Sacha inchi oil alleviates gut microbiota dysbiosis and improves lipid dysmetabolism in high-fat diet-fed rats

Pan Li [1], Jianzhao Huang [1], Nan Xiao [1], Xin Cai [1], Yunyun Yang [3], Jiewei Deng [4], Lian-Hui Zhang [2,*], Bing Du [1,*]

Short title: Sacha inchi oil improves lipid dysmetabolism

[1]College of Food Science, South China Agricultural University, Guangzhou 510642, China;
[2]Guangdong Province Key Laboratory of Microbial Signals and Disease Control, Integrative Microbiology Research Centre, South China Agricultural University, Guangzhou 510642, China;
[3]Guangdong Engineering and Technology Research Center for Ambient Mass Spectrometry, Guangdong Provincial Key Laboratory of Emergency Test for Dangerous Chemicals, Guangdong Institute of Analysis (China National Analytical Center Guangzhou), 100 Xianlie Middle Road, Guangzhou 510070, China;
[4]State Key Laboratory of Biocontrol, South China Sea Bio-Resource Exploitation and Utilization Collaborative Innovation Center, School of Life Sciences, Sun Yat-Sen University, 135 Xingangxi Road, Guangzhou 510275, China

[*] **Corresponding authors:** Bing Du, Fax number: 020-85283592, Telephone number: +86-13929522370, E-mail address: dubing@scau.edu.cn; Lian-Hui Zhang, Email address: Lhzhang01@scau.edu.cn.

Online supplementary Figures

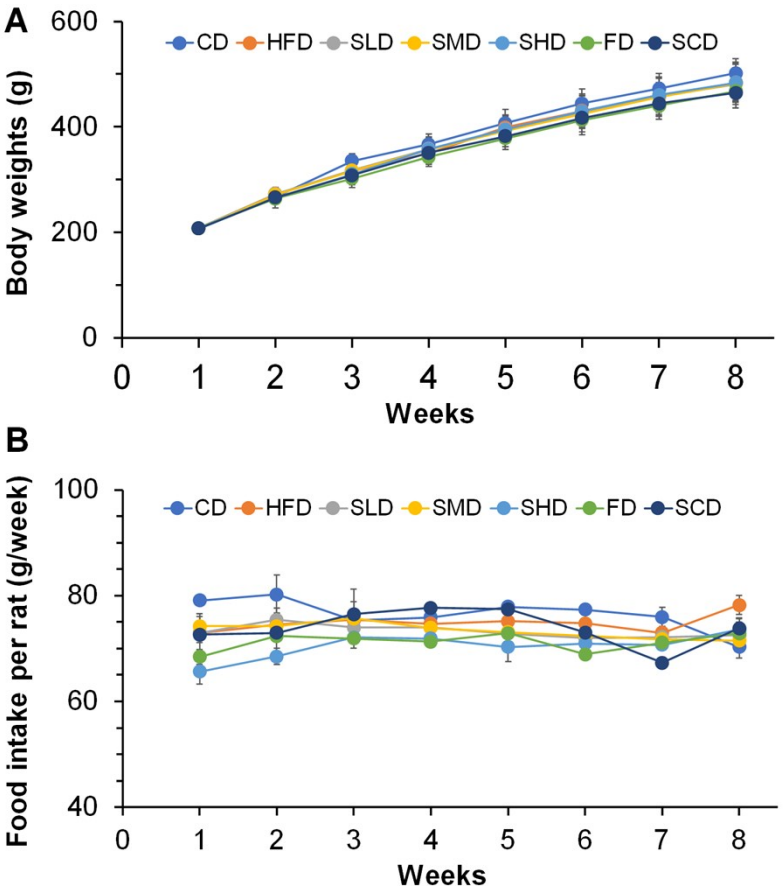

Figure S1. Changes in body weight and food intake in rats for 8 weeks. (A) Body weight (a), Weekly food intake per rat per week (B).

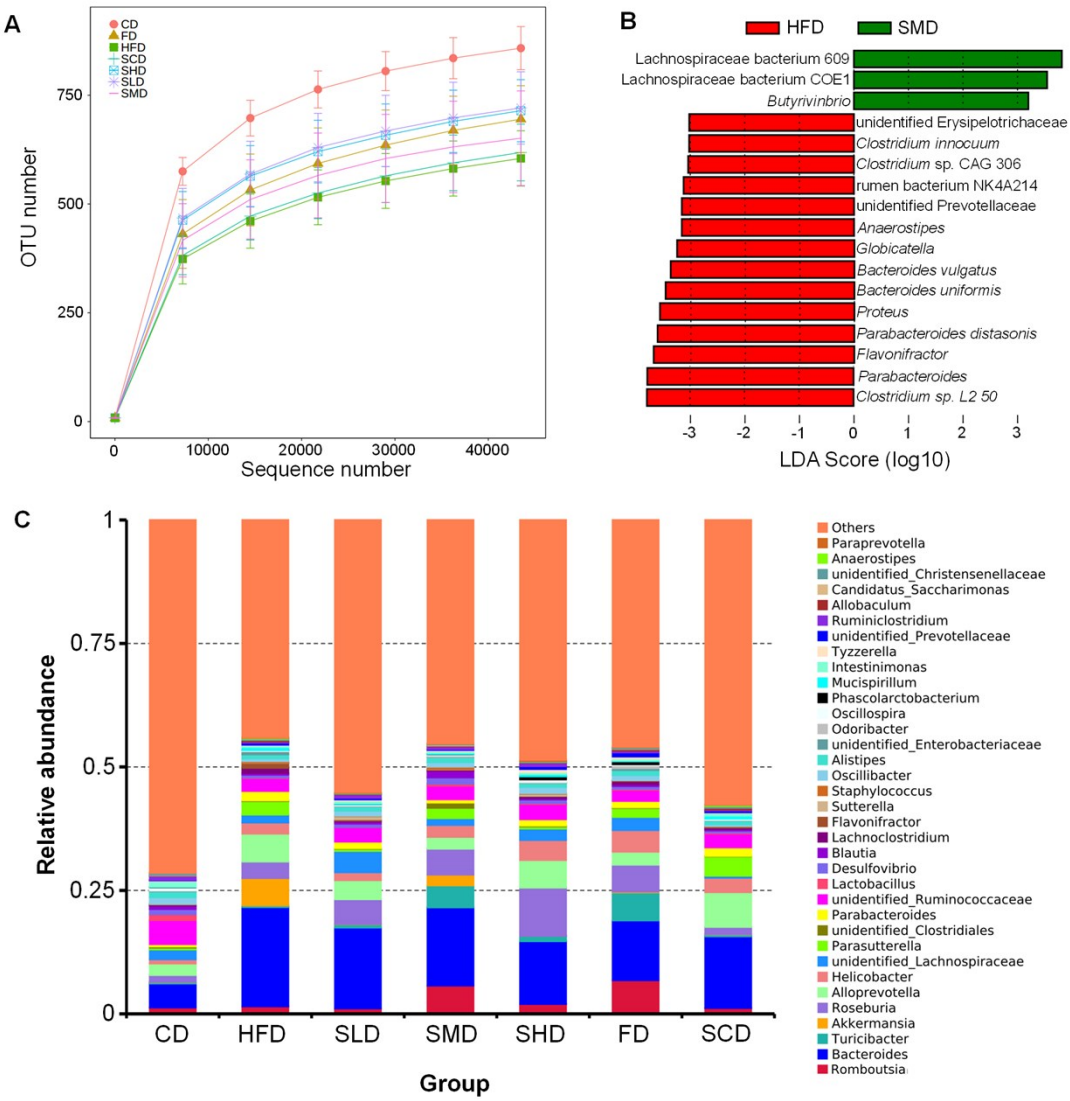

Figure S2. The rarefaction curves approached the saturation plateau (A); LEfSe analysis between SMD and HFD (B), bars represent bacterial taxa; microbiota compositions at the genus level (C).

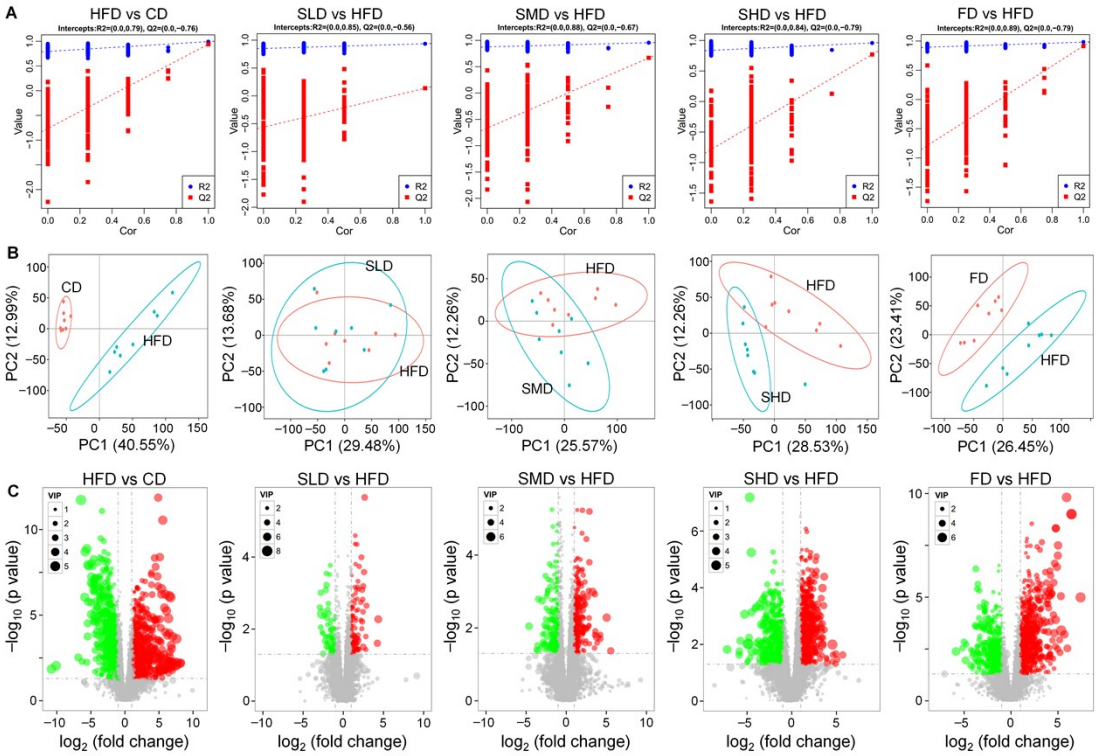

Figure S3. Validation of PLS-DA model based on faecal metabolic profiles (A), indicating no overfitting phenomenon between each comparisons; The PLS-DA scores plot based on faecal metabolic between each comparisons (B); Volcano plots of fold change (log 2) values of all metabolites among different comparisons (C), significant up-regulated metabolites are labeled in red, while significant down-regulated metabolites are labeled in green.

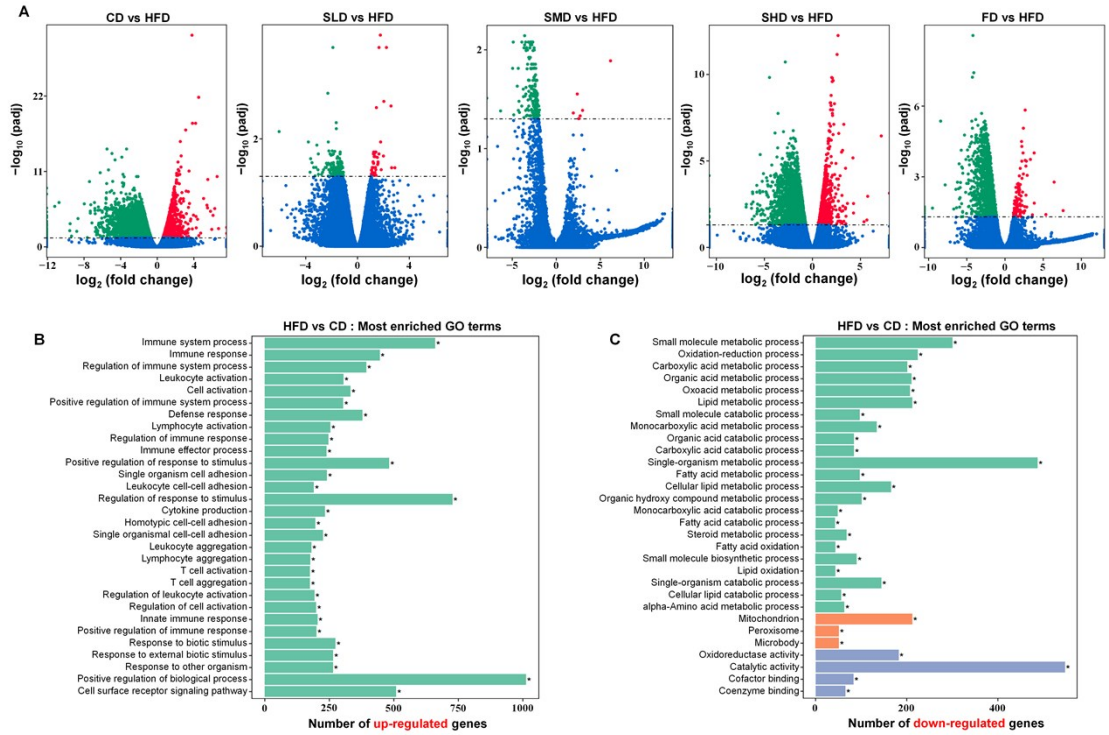

Figure S4. Volcano plots of fold change (log 2) values of all genes among different comparisons (C), significant up-regulated genes are labeled in red, while significant down-regulated genes are labeled in dark-green; GO enrichment analysis for biological processes of up-regulated (B) and down-regulated (C) genes between HFD and CD.

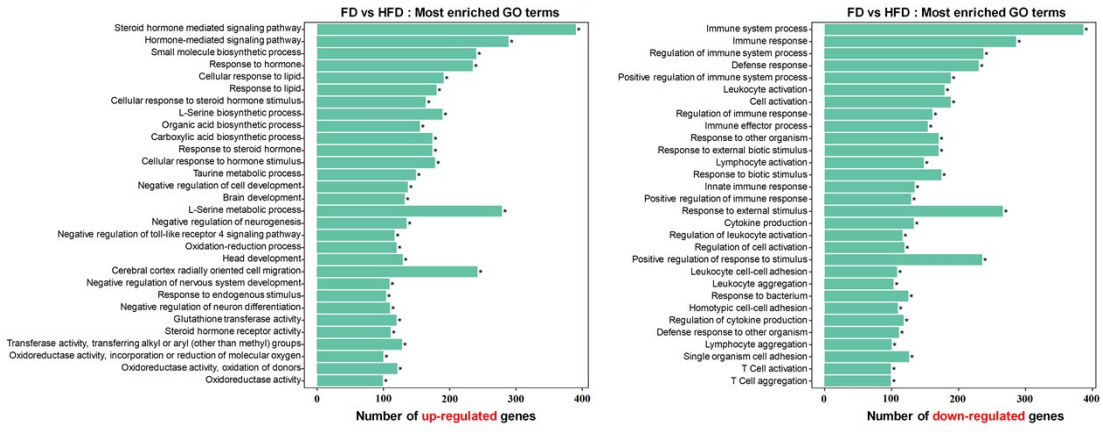

Figure S5. GO enrichment analysis for biological processes of up-regulated and down-regulated genes between FD and HFD.

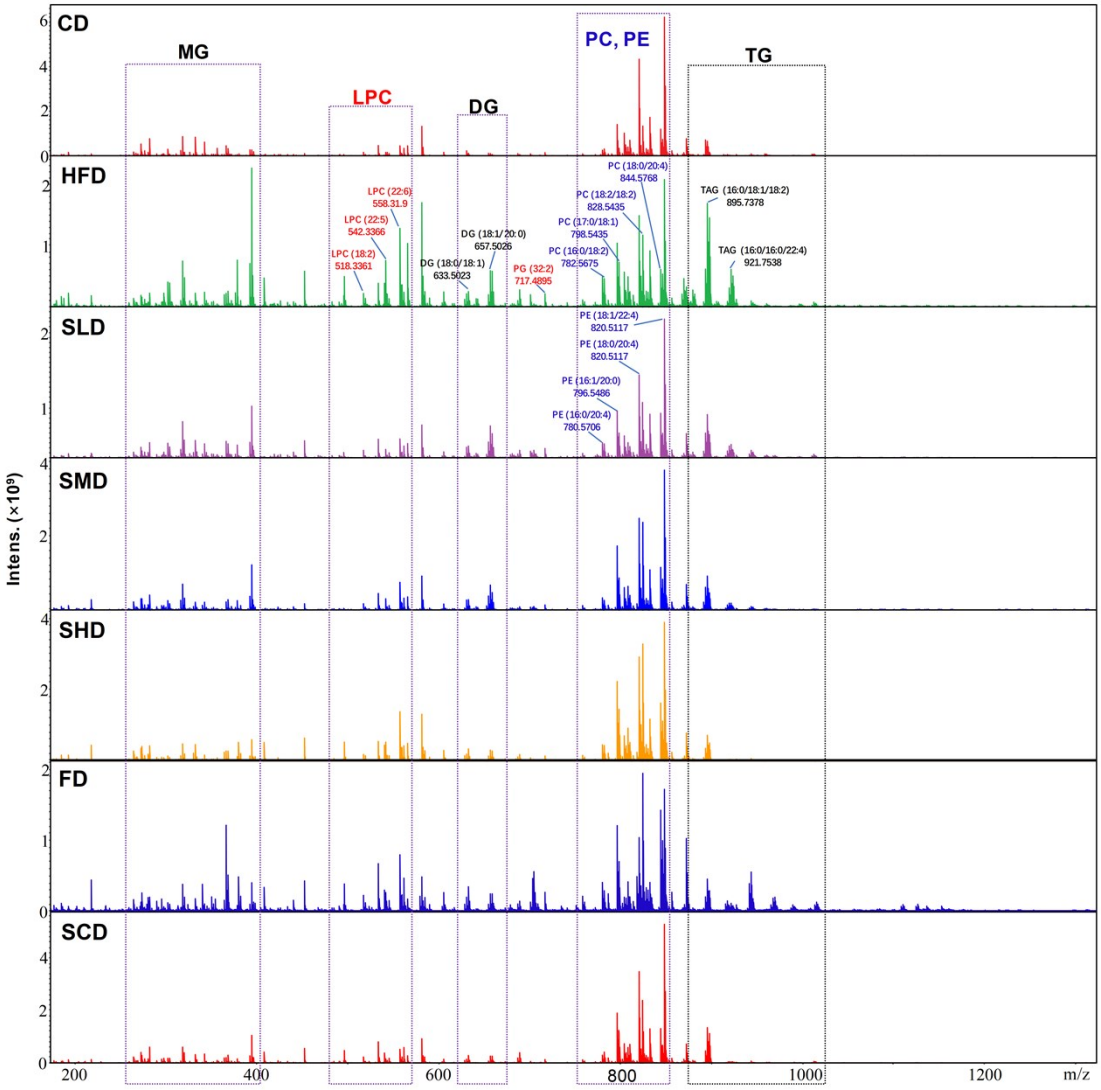

Figure S6. The comprehensive hepatic lipidome analysis by nanoESI-MS/MS. The nanoESI-MS spectra of lipids in each group were shown, indicating the altered lipid levels after sacha inchi oil treatments in HFD-fed rats.

Online supplementary Tables

Table S1 The nutrients compositions of research diets in this study.

Compositions	**HF45**		**LF10B**	
	gm%	kcal%	gm%	kcal%
Proteins	24	20	19.2	20
Carbohydrates	41	35	67.3	70
Fats	**24**	**45**	**4.3**	**10**
kcal/gm	4.73		3.85	
	Weight (g)	**Energy (kcal)**	**Weight (g)**	**Energy (kcal)**
Casein	200	800	200	800
L-Cystine	3	12	3	12
Cornstarch	72.8	291.2	452.2	1808.8
Maltodextrin	100	400	75	300
Sucrose	172.8	691.2	172.8	691.2
Cellulose	50	0	50	0
Soybean oil	25	225	25	225
Lard	**177.5**	**1597.5**	**20**	**180**
Minerals (#210088)	10	0	10	0
$CaHPO_4$	13	0	13	0
$CaCO_3$	5.5	0	5.5	0
$C_6H_5K_3O_7 \cdot H_2O$	16.5	0	16.5	0
Vitamins (#300050)	10	40	10	40
Choline bitartrate	2	0	2	0
Red pigments	0.05	0	0.025	0
Yellow pigments	-	-	0.025	0

Table S2 Fatty acid compositions and antioxidants of sacha inchi oil.

Sacha inchi oil			
Fatty acid	**Content (%)**	**Antioxidants**	**Content (mg/100m)**
palmitic acid	3.83±0.15	total polyphenols	14.67±0.10
stearic acid	3.09±0.09	phytosterols	2.21±0.02
oleic acid	**8.39±0.28**	total vitamin E	63.89±0.06
linoleic acid	**38.11±0.20**	□-tocopherol	31.39±0.07
α-linolenic acid	**45.62±0.38**	γ-tocopherol	32.50±0.07
arachidic acid	0.30±0.02		
8-cis-eicosenoic acid	0.34±0.03		
behenic acid	0.12±0.01		
total SFAs	7.43±0.29		
total MUFAs	8.73±0.36		
total PUFAs	83.73±0.52		
total UFAs	92.46±0.48		

Fatty acids and antioxidants were determined as our previously methods.[1]

References

1 P. Li, J. Deng, N. Xiao, X. Cai, Q. Wu, Z. Lu, Y. Yang and B. Du, Identification of polyunsaturated triacylglycerols and C=C location isomers in sacha inchi oil by photochemical reaction mass spectrometry combined with nuclear magnetic resonance spectroscopy, *Food Chem.*, 2020, **307**, 125568.