

Role of the Gut Microbiota in Long-Term Dietary Patterns Rich in Torularhodin via OSA Colon-Targeted Delivery

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Abstract: Torularhodin is a carotenoid with various activities, and carotenoids can be used by the intestinal microbiome. Hence, a mechanism to pass through an effective delivery system is crucial to the bioavailability and healthy functioning of torularhodin. However, the effect of torularhodin on the gut microbiota is not yet clear. In this study, the octenyl succinic anhydride (OSA) colon-targeted delivery system, and an *in vitro* gut digestive system were used to explore the role of the gut microbiota in long-term dietary patterns rich in torularhodin. Results suggested that the gut microbiota was affected in the diet rich in torularhodin, mainly including *Frisingicoccus*, *Butyricoccus*, *Eubacterium*, *Bacteroides*, *Dialister*, *Lachnoclostridium*, *Streptococcus*, and *Ruminococcus torques*. Torularhodin inhibited the growth of pathogenic bacteria belonging to Enterobacteriaceae and transformed beneficial bacteria *Bifidobacterium* and *Bacteroides* into dominant bacteria under long-term dietary patterns. The functional analysis of gut microbiota showed that differential genes were mainly enriched in glycolysis/gluconeogenesis and pentose phosphate pathways. The metabolome results also demonstrated that torularhodin mainly regulated fructose-1,6-bisphosphatase in the above mentioned pathway. Finally, the interaction network revealed that gut microbiota (*Bacteroides*, Lachnospiraceae, and *Megasphaera*), metabolites (D-glucose, citric acid, tartaric acid, and propionic acid), and metabolic functions (pyruvate metabolism, glycolysis/gluconeogenesis, and pentose phosphate pathway) might be the key factors regulating the effect of torularhodin on the gut microbiota-metabolite-metabolism. Therefore, this study explored the mechanism of "torularhodin-gut microbiota-metabolite-metabolism" cross-feeding based on the bioinformatics methods, providing a theoretical basis for optimizing the gut microecology of a torularhodin-rich diet.

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