Polymerization level of dietary fructans differentially affect the intestinal microbiota interactions

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Objective: Fructans as dietary carbohydrates have been shown to be selectively utilized by the intestinal microbiota to confer health benefits, with though the specific impact of different types of fructans on microbial changes and functions still unclear. Here, we aimed to investigate the varying effects of fructans with different polymerization degrees on the gut microbiota in the context of colitis-associated gut dysbiosis.

Design: This study employed a colitis mouse model to trigger intestinal inflammation and microbiota dysbiosis. The effects of low molecular weight fructo-oligosaccharides (FOS) and high molecular weight levan on disease progression, gut inflammation, fibrosis, and gut microbiota were assessed. Multi-omics technologies, including 16S rRNA gene sequencing, metagenomics, and targeted metabolomics, were utilized to analyze the compositional and functional changes in the gut microbiota in response to dietary interventions.

Results: Both FOS and levan showed inhibitory effects on intestinal inflammation in colitis mice, effectively mitigating intestinal fibrosis and dysbiosis. Notably, levan demonstrated superior therapeutic efficacy than FOS. Interestingly, distinct patterns of microbiota modulation were observed depending on the degree of polymerization of the fructans. FOS primarily enriched the bacteria involved in the production of short-chain fatty acids (SCFAs), while levan further increased the diversity and richness of the intestinal microbiota. A specific bacterium, *Dubosiella newyorkensis*, was specifically promoted by levan and demonstrated therapeutic effects against colitis, which exhibited similar microbiota-modulating effects as levan.

Conclusion: This study underscores the significance of the polymerization level of dietary fructans in shaping the gut microbiota. Both FOS and levan ameliorated colitis-associated symptoms, but levan exhibited a stronger and longer-lasting effect. The promotion of *D. newyorkensis* by levan and its therapeutic benefits suggest that this specific bacterium has the potential to serve as a probiotic for the treatment of inflammatory diseases. These findings contribute to our understanding of the complex interactions between dietary fructans, gut microbiota, and inflammatory conditions, offering potential avenues for the development of targeted therapeutic approaches.