Optimization of an Innovative Hydrothermal Processing on Prebiotic Properties of Eucheuma denticulatum, a Tropical Red Seaweed

ABSTRACT

Seaweed is a sustainable source of marine oligosaccharides that potentially could be used as a prebiotic ingredient for functional food development. The study aims to optimize the oligosaccharide preparation through thermal hydrolysis of an under-utilized red seaweed, Eucheuma denticulatum. Response surface methodology (RSM) applying Box–Behnken design (BBD) was used on three parameters including temperature (105–135 ◦C), hydrolysis time (15–35 min) and sulfuric acid concentration (0.05–0.2 M). Optimized fractions with good prebiotic activity were characterized using high-performance size-exclusion chromatography (HP-SEC) and Fourier transform infrared spectroscopy (FT-IR). Eucheuma denticulatum oligosaccharides fraction 1 (ED-F1) was shown to promote the growth of beneficial gut microbiota including Lactobacillus plantarum, L. casei, L. acidophilus, Bifidobacterium animalis and B. longum with the highest prebiotic activity score of 1.64 ± 0.17. The optimization studies showed that hydrolysis time was the most significant parameter for the oligosaccharides yield. Optimal hydrolysis conditions for ED-F1 were 120 ◦C, 21 min, 0.12 M H2SO4 with the highest yield achieved (11.15 g/100 g of dry weight). The molecular weight of ED-F1 was determined at 1025 Da while FT-IR analysis revealed the presence of sulfated oligosaccharides with similar characteristics of i-carrageenan. These findings signify the innovative method for the efficient production of seaweed derived prebiotic oligosaccharides, which could be a promising source of functional food ingredients for the development of health foods and beverages.