A Multi-mics Study of Hypoglycemic Mechanism of *Spirulina Platensis* Polysaccharide and Its Selenide in Type 2 Diabetic Mice

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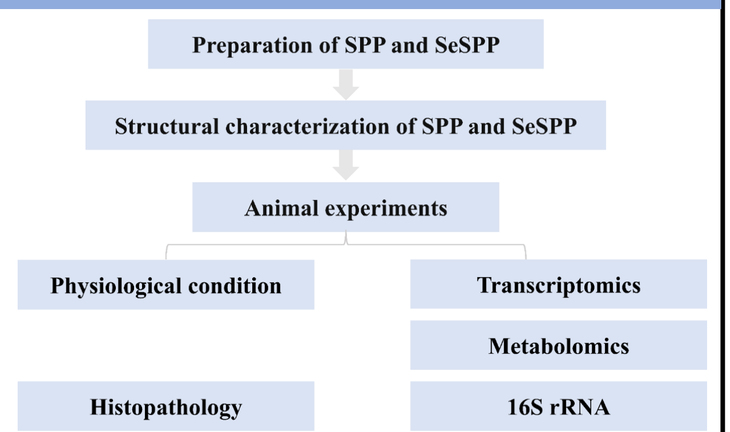
Absrtact

Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterized by hyperglycemia and insulin resistance, often associated with imbalances in gut microbiota and dysregulated metabolic pathways. In this study, we prepared *Spirulina platensis* polysaccharides (SPP) and selenium-enriched SPP (SeSPP), and assessed their structural properties and hypoglycaemic functions both *in vitro* and *in vivo*. The interaction between SPP and selenium primarily occurred in the forms of Se-O-C and O-Se-O through covalent interactions. *In vitro* and *vivo* assays demonstrated that SeSPP exhibited significantly enhanced hypoglycaemic and antioxidant properties compared to SPP. Additionally, both SPP and SeSPP significantly improved the gut microecological balance. Multi-omics analysis revealed that their hypoglycemic effects were mediated through the regulation of lipid and carbohydrate metabolism, as well as cellular signaling pathways. In conclusion, SPP demonstrated strong potential as a dietary supplement or adjunctive therapy for T2DM, leveraging multi-target and multi-pathway mechanisms to alleviate metabolic disorders.



Backgrounds

1. T2DM, as a complex chronic metabolic disease, poses a major challenge to global health.
2. Natural polysaccharides, as an important class of bioactive compounds, exhibit significant potential in T2DM treatment due to their diverse sources, excellent biocompatibility, low toxicity, and minimal side effects. Selenium modification has emerged as an effective strategy, significantly enhancing the bioactivity of polysaccharides
3. Although functional polysaccharides have become a research hotspot due to their wide range of bioactivities, their activity mechanisms have not been thoroughly elucidated. The integrated application of multi-omics technologies provides new ideas for breaking through this bottleneck.

Results

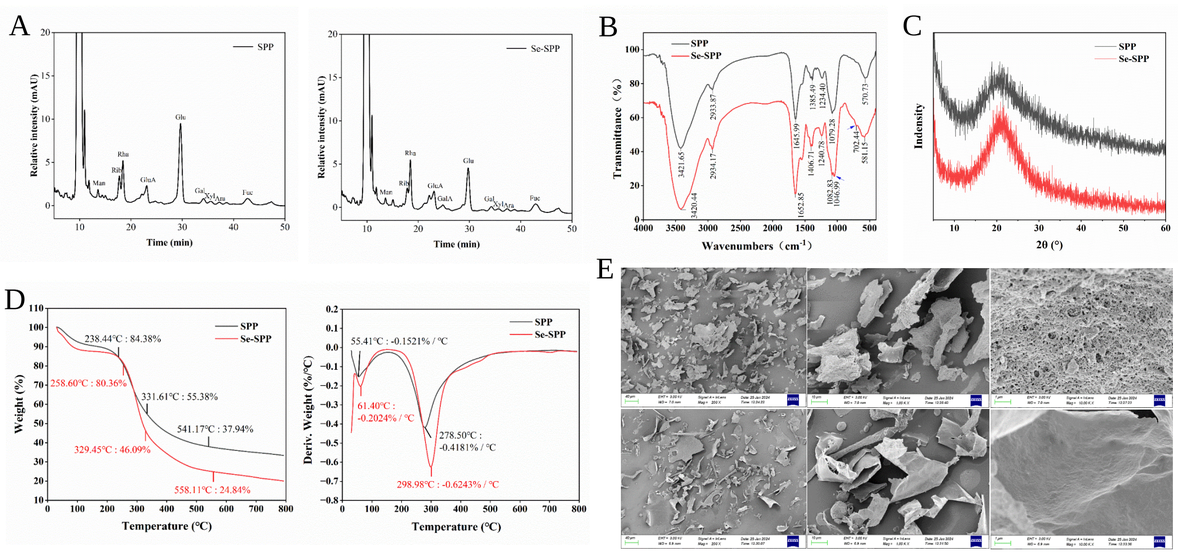


Fig. 1. Structural characterizations of SPP and SeSPP

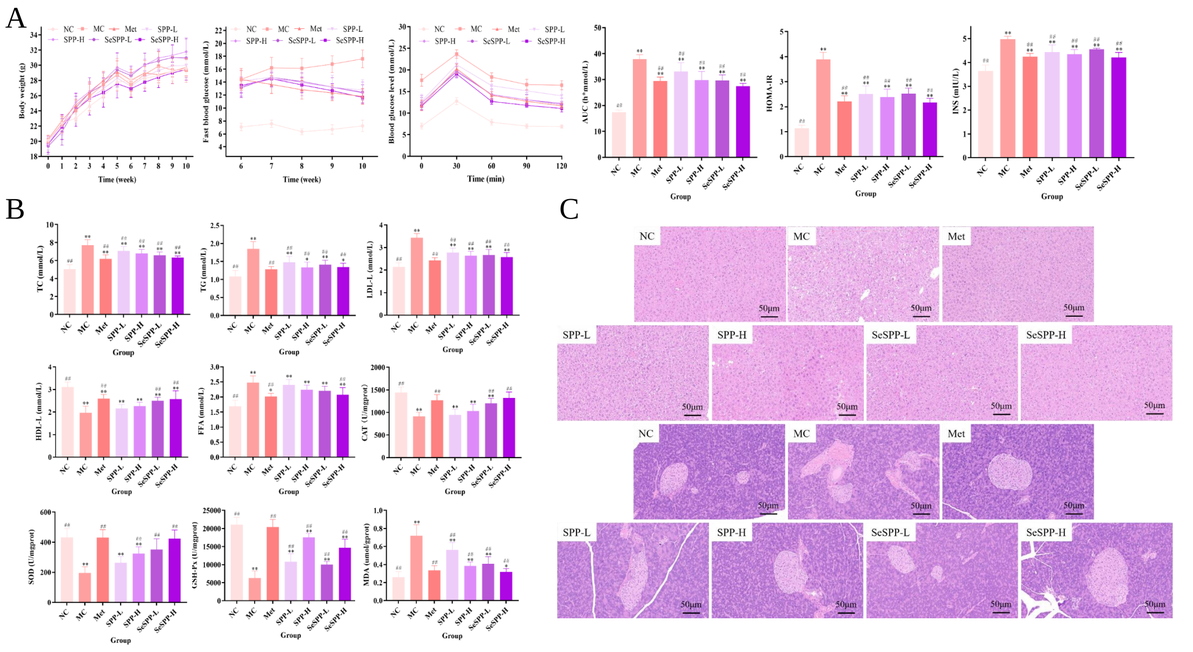
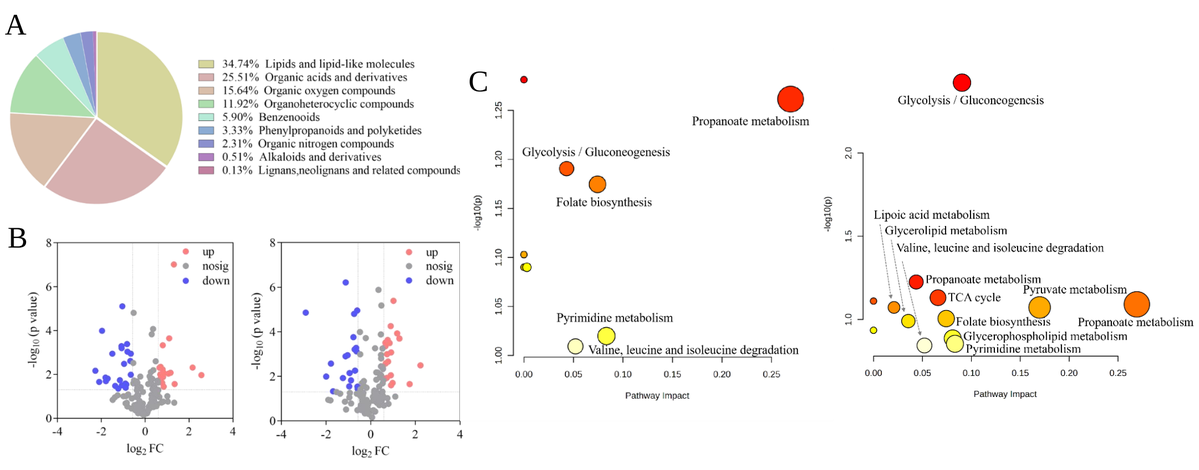


Fig. 2. Effects of SPP and SeSPP on T2DM



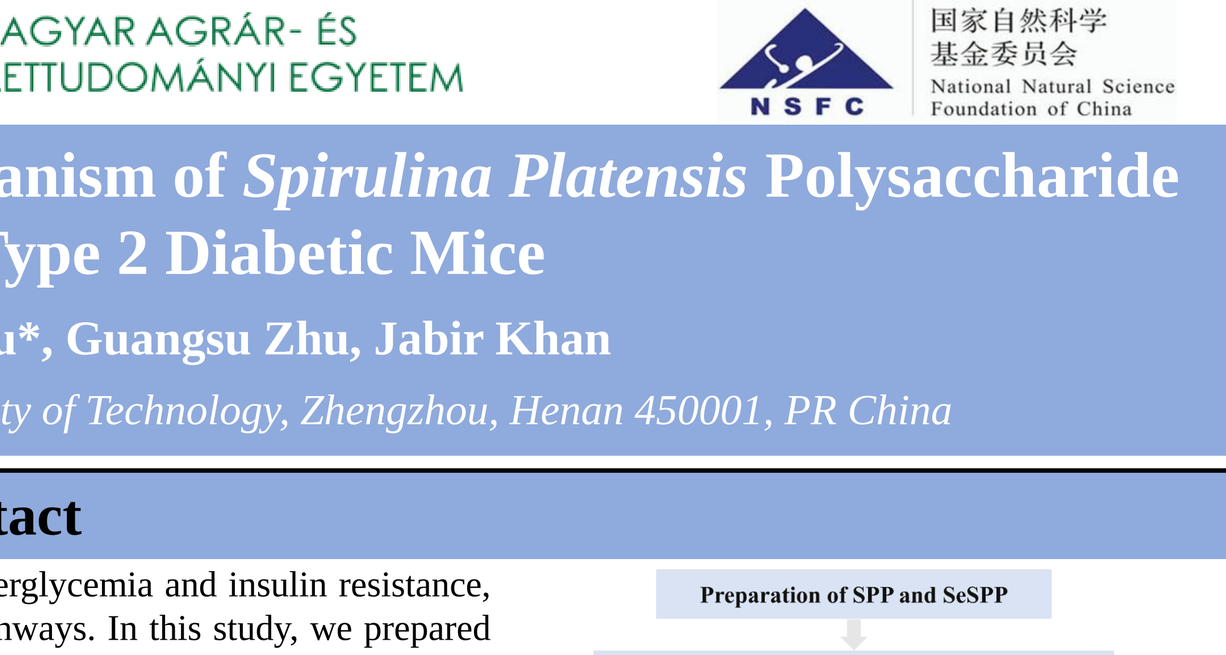


Fig. 3. Effects of SPP and SeSPP on the differentially metabolites and differentially expressed genes in the liver of T2DM mice

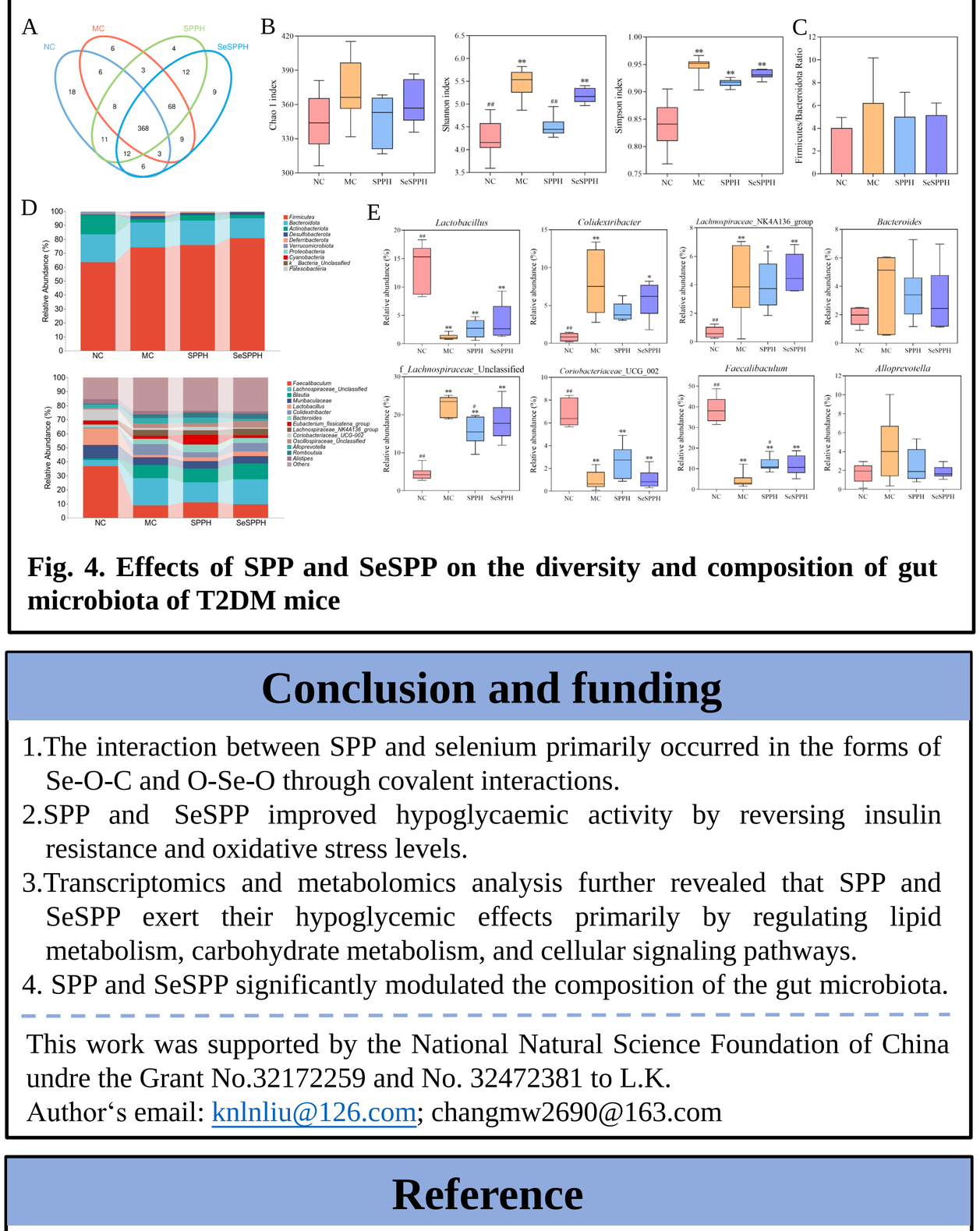


Fig. 4. Effects of SPP and SeSPP on the diversity and composition of gut microbiota of T2DM mice

Conclusion and funding

1.The interaction between SPP and selenium primarily occurred in the forms of Se-O-C and O-Se-O through covalent interactions.
2.SPP and SeSPP improved hypoglycaemic activity by reversing insulin resistance and oxidative stress levels.
3.Transcriptomics and metabolomics analysis further revealed that SPP and SeSPP exert their hypoglycemic effects primarily by regulating lipid metabolism, carbohydrate metabolism, and cellular signaling pathways.
4. SPP and SeSPP significantly modulated the composition of the gut microbiota.

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Reference

[1] Chang, M., Liu, K., Zhu, G., Gul, P., & Khan, J. Structural characterization and hypoglycaemic effects on type 2 diabetic mice of *Spirulina platensis* polysaccharides and Se-modified polysaccharides. *Food Bioscience*, 2025, *64*, 105826.