓, IL-10	not found	<i>Lactobacillus</i> spp.↑	propionate and butyrate ↑

										level ↑ epididymal adipose tissue AMPK protein level ↑			
Kang et al., 2022 [102]	C57B- L/6 J mice	male	3 weeks old	<i>Lactobacillus acidophilus</i>	isolated from porcine guts	5×10 ⁹ CFU/day	12 weeks	body weight↓ serum TC, TG and HDL levels ↓	liver weight↓ lipid area, LPS ↓ TNF-α, IL-1β, F4/80, NF-κB, TLR4, IκB and P-IκB protein levels ↓ Leptin mRNA expression level↑,PPARγ level↓	epididymal white adipose tissue↓ UCP-1 expression level ↓ TNF-α and IL-1β protein levels↓ CPT-1, Leptin, HSL mRNA expression levels↑ FAS and PPARγ mRNA expression levels ↓	TNF-α and IFN-γ protein levels ↓	<i>Lactobacillus</i> , <i>Bifidobacterium</i> , <i>Bifidobacterium pseudolongum</i> , <i>Lactobacillus johnsonii</i> ↑	not found
Tang et al., 2021 [103]	Kun- ming mice	male	4 weeks old	<i>Lactobacillus acidophilus</i> NX2-6	not found	10 ⁹ CFU/mL	17 weeks	body weight↓	PGC-1α, SIRT1, nrf1, p-AMPKα, GLUT2, PI3K, p-AKT, Glucokinase and FGF21 protein levels ↑ PEPCK, Ser307, p50, p-p65, p-p38, p-JNK, p-ERK protein levels↓	PEPCK, p50, p-p38 and Ser307 protein levels↓ GLUT2, PI3K, p-AKT, Glucokinase, p-AKTand Glucokinase protein levels↑	PEPCK, GLUT2, Glucokinase protein levels↑	not found	not found
Song et al., 2015 [104]	C57B- L/6 mice	male	7 weeks old	<i>Lactobacillus acidophilus</i> NS1	isolated from infant feces	1.0 × 10 ⁸ CFU/mL	10 weeks	body weight↓ serum TG, TC, LDL-c levels ↓	TC and TG level↓ SREBP2 and LDLR mRNA expression level↑	not found	not found	not found	not found
Ondee et al., 2021 [105]	C57B- L/6 mice	male	8 weeks old	<i>Lactobacillus acidophilus</i> LA5	Chr. Hansen, Hørsholm, Denmark	1 × 10 ⁸ CFU/day	8 weeks	body weight↓ serum TG, TC, HDL, LDL, TNF-α, IL-6, and IL-10 ↓	not found	mesentery, retro-peritonium , peri-gonadal, peri-renal and subcutaneous fat ↓	ZO-1 and MUC2 protein levels↑	Firmicutes, Verrucomycobia, Cyanobacteria, <i>Akkermansia muciniphila</i> ↑ Gammaproteobacteria ↓	not found
Zheng et al., 2024 [106]	mice	not found	not found	<i>Lactobacillus acidophilus</i> GOLDGU- TLA100	not found	not found	not found	body weight ↓ serum glucose and cholesterol level↓	lipid accumulation↓	adipose inflammation↓	not found	not found	not found
Molin a-Tije ras et	C57B- L/6 J mice	male	5 weeks old	<i>Lactobacillus fermentum</i>	Biosearch, S. A. (Granada,	5 × 10 ⁸ CFU / animal /	11 weeks	body weight ↓ plasma Glucose, HOMA-IR,	IL-6, TNF-α, MCP-1, JNK-1, TLR4 mRNA expression levels ↓	abdominal fat and epididymal fat ↓	MUC-1, MUC-2, MUC-3,	<i>Bacteroides</i> , <i>Akkermansia</i> sp.↑ Erysipelotrichi class	not found

al., 2021 [107]				CECT5716	Spain)	day		LDL-c, TG levels↓	GLUT4, Leptin-R mRNA expression level↑	adipocytes area↓ fat IL-6, TNF- α , MCP-1, JNK-1, TLR4, Leptin mRNA expression levels ↓ fat PPAR α , GLUT4, AMPK, Adiponectin, Leptin-R mRNA expression levels↑	ZO-1, Occludin and TFF-3 mRNA expression levels↑ Occludin protein level↑ LPS level↓	and <i>Clostridium</i> spp↓	
Li et al., 2024 [108]	C57B-L/6 J mice	male	6 weeks old	<i>Limosilact-obacillus fermentum</i> HNU312	isolated from fermented Yucha (a traditional fermented food from Hainan Province, China)	1×10^8 CFU / animal / day	10 weeks	body weight↓ serum TG, TC, LDL-c, HDL-c, IL-6 and TNF- α levels↓ blood glucose, insulin levels↓	liver weight↓ lipid droplet area ↓	epididymal fat weight↓ adipocyte size↓	not found	<i>Akkermansia muciniphila</i> and <i>Bacteroides xylanisolvens</i> ↑ <i>Enterorhabdus caecimuris</i> ↓	acetic acid, propionic acid, butyric acid, isobutyric acid, valeric acid, isovaleric acid concentrations ↑
Kim et al., 2021 [109]	C57B-L/6J mice	male	4 weeks old	<i>Limosilact-obacillus fermentum</i> MG4231 <i>Limosilact-obacillus fermentum</i> MG4244	Mediogen Co., Ltd. (Jecheon, Korea)	2×10^8 CFU / animal / day	8 weeks	body weight ↓ plasma ALT, TC, LDL, Leptin levels↓ the combination of MG4231 and MG4244 group plasma Adiponectin level ↑	TG level↓ SREBP-1c, FAS protein levels↓ p-AMPK, p-ACCprotein leves ↑	adipose tissue (liver, epididymal and subcutaneous) weight↓ the combination of MG4231 and MG4244 group adipocyte diameter↓ epididymal adipose tissue (MG4244 and combination group) PPAR γ , FAS, aP2 protein levels↓	not found	not found	not found
Lee et al., 2023 [110]	C57B-L/6 mice	male	5 weeks old	<i>Limosilact-obacillus fermentum</i> MG4294 <i>Lactiplantibacillus plantarum</i> MG5289	MEDIORG Co., Ltd. (Jecheon, Republic of Korea)	1×10^9 CFU / animal / day	12 weeks	body weight↓ serum AST, ALT, TC, LDL-c levels↓	liver weight↓ lipid droplets↓ TG and TC levels↓ PPAR γ , C/EBP α , p-AMPK, m-SREBP1, and FAS protein levels ↓	not found	TNF- α , IL-1 β and IL-6 protein levels↓	not found	not found

Yoon et al., 2020 [111]	C57BL/6N mice	male	6 weeks old	<i>Lactobacillus fermentum</i> LM1016	obtained from Lactomas on (South Korea)	1×10^9 CFU / animal / day	8 weeks	body weight↓ fasting blood glucose, fasting serum insulin, leptin and TC levels↓	liver weight↓ lipid droplet size and TG accumulation↓ CYP7A1 and CYP27A1 mRNA expression levels↑, FGF15, GCK, PEPCK, G6PASE, PPAR γ , SREBP1, ACC, FAS, SCD1, ACACB, DGAT2, CHERBP, CIDEA, G0S2 levels ↓	brown adipose tissue lipid droplet sizes↓ Inguinal white adipose tissue and gonadal white adipose tissue weight ↓ brown adipose tissue UCP1, DIO2, ACADM, ESRR, and AOX mRNA expression levels↓ gonadal white adipose tissue F4/80, Mcp1, TGF- β , IFN- γ , IL-1 β , and IL-18 mRNA expression levels↓, TNF- α signaling via nuclear factor NF- κ B↓	not found	not found	serum bile acid levels↑
Song et al., 2023 [112]	C57BL/6 J mice	male	6 weeks old	<i>Lactobacillus fermentum</i> CKCC1858 <i>Lactobacillus fermentum</i> CKCC1369 <i>Lactiplantibacillus plantarum</i> CKCC1312 <i>Lactobacillus gasseri</i> CKCC1913	isolated from infant feces isolated from fermented bamboo shoot isolated from pickles isolated from goat milk curd	5×10^{10} CFU/kg of body weight	7 weeks	fasting blood glucose levels↓	TG, TC, LDL-C, FFAs, SOD, GSH, and CAT levels↓ MDA, IL-6 and TNF- α levels ↓	not found	not found	Firmicutes/Bacteroidetes ratio↓ <i>Lactobacillus fermentum</i> CKCC1858: <i>Lactobacillus</i> ↑, <i>Faecalibaculum</i> ↓ <i>Lactobacillus fermentum</i> CKCC1369: <i>Bifidobacterium</i> and <i>Dubosiella</i> ↑, <i>Faecalibaculum</i> ↓ <i>Lactiplantibacillus plantarum</i> CKCC1312: <i>Lactobacillus</i> , <i>Prevotella</i> and <i>Akkermansia</i> ↑, <i>Faecalibaculum</i> ↓ <i>Lactobacillus gasseri</i> CKCC1913: <i>Lactobacillus</i> and <i>Prevotella</i> ↑,	not found

												<i>Faecalibaculum</i> ↓	
Schmidt et al., 2024 [113]	C57BL/6 mice	male	3 weeks old	<i>Lactocasei-bacillus rhamnosus</i> LB1.5	isolated from raw buffalo milk	3.1×10^8 CFU/mL	13 weeks	body weight and biochemical parameters no difference serum IL-6 level ↓	not found	not found	not found	not found	not found
Feng et al., 2022 [114]	C57BL/6 mice	male	6 weeks old	<i>Lactobacillus rhamnosus</i> TR08	isolated from human gut	1×10^8 CFU / animal / day	8 weeks	body weight and biochemical parameters no difference	not found	not found	not found	<i>Bifidobacterium</i> and <i>Bacteroides</i> ↑ <i>Enterococcus</i> ↓	acetic acid, propionic acid, and butyric acid↑
Chen et al., 2022 [115]	C57BL/6 mice	male	7 weeks old	<i>Lactobacillus rhamnosus</i> strain LRH05	/	1×10^9 CFU / animal / day	10 weeks	body weight↓ serum TG levels↓	TG levels↓ PGC-1α, NRF-1, SOD mRNA expression levels ↑	epididymal WAT and inguinal WAT weight↓ cross-sectional area of adipocytes in epididymal WAT, retroperitoneal WAT, and inguinal WAT↓ MOGAT1, ACOX1, IGF-1, MCP-1 mRNA expression levels↓	not found	Enterobacteriaceae, Ruminococcaceae, <i>Romboutsia</i> , <i>Lachnoclostridium</i> , <i>Eubacterium_coprostanoligenes_group</i> , <i>Lactobacillus rhamnosus</i> ↑ <i>Ruminococcaceae UCG 014</i> and <i>Lactococcus lactis</i> ↓	propionic, and butyric acids↑
Ivanovic et al., 2015 [116]	C57BL/6 mice	male	6-8 weeks old	<i>Lactobacillus rhamnosus</i> LA68 <i>Lactiplantibacillus plantarum</i> WCFS	Institute of Virology, Vaccines and Sera, “Torlak”, Serbia	2×10^9 CFU	16 weeks	body weight↓ <i>Lactobacillus rhamnosus</i> LA68 group serum TC, HDL, Adiponectin levels ↓ <i>Lactiplantibacillus plantarum</i> WCFS group serum TG, LDL, Leptin levels↓	not found	not found	not found	not found	not found
Cheng and Liu, 2020 [117]	Balb/C mice	male	7 weeks old	<i>Lactobacillus rhamnosus</i> GG	obtained from the American Type Culture Collection (ATCC; Manassas, VA, USA)	1×10^8 CFU / animal / day 1×10^{10} CFU / animal / day	10 weeks	body weight no significant difference	lipid accumulation↓ lipid droplets↓	not found	the ratio of villus height to crypt depth↑	Firmicutes↑ Proteobacteria↓	not found
Sun et al., 2020	C57BL/6 J mice	female	4 weeks old	<i>Lactobacillus rhamnosus</i>	supplied by Wecake-b	1×10^9 CFU / animal /	8 weeks	body weight↓ serum insulin, TG, TC, and	lipid accumulation↓	epididymal adipose tissues overall size of	not found	Firmicutes, Actinobacteria, <i>Faecalibaculum</i> ,	not found

[118]				LRa05	io Co., Ltd. (Suzhou, China)	day		LDL-C levels↓		the adipocytes↓		<i>Desulfovibrio</i> , <i>Bifidobacterium</i> , <i>Streptococcus</i> , <i>Enterorhabdus</i> , and <i>Dubosiella</i> ↓ Proteobacteria, Bacteroidetes, <i>Bacteroides</i> , <i>Alloprevotella</i> , <i>Intestinimonas</i> , and <i>Oscillibacter</i> ↑	
Fang et al., 2019 [119]	ApoE-/- mice C57BL/6J mice	male	8 weeks old	<i>Lactobacillus rhamnosus</i> GR-1	not found	5×10^7 CFU / animal / day 5×10^8 CFU / animal / day	12 weeks	body weight↓ serum ALT, AST levels ↓ high dosage oxLDL, MDA, TNF-α, MCP-1, IL-6 levels ↓	not found	not found	not found	not found	not found
Ukibe et al., 2015 [120]	C57BL/6 J mice	male	6 weeks old	<i>Lactobacillus gasseri</i> SBT2055	isolated from human faeces	1×10^{11} CFU/g	6 weeks	body weight no significant difference fasting glucose levels↓	not found	abdominal fat weight no significant difference CCL2, CCR2 and LEP mRNA expression levels↓ the population of macrophages in adipose↓	not found	not found	not found
Kim et al., 2025 [121]	C57BL/6 J mice	male	8 weeks old	<i>Lactobacillus paragasseri</i> SBT2055	provided by MEGMIL K SNOW BRAND Co., Ltd. (Tokyo, Japan) and supplied by Ju Yeong Ns Co., Ltd (Seoul, South Korea)	1×10^8 CFU / animal / day 1×10^{10} CFU / animal / day	12 weeks	body weight↓ plasma TC, FFA, LDL-c, Leptin levels↓, HDL-c, Adiponectin levels ↑	not found	Epididymal, Perirenal, Mesenteric, Retroperitoneum, Visceral, Subcutaneous white adipose tissues↓ epididymal WAT Adipocyte number↑ epididymal WAT PGC1α, CPT1a protein levels↑	FABP1, FABP2, FATP4, CD36, APOB48 mRNA expression levels↓, ABCG8 levels↑	Bacteroidota↑ Firmicutes/Bacteroidota ratio↓	not found
Lee et al., 2021 [122]	C57BL/6 J mice	male	10 weeks old	<i>Lactobacillus johnsonii</i> 3121 <i>Lactobacillus</i>	not found	1×10^{10} CFU / animal / day	12 weeks	body weight↓ serum TC, LDL and VLDL levels↓	TC levels↓ lipid droplet↓	epididymal and inguinal adipose tissue weight↓ size of the adipocytes↓	not found	Firmicutes/Bacteroidota ratio ↓ <i>Roseburia</i> spp↓ <i>Faecalibacterium prausnitzii</i> and	not found

				<i>rhamnosus</i> 86 <i>Pediococcus pentosaceus</i> KID7						<i>L. johnsonii</i> 3121 and <i>L. rhamnosus</i> 86 PPAR γ , C/EBP α , LPL, CD36 mRNA expression levels↓ <i>L. johnsonii</i> 3121 aP2, FASN and ACC mRNA expression levels ↓		<i>Akkermansia muciniphila</i> ↑	
Hong et al., 2023 [123]	C57B-L/6 mice	male	7 weeks old	<i>Lactobacillus johnsonii</i> JNU3402	isolated from the feces of a healthy infant	1×10^8 CFU/mL	14 weeks	body weight↓	liver weight↓ lipid accumulation↓ FFA, TG, AST, ALT levels↓ SREBP-1c, FAS, ACC mRNA expression levels↓	epididymal and inguinal adipose tissue weight↓	not found	not found	not found
Lee et al., 2024 [124]	C57B-L/6 mice	male	6 weeks old	<i>Lactobacillus curvatus</i> HY7601 and <i>Lactiplantibacillus plantarum</i> KY1032 (1:1 mix)	isolated from kimchi	1×10^8 CFU / animal / day 1×10^9 CFU / animal / day	7 weeks	body weight↓ serum adiponectin, HDL-c levels ↑ serum TG、TC, LDL-c levels↓	PPAR α , Hmgcr, SREBP2, ABCG5, ABCG8, LXR α , LXR, and CYP7A1 mRNA expression levels ↑	epididymal and inguinal adipose tissue weight↓ adipocytes size↓ UCP1, SIRT1, PGC1 α protein levels↑	ABCG5, LXR α mRNA expression levels↑	not found	not found
Park et al., 2013 [125]	C57B-L/6J mice	male	4 weeks old	<i>Lactobacillus curvatus</i> HY7601 <i>Lactiplantibacillus plantarum</i> KY1032	isolated from Korean traditional fermented cabbage	5×10^9 CFU / animal / day	18 weeks	body weight↓ plasma ALT, TC, leptin and insulin levels↓	PGC1 α , CPT1 , CPT2, HSL, CYP7A1, LDLR and ACOX1 mRNA expression levels↑, LPL, FAS levels ↓	total white fat mass↓ the size of the adipocytes↓ epididymal fat FAS and SCD1, TNF α , IL6, IL1 β , MCP1, UCP2 and LPL mRNA expression levels ↓ , HSL levels ↑	not found	<i>Bifidobacterium pseudolongum</i> ↑	not found
Li et al., 2019 [126]	C57B-L/6 mice	male	4 weeks old	<i>Lactobacillus reuteri</i> FN041	isolated from human breast milk	1×10^9 CFU/mL	7 weeks	body weight↓ serum TG, TC, LDL-c, TNF- α levels ↓ serum HDL-c levels ↑	fat infiltration↓ FAS, SREBP-1c mRNA expression levels↓	testicular fat↓	occludin, ZO-1, claudin-6, plgR mRNA expression levels↑	<i>Christensenellaceae</i> R7 group, <i>Bifidobacterium</i> , <i>Mucispirillum</i> , <i>Acetatifactor</i> , <i>Acetivibrio ethanoligignens</i> group, <i>Peptococcus</i> , <i>Eisenbergiella</i> , and	propionic acid, and butyrate↑

												<i>Clostridium sensu stricto 1. Clusters III and IV</i> ↑ <i>Ruminiclostridium 5, Turicibacter, Enterorhabdus, the Eubacterium coprostanoligenes group, and Coriobacteriaceae UCG 002</i> ↓	
Abot et al., 2024 [127]	C57B-L/6J mice	male	9 weeks old	<i>Limosilact- obacillus reuteri</i> BIO7251	isolated from Corsican clementine in HFD fed mice	1×10^9 CFU / animal / day	5 weeks	body weight↓ plasma FFA levels↑	not found	subcutaneous adipose tissue↓ adipocytes number↓ ACC1, F4/80, CD68 mRNA expression levels↓	not found	not found	not found
Zheng et al., 2021 [128]	C57B-L/6J mice	male	5 weeks old	<i>Lactobacillus rhamnosus</i> FJSYC4-1 <i>Lactobacillus reuteri</i> FGSZY33-L6	isolated from the feces of healthy subjects	5×10^9 CFU/mL	12 weeks	body weight ↓ serum TC, LDL-c, fasting blood glucos levels↓	pathology score↓ IL-6 levels↓	adipose weight↓	not found	<i>L. reuteri</i> FGSZY33L6: <i>Romboutsia</i> and <i>Desulfovibrioceae</i> ↑ <i>L. rhamnosus</i> FJSYC4-1: <i>Ruminiclostridium</i> , <i>Lachnospiraceae</i> _U-CG_006 and <i>Lactobacillus</i> ↑	butyric acid↑
Park et al., 2019 [129]	C57B-L/6 mice	male	7 weeks old	<i>Lactobacillus amylovorus</i> KU4	not found	1.0×10^8 CFU/mL	14 weeks	body weight↓ plasma glucose levels and fasting insulin levels↓	TG levels↓	liver, epididymal, and inguinal WAT weight↓ adipocyte size in eWAT and lipid droplet↓ TG levels↓ UCP1, PPARγ, and PGC-1α proteins levels↑	not found	not found	not found
Liang et al., 2021 [130]	C57B-L/6J mice	male	3 weeks old	<i>Ligilactobacillus Salivarius</i> LCK11	Dairy Science and Probiotic Engineering Lab, Harbin Institute of Technology	5×10^8 CFU/mL	8 weeks	body weight ↓ serum TG, CHOL, ALT and AST levels↓	TG and TCHO levels↓	including epididymal white adipose tissue, perirenal white adipose tissue, and inguinal white adipose tissue weights↓	PYY, TLR2 and NF-κB mRNA and protein levels↑	Bacteroidetes, Bacteroidales, Coribacteriales, and Verrucomicrobiales↑ Clostridiales, Deferribacteriales, and Desulfovibrionales↓ Firmicutes/Bacteroidetes ratio↓	not found

					(Harbin, China)								
Kim et al., 2017 [131]	C57B-L/6 mice	male	4 weeks old	<i>Lactobacillus kefir</i> DH5	Isolation of lactic acid bacteria from kefir	2×10^8 CFU	6 weeks	body weight ↓ plasma TG and LDL-c levels ↓	liver weight ↓ lipid droplets ↓	epididymal adipose tissue ↓ PPAR- α , FABP4, and CPT1 mRNA expression levels ↑	not found	Proteobacteria and Enterobacteriaceae ↓	not found
Zeng et al., 2020 [132]	C57B-L/6J mice	female	15-16 weeks old	<i>Lactobacillus pentosus</i> S-PT84	provided from Suntory Wellness Ltd. (Kyoto, Japan)	0.06% (w/w) 0.6% (w/w)	20 weeks	plasma endotoxin, LBP, MCP-1, TNF- α , TG, LDL-c, ALT insulin levels ↓, adiponectin, HDL-c levels ↑	not found	adiponectin and IL-10 levels ↑ macrophage infiltration in white adipose tissues ↓ PPAR- γ , IRS-1 protein levels ↑	ZO-1, JAMA, claudin 1, claudin 3, claudin 4, claudin 5, and claudin 7 mRNA expression levels ↑	not found	not found
Jang et al., 2024 [133]	C57B-L/6J mice	male	4 weeks old	<i>Lactobacillus delbrueckii subsp. lactis</i> CKDB001	not found	1×10^9 CFU/g	24 weeks	serum insulin, TG, ALT levels ↓	liver weight ↓ TG levels ↓ p-AMPK protein levels ↑ SREBP-1c mRNA expression levels ↓	Epididymal adipose tissue leptin mRNA expression levels ↓	not found	not found	not found
Song et al., 2023 [134]	Balb/c mice	male	5-7 weeks old	<i>Lactobacillus coryniformis</i> subsp. <i>torquens</i> T3	screened from traditional yaks' milk cheese from Lhasa	1×10^9 CFU/mL	6 weeks	body weight ↓ serum TG, TC, IL-6, TNF- α , LPS levels ↓	lipid droplets ↓ TC, TG, AST, ALT levels ↓ NF- κ B, TNF- α , and IL-1 β mRNA expression levels ↓, NQO-1 and SOD levels ↑ KEAP1 protein levels ↓	white adipose tissue weight ↓ adipocyte deformation and inflammation ↓ UCP1 protein levels ↑	ZO-1, Claudin-1, and Occludin mRNA expression levels ↑	<i>Harryflintia</i> , <i>Intestinimonas</i> , <i>Helicobacter</i> , <i>Angelakisella</i> , <i>Mucispirillum</i> , and <i>Ruthenibacterium</i> ↓ <i>Streptococcus</i> and <i>Alistipes</i> ↑	propionic acid, isobutyric acid, and valeric acid ↑ hexanoic acid ↓

Supplementary table S2 Effects of oral administration of a strain (belonging to the *Bifidobacterium*) on mice fed a high-fat diet

Refer-ences	Species	Sex	Age or weight	Probiotic/Potential Probiotic	Resources	Bacterial concentration	Treatment cycle	Body weight and serum biochemical indicators	Liver	Adipose tissue	Intestinal	Gut microbe	SCFA and BA content
Rahman et al., 2021 [135]	C57BL/6 mice	male	6 weeks old	<i>Bifidobacterium longum</i> subsp. <i>infantis</i> YB0411	isolated from infant stools	1×10^9 cells/kg	7 weeks	body weight ↓	not found	visceral and epididymis white adipose tissues lipid droplet area ↓	not found	not found	not found
Kou et al., 2023 [136]	C57BL/6J mice	male	4-6 weeks old	<i>Bifidobacterium longum</i> subsp. <i>infantis</i> FB3-14	screened from the feces of breastfed healthy infants	1×10^9 CFU / animal / day	8 weeks	body weight ↓ serum TC and LDL-C levels ↓	liver weight ↓ serum LPS, IL-6, IL-1β, TNF-α levels ↓	epididymal fat weight ↓ adipocyte size ↓ IL-6 and TNF-α mRNA expression levels ↓	ADIPOR1, ADIPORQ mRNA expression levels ↑	Firmicutes/Bacteroides ratio ↓ Verrucomicrobiota, unclassified_Muribaculaceae, <i>Akkermansia muciniphila</i> , <i>Bifidobacterium</i> , <i>Lachnospiraceae_NK4A136_group</i> , unclassified_Oscillospiraceae ↑	butyric acid ↑
In et al., 2019 [137]	C57BL/6 mice	male	6 weeks old	<i>Lactobacillus plantarum</i> LC27 <i>Bifidobacterium longum</i> LC67	not found	1×10^9 CFU / animal / day	8 weeks	body weight ↓ blood TG, TC, LDL-c, TNF-α, LPS, ALT, AST levels ↓, HDL-c levels ↑	liver weight ↓ TG, TC, TNF-α, LPS, MPO levels ↓ iNOS, p-p65, p-Iκ-Bα, α-SMA protein levels ↓ p-AMPK, Claudin-1, Occludin protein levels ↑	not found	p-AMPK, claudin-1 and occludin protein levels ↑ iNOS, p-p65, p-Iκ-Bα, α-SMA protein levels ↓	Firmicutes/Bacteroidetes ratio ↓ Firmicutes, Bacteroidetes, Proteobacteria, Defferibacteres ↓	not found
Wu et al., 2020 [138]	C57BL/6J mice	male	13 ± 2 g	<i>Bifidobacterium longum</i> subsp. <i>longum</i> BL21	supplied by Wecake-bio Co., Ltd. (Suzhou, China)	1×10^9 CFU / animal / day	8 weeks	body weight ↓ serum TG, TC, LDL-c levels ↓	lipid accumulation ↓	the size of the adipocytes ↓	not found	Firmicutes/Bacteroidetes ratio ↓ <i>Lachnospiraceae</i> , <i>Alistipes</i> , <i>Akkermansia</i> , <i>Bacteroides</i> , <i>Roseburia</i> , <i>Alloprevotella</i> , <i>Oscillibacter</i> , and unidentified_Lachnospiraceae ↑ <i>Lactobacillus</i> , <i>Faecalibaculum</i> , <i>Desulfovibrio</i> , and unidentified_Ruminococcaceae ↓	not found
Lim et al., 2017 [139]	C57BL/6 mice	male	6 weeks old	<i>Bifidobacterium adolescentis</i> IM38	not found	2×10^9 CFU / animal / day	6 weeks	body weight ↓ blood LPS levels ↓	not found	epididymal fat weight ↓	ZO-1, occludin, and claudin-1 protein levels ↑ MAPKs ERK, JNK, and p38, TNF, IL-β	Proteobacteria/Bacteroidetes ratio ↓	not found

											protein levels↓		
Wang et al., 2020 [140]	C57BL/6J mice	male	4 weeks old	<i>Bifidobacterium adolescentis</i> (FSDJN4-N3, HuNan2016 7-2, CCFM8630) <i>Lactobacillus rhamnosus</i> (LGG, FHeNJZ7-1, FJSWX10-1)	isolated from human faeces in China	1×10^9 CFU/mL	23 weeks	body weight ↓ serum TG, TC, LDL-c, ALT, AST changes in different group	TG, TC, LDL-c, TNF- α , IL-1 β , IL-6 changes in different group	not found	ZO-1, occludin, and claudin-1 mRNA expression levels changes in different groups	Firmicutes/Bacteroidetes ratio↓ <i>Clostridium</i> and <i>Streptococcus</i> ↓ <i>Bifidobacterium</i> ↑	Acetic acid, Propionic acid, Butyric acid, Isobutyric acid changes in different groups
Ma et al., 2022 [141]	C57BL/6J mice	male	7 weeks old	<i>Bifidobacterium animalis</i> subsp. <i>lactis</i> LKM512	purchased from Meito Sangyo Co., Ltd. (Tokyo, Japan)	1×10^8 CFU 1×10^9 CFU	12 weeks	plasma TC, TG, NEFA, LPS levels↓ fasting glucose and insulin levels↓	liver weight↓ lipid droplet accumulation↓ ACC, SCD1, PKM2, G6P, F4/80, MCP1, CCL5, IL-6, iNOS mRNA expression levels↓, CPT1 levels↑	IL-6, iNOS mRNA expression levels↓	colon length↑ ZO-1, Claudin1, Occludin protein levels↑ MUC1, MUC2, DEFA, REG3G mRNA expression levels↑ F4/80, MCP1, CCL5, CD11C, CD3, CD4, CD8 mRNA expression levels↓	Proteobacteria, <i>Alistipes</i> , <i>Rikenellaceae RC9 gut group</i> , <i>Rikenella</i> , <i>Ruminococcaceae NK4A214 group</i> , <i>Romboutsia</i> , <i>Peptococcus</i> ↓ <i>Anaerotruncus</i> , <i>Mucispirillum</i> , <i>Lachnospiraceae NK4A136 group</i> , <i>Enterorhabdus</i> , <i>Blautia</i> , <i>Acetatifactor</i> , <i>Butyricicoccus</i> , <i>Faecalibaculum</i> ↑	not found
Zhang et al., 2024 [142]	C57BL/6J mice	male	5 weeks old	<i>Bifidobacterium animalis</i> subsp. <i>lactis</i> MN-Gup	not found	2×10^9 CFU/kg 1×10^{10} CFU/kg	13 weeks	not found	not found	not found	epithelial cell damage and sloughing↓	<i>Bifidobacterium</i> ↑ <i>Escherichia-Shigella</i> and <i>Staphylococcus</i> ↓	acetate↑
Ban et al., 2023 [143]	C57BL/6J mice	male	6 weeks old	<i>Bifidobacterium lactis</i> IDCC 4301	Breast-fed infant's feces	1×10^8 CFU/day 5×10^8 CFU/day	12 weeks	body weight ↓ serum TC, LDL-c, leptin levels ↓	AST, ALT levels↓	adipose tissue weight ↓ adipocyte sizes↓ epididymal adipose tissue FAS, PPAR γ , C/EBP α mRNA expression levels↓, HSL, PPAR α levels↑	not found	not found	not found

Kondo et al., 2010 [144]	C57BL/6J mice	male	5 weeks old	<i>Bifidobacterium breve</i> strain B-3	isolated from the feces of infants	1×10^8 CFU/day 1×10^9 CFU/day	8 weeks	body weight ↓ serum TC, Glucose, Insulin levels ↓	not found	epididymal adipose tissue weight ↓ epididymal fat pad Adiponectin mRNA expression levels ↑	Proglucagon mRNA expression levels ↑	<i>Bifidobacteria</i> ↑	not found
Cano et al., 2013 [145]	C57BL/6 mice	male	6-8 weeks	<i>Bifidobacterium pseudocatenulatum</i> CEC-T 7765	Spanish Type Culture Collection	5×10^8 CFU	7 weeks	body weight ↓ serum TC, TG, glucose, leptin, IL-6, MCP-1, IL-10 levels ↓, IL-4 level ↑ fasting insulin level ↓	steatosis ↓	adipocyte size no significant difference	the number of fat micelles in the enterocytes ↓	<i>Bifidobacterium</i> spp. ↑ Enterobacteriaceae ↓	not found
Rahman et al., 2023 [146]	C57BL/6 mice	male	6 weeks old	<i>Bifidobacterium bifidum</i> DS0908 <i>Bifidobacterium longum</i> DS0950	isolated from human fecal	1×10^9 cells/kg	7 weeks	body weight ↓ serum TG, CHO, LDL levels ↓	not found	adipocyte size ↓	not found	not found	not found

Supplementary table S3 Effects of oral administration of a strain (other probiotics / potential probiotic) on mice fed a high-fat diet

References	Species	Sex	Age or weight	Probiotic/Potential Probiotic	Resources	Bacterial concentration	Treatment cycle	Body weight and serum biochemical indicators	Liver	Adipose tissue	Intestinal	Gut microbe	SCFA and BA content
Huang et al., 2023 [147]	C57BL/6J mice	male	5 weeks old	<i>Bacillus coagulans</i> BC69	isolated from thick broad bean sauce	3×10 ⁵ CFU	16 weeks	body weight↓ serum TNF-α level↓	liver weight↓ inflammatory cell infiltration↓	not found	not found	<i>Bifidobacterium</i> ↑ <i>Ileibacterium</i> , <i>Dubosiella</i> ↓	acetate and butyrate↑
Kim et al., 2018 [148]	C57BL/6J mice	male	5 weeks old	<i>Bacillus sonorensis</i> JJY12-3 <i>Bacillus paralicheniformis</i> JJY12-8 <i>Bacillus sonorensis</i> JJY13-1 <i>Bacillus sonorensis</i> JJY 13-3 <i>Bacillus sonorensis</i> JJY 13-8	isolated from long-term fermented soybean paste	1 x 10 ⁸ CFU/day	13 weeks	body weight↓ liver weight↓ TNFα, INFγ, MCP-1, IL-12 mRNA expression levels↓ fat deposition↓ PGC1α protein level↑	liver weight↓ TNFα, INFγ, MCP-1, IL-12 mRNA expression levels↓ fat deposition↓ PGC1α protein level↑	subcutaneous adipose tissue, mesenteric adipose tissue, interscapular adipose tissue↓ TNFα, INFγ, MCP-1, IL-6 CD36, LDLR, SREBP1c, ACC, FAS, SCD1 mRNA expression levels↓	tight junction-associated proteins, Occludin, ZO-1 mRNA expression levels↑	<i>Bacteroides</i> ↓	acetate↓
Wang et al., 2019 [149]	C57BL/6J mice	male	6 weeks old	<i>Bacillus amyloliquefaciens</i> SC06	stored in China Center for Type Culture Collection (No. M 2012280)	1 x 10 ⁸ CFU/g	8 weeks	serum leptin, IL-6, TNF-α levels↓	steatosis↓ CAT level↑, MDA level↓	subcutaneous fat weight ↓ size of adipocytes↓	not found	Firmicutes/Bacteroidetes ratio↓ <i>Prevotella</i> ↓	not found
Hashemnia et al., 2023 [150]	C57BL/6J mice	male	6 weeks old	<i>Bacillus coagulans</i> T4	IBRC-N1 0791	1 x 10 ⁹ CFU / animal / day	18 weeks	body weight↓ fasting glucose levels↓ serum TG, insulin, Leptin, Resistin levels↓	not found	visceral fat and subcutaneous fat weight↓ SAT Adgre1, IL-1β, IL-6, Adipoq, TLR2, TLR4, SREBP1, FASN, CPT1A mRNA expression levels↓, Mrc1, Arg1, Itgax, Nos2, IL-10 levels↑ EAT Adgre1, Nos2, Itgax, TNF, IL-1β, IL-6, CCL2, Adipoq, TLR4 mRNA expression levels↓, Mrc1, Arg1, IL-10, SREBP1, FASN, ACACA, CPT1A levels↑ white adipose tissue	not found	Firmicutes/Bacteroidetes ratio↓ <i>Lactobacillus</i> and <i>Faecalibacterium</i> ↑	Propionate and acetate↑

Cao et al., 2019 [151]	C57B-L/6J mice	male	8 weeks old	<i>Bacillus licheniformis</i>	obtained from the SLAC Laboratory Animal Central (Changsha, China)	1 x 10 ⁸ CFU / animal / day	8 weeks	body weight↓ serum TG levels↓	TG levels↓	Epididymal fat weight↓	not found	<i>Bilophila</i> , <i>Bacillus</i> , <i>Enterorhabdus</i> , <i>unidentified_Rumi-nococcaceae</i> , and <i>Marvinbryantia</i> ↑	not found
Wen et al., 2024 [152]	C57B-L/6J mice	male	8 weeks old	<i>Bacteroides vulgatus</i>	not found	6-7 × 10 ⁸ CFU/mL	12 weeks	body weight↓ serum TC, TG, HDL-c, LDL-c levels↓	liver weight↓	epididymal adipocyte size ↓	chylomicron uptake↓	not found	not found
Li et al., 2024 [153]	C57B-L/6J mice	male	25.0-27.0 g	<i>Bacteroides thetaiotaomicron</i> ATCC 29,148	derived from ATCC	1 x 10 ⁸ CFU / animal / day	12 weeks	body weight↓ serum TG, CHO levels↓ non-fasting blood glucose and fasting insulin levels↓	liver index↓ TG, CHO levels↓ palmitoleic/7-hexa decenoic acid (C16:1) levels↓	not found	not found	Firmicutes/Bacteroidetes ratio↓	not found
Sun et al., 2024 [154]	C57B-L/6J mice	male	4-5 weeks old	<i>Bacteroides ovatus</i>	isolated from 20 healthy Chinese people	2 x 10 ⁹ CFU	12 weeks	body weight↓ serum LPS, CD163, IL-1β, TNF-α levels↓	liver weight↓ hepatic steatohepatitis↓ PPARα mRNA expression level↑, FASN, SCD1, ACACA, SREBF1 levels↓	not found	not found	Firmicutes/Bacteroidetes ratio↓ <i>Ruminococcus_torques_group</i> , <i>Ruminococcus_ga-uvreauui_group</i> , <i>Erysipelatoclostridium</i> ↓ <i>Lachnospiraceae</i> NK4A136_group, <i>norank_f__Oscillospiraceae</i> , <i>Colidextribacter</i> ↑	not found
Wang et al., 2020 [155]	C57B-L/6N mice	male	9 weeks old	<i>Pediococcus pentosaceus</i> PP04	isolated from the Northeast pickled cabbage (China)	1 x 10 ⁹ CFU / animal / day	8 weeks	body weight↓ serum TC, TG, LDL-c, FFA, Leptin, MDA levels↓, SOD, GSH-Px levels↑	TC, TG, SOD, GSH-Px levels↑ p-AMPK, p-ACC1, MTP, PPARα, CPT1, NRF2 protein levels↑ SREBP-1c, FAS, SCD1, CYP2E1 protein levels↓	epididymal fat index and perirenal fat index↓	not found	not found	not found

Wang et al., 2021 [156]	C57BL/6N mice	male	9 weeks old	<i>Pediococcus pentosaceus</i> PP04	isolated from the Northeast pickled cabbage (China)	1 x 10 ⁹ CFU / animal / day	8 weeks	not found	not found	not found	Occludin, Claudin-1 and ZO-1, NRF2 protein levels↑ TLR4, MyD88, pIκB-α/IκB-α, pNF-κB/NF-κB, CYP2E1 protein levels↓ IL-6, IL-1β, CYP2E1 mRNA expression levels↓, HO-1, NQO1 level↑ CAT, SOD levels↑	Firmicutes/Bacteroidetes ratio↓ <i>Pediococcus</i> , <i>Coprococcus</i> , <i>Allobaculum</i> , <i>Faecalibacterium</i> and <i>Butyricicoccus</i> ↑ <i>Bacteroides</i> and <i>Pseudomonas</i> ↓	not found
Yang et al., 2022 [157]	C57BL/6 mice	male	6 weeks old	<i>Clostridium cochlearium</i>	isolated and obtained from the Department of Nutrition and Food Science Wayne State University	2 x 10 ⁹ CFU / animal / day	17 weeks	body weight↓ fasting blood glucose, Insulin↓	not found	fat mass↓	not found	not found	Acetate, Propionate, Butyrate ↓
Luo et al., 2024 [158]	C57BL/6J mice	male	4 weeks old	<i>Clostridium tyrobutyricum</i> ATCC25755	Ohio State University	1 x 10 ⁷ CFU / mL 1 x 10 ⁸ CFU / mL	12 weeks	body weight↓ serum TG, LDL-c levels↓	liver weight↓ TC, TG, NEFA levels↓ PPARγ mRNA expression levels↓, AMPK, PPARα, HSL levels↑	not found	Villus height and the V/C, colon length↑ TNF-α, IL-1β, and IL-6 mRNA expression levels↓, IL-10, Occludin levels↑	<i>Deferribacteres</i> , <i>Blautia</i> and <i>Mucispirillum</i> ↓ <i>Colidextribacter</i> , <i>Intestinimonas</i> , <i>Acetatifacter</i> , <i>Lachnospiraceae</i> <i>NK4A136_group</i> , <i>GCA-900066575</i> , and <i>Tuzzerella</i> ↑	Propionic acid↑
Benvenuti et al., 2023 [159]	C57BL/6J mice	male	5 weeks old	<i>Enterococcus faecium</i> SF68	not found	1 x 10 ⁸ CFU / animal / day	8 weeks	body weight↓ plasm IL-1β↓	not found	not found	acidic mucins level↑ tight junction protein, NF-κB level↑ TLR4 protein levels↓ SMCT1 protein levels↑	Firmicutes and Bacteroides↓	not found
Xu et al., 2023 [160]	C57BL/6J mice	male	8 weeks old	<i>Blautia producta</i>	Beijing QuantHealth Technology Co., Ltd. (Beijing, China)	1 x 10 ⁹ CFU / 0.2 mL	8 weeks	body weight↓ blood TG, TC, and LDL-c levels↓	liver TG and TC levels↓	lipid accumulation↓	not found	<i>Akkermansia</i> ↑ <i>Desulfovibrio piger</i> and <i>Desulfovibrio</i> sp. G11↓	not found

Castro-Rodriguez et al., 2020 [161]	C57BL/6 mice	male	5-6 weeks old	<i>Leuconostoc mesenteroides</i> subsp. <i>mesenteroides</i> SD23	isolated from aguamiel of Agave salmiana	1×10^{10} CFU/mL	14 weeks	body weight↓ serum Glucose, TC, Leptin levels↓	fat liver area↓ SREBP-1c, FAS, TLR4, CD14, TNF- α mRNA expression levels↓, IL-10 level↑	adipose tissue weight↓ adipocyte area↓	Villus height and width, crypts depth↓, goblet cells↑	not found	not found
Huang et al., 2025 [162]	C57BL/6 mice	male	5 weeks old	<i>Roseburia hominis</i> A2-183	obtained from the Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures	1×10^9 CFU	11 weeks	body weight↓ serum TC, TG levels↓	lipid accumulation ↓ TG, ALT, AST levels ↓	adipocyte diameter↓ white adipose tissue area↓ brown adipose tissue CIDEA mRNA expression levels↑	not found	<i>Faecalibacterium prausnitzii</i> , <i>Dysosmobacter welbionis</i> , <i>Parabacteroides goldsteinii</i> , and <i>Lactobacillus johnsonii</i> ↑ <i>Olsenella</i> ↓	not found
Lu et al., 2024 [163]	C57BL/6 mice	male	6-8 weeks old	<i>Coprococcus</i>	not found	1×10^9 CFU / animal / day	16 weeks	serum ALT, TC, LDL-c levels↓	liver lipid accumulation, inflammation, and fibrosis↓ TG level↓ FASN, SCD1, CD36, TNF- α , IFN γ , TIMP1 mRNA expression levels↓	not found	not found	not found	not found
Wu et al., 2023 [164]	C57BL/6 mice	male	6 weeks old	<i>Akkermansia muciniphila</i> MucT (ATCC BAA-835)	purchased from ATCC	1.5×10^9 CFU	21 weeks	body weight↓ serum ALT, AST levels↓	liver weight↓ TG, insulin, leptin and resistin level↓ FGFR4 mRNA expression levels↑, CYP7A levels↓	subcutaneous, mesenteric, and epididymal white adipose tissue↓	Occludin, TJP1, FXR, SHP, FGF15 mRNA expression levels↑, TNF- α , F4/80 levels↓	<i>Alistipes</i> , <i>Lactobacilli</i> , <i>Tyzzerella</i> , <i>Butyricimonas</i> and <i>Blautia</i> ↓ <i>Ruminiclostridium</i> , <i>Oscilibacter</i> , <i>Allobaculum</i> , <i>Anaeroplasm</i> and <i>Rikenella</i> ↑	total BAs↓ DCA and LCA levels↓