IOCTO 2025 Conference
The 2nd International Online Conference on Toxics
08–10 September 2025 | Online
MDPI

Role of Akkermansia muciniphila and Its Outer Membrane Vesicles in High-Fat Diet and Nano Titanium Dioxide-Induced Metabolic Dysfunction-Associated Fatty Liver Disease

Ma Ying, Yu Nairui, Zhang Yi, Shi Jiaqi, Zhou Xinyan, Chen Zhangjian *
Department of Occupational and Environmental Health Sciences, School of Public Health, Peking University, Beijing 100191, P.R. China.

INTRODUCTION & AIM

Metabolic dysfunction-associated fatty liver disease (MAFLD) is a common metabolic disorder in which the gut–liver axis plays a central role. Titanium dioxide nanoparticles (TiO_2), widely used as food additives, may influence gut microbiota and host metabolism. Akkermansia muciniphila and its outer membrane vesicles (OMVs) are important regulators of lipid metabolism and intestinal barrier function, yet their interaction with TiO_2 exposure under high-fat diet (HFD) conditions remains unclear. This study investigates how TiO_2 modulates the growth and OMV production of A. muciniphila, and explores the effects of these OMVs on hepatic lipid accumulation. Using in vitro and in vivo experiments, and integrated multi-omics analysis, we aim to elucidate the role of A. muciniphilaand its OMVs in TiO_2-induced alterations of the gut–liver axis and the progression of MAFLD.

RESULTS

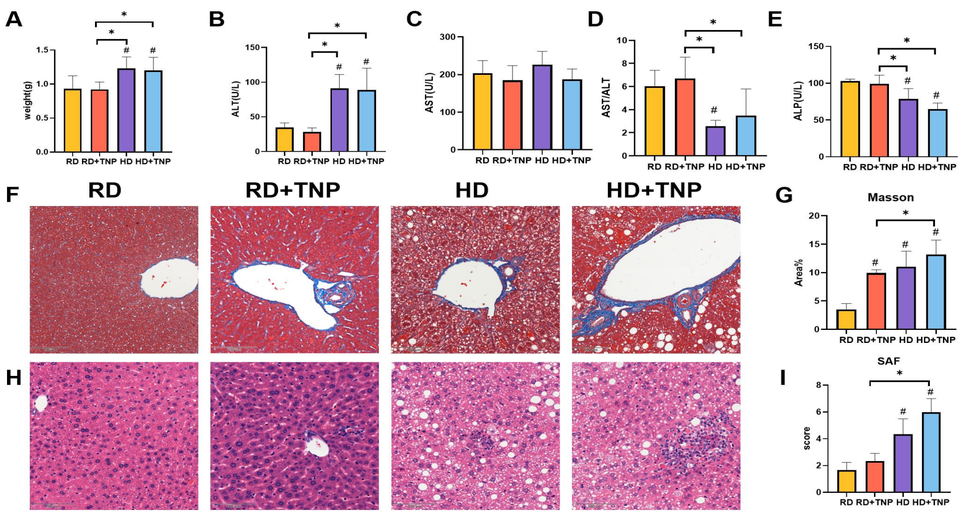

Figure 1. Liver damage caused by TiO_2 NPs and a high-fat diet. A. Body weight of mice; B-E. Blood biochemistry of mice; F-G. Masson results in mice; H. HE results of mice; I SAF results of mice.

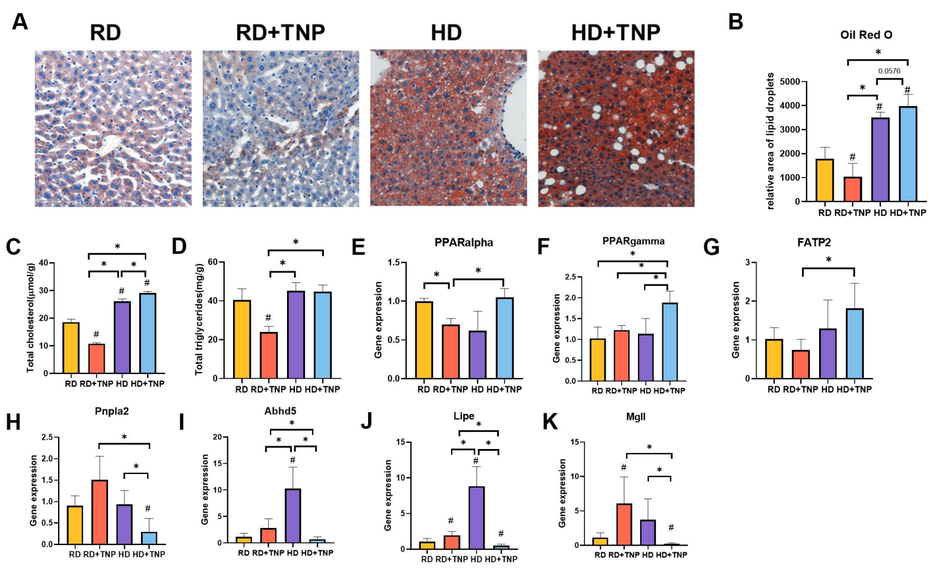

Figure 2. TiO_2 NPs induces distinct hepatic lipid states in the presence or absence of a high-fat diet. A-B. Oil red of mice; C. The total cholesterol level of mice; D. The total triglyceride level of mice; E-G. The gene levels related to lipid generation or degradation.

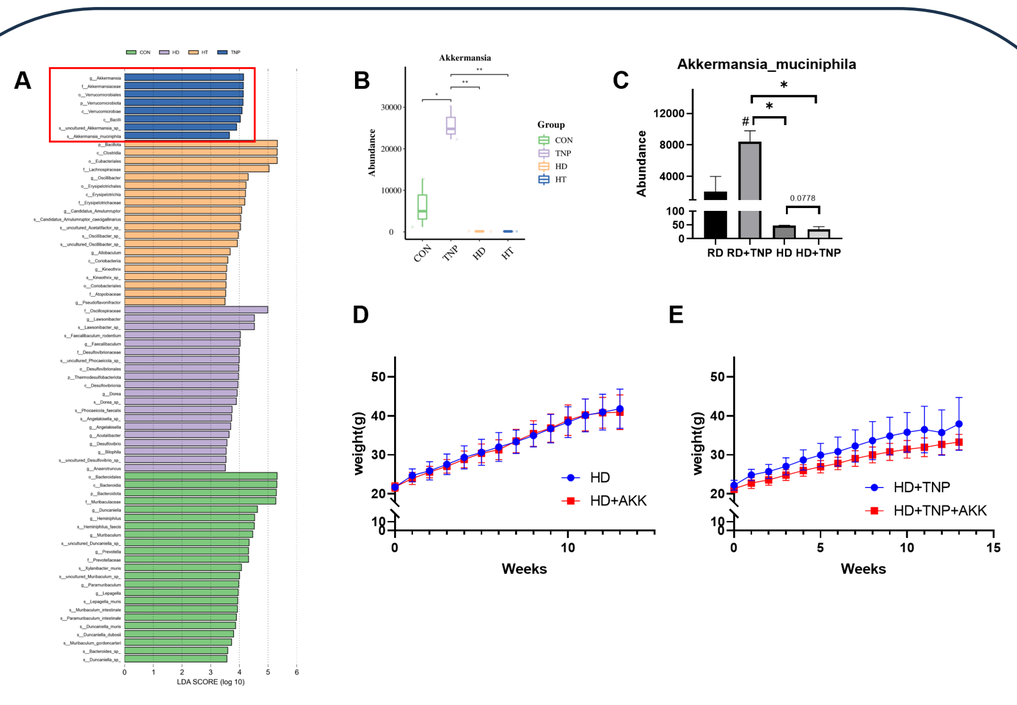

Figure 3. Akkermansia muciniphila is a key gut bacterium in regulating hepatic lipid metabolism. A-C. Metagenomic results in mice; D-E. The total cholesterol level of mice; D. The total triglyceride level of mice; E-G. Body weight changes over 13 weeks with oral A. muciniphila treatment.

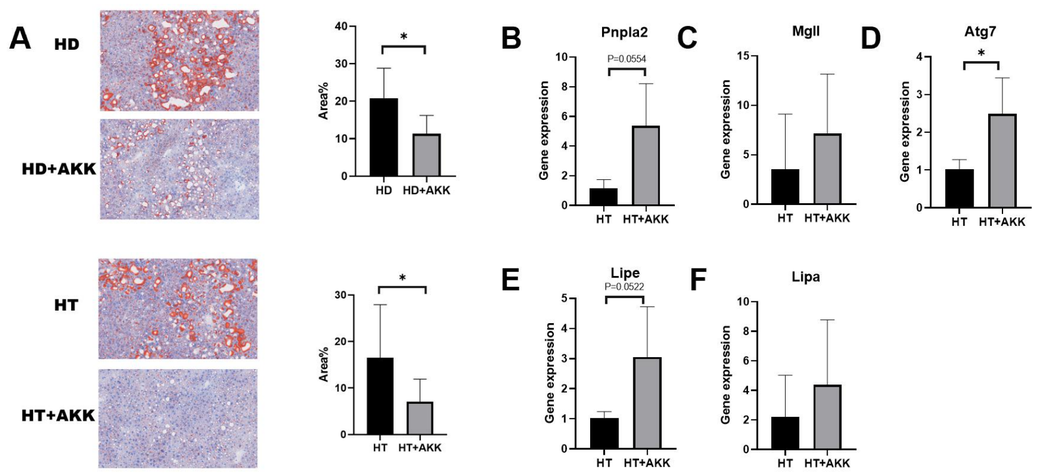

Figure 4. Oral A. muciniphila alleviates hepatic lipid accumulation. A. Oil red of mice; B-F. The gene levels related to lipid degradation.

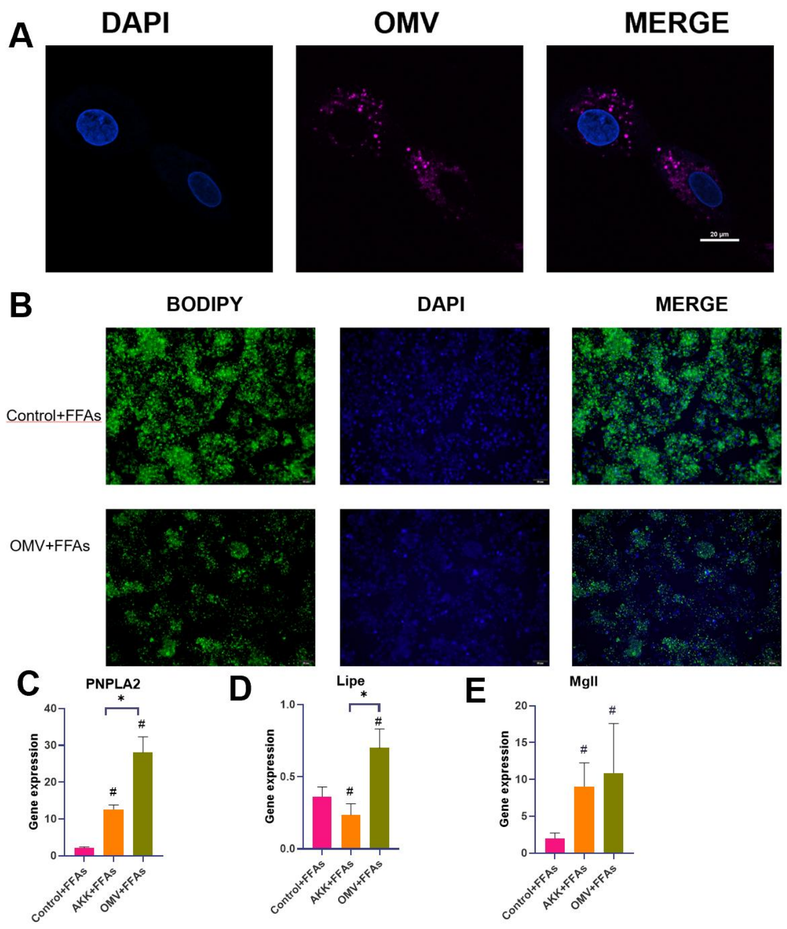

Figure 5. Akkermansia muciniphila alleviates lipid accumulation in hepatocytes. A. OMV uptake by HepG2 cells; B. A. muciniphila reduces lipid accumulation in hepatocytes; C-E The gene levels related to lipid degradation.