Bioactive polysaccharides promote gut immunity via different ways

Xincheng Wu[a], Xiaojun Huang[a], Wanning Ma[a], Mingzhi Li[a], Jiajia Wen[a], Chunhua Chen[a], Liandi Liu[a], Shaoping Nie*[a]

[a] State Key Laboratory of Food Science and Technology, China-Canada Joint Lab of Food Science and Technology (Nanchang), Key Laboratory of Bioactive Polysaccharides in Jiangxi Province, Nanchang University, 235 Nanjing East Road, Nanchang 330047, China

Abstract: Numerous kinds of bioactive polysaccharides are identified as having intestinal immunomodulatory activity; however, the ways in which the different polysaccharides work differ. Therefore, we selected nine representative bioactive polysaccharides, including xanthan gum, inulin, guar gum, arabinogalactan, carrageenan, glucomannan, araboxylan, xylan, and fucoidan, and compared their intestinal immunomodulatory mechanisms. A cyclophosphamide (CTX)-induced immunosuppressed model was used in this experiment, the expression of CD4+ and CD8+ T cells in the ileum was detected by immunohistochemical staining, the relative expression levels of RORγt and T-bet in the ileum were determined by real-time quantitative PCR, the secretion of ileal cytokines TNF-α, IFN-γ, IL-17, and IL-22 was detected by ELISA kit, and the levels of SCFAs in the cecum contents were determined by gas chromatography, combined with UPLC-QTOF/MS for metabolomics analysis of colon contents, and 16S rRNA sequencing of gut microbes. The effects of these polysaccharides on the number of T cells in the intestinal mucosa,

expression of transcription factors and inflammatory factors, intestinal metabolome and gut microbiota were compared and discussed. The results revealed that the nine polysaccharides promote intestinal immunity in different ways. In detail, guar gum, inulin and glucomannan better alleviated immune suppression in intestinal mucosal T cells. Inulin improved the intestinal microenvironment by significantly upregulating the abundance of *Lactobacillus* and *Monoglobus* and promoted short chain fatty acid (SCFA) production. Fucoidan and carrageenan promoted the colonization of the beneficial bacteria *Rikenella* and *Roseburia*. In addition, fucoidan, inulin and carrageenan inhibited the colonization of harmful bacteria *Helicobacter*, upregulated the abundance of *Clostridia_UCG-014* and alleviated the accumulation of amino acids, bile acids and indoles in the large intestine. In conclusion, our study uncovered the different intestinal immunomodulatory mechanisms of the different polysaccharides and provided a guideline for the development of superior intestinal immunomodulatory polysaccharides.

Keywords: polysaccharides; cyclophosphamide; intestinal immunity; gut microbiota; short chain fatty acids; metabolites