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An in-vitro investigation into the prebiotic potential of xylan derived from the edible red seaweed *Palmaria palmata*

Philip Allsopp[1], Cherry Paul[1], Conall Strain[2], Supriya Yadav[2], Thomas Smyth[3], Paul Ross[4], Emeir McSorley[1] and Catherine Stanton[2]
[1]*Ulster University, Coleraine, Ireland,*
[2]*Teagasc Food Research Centre, Fermoy, Ireland,*
[3]*Sligo IT, Sligo, Ireland and*
[4]*University College Cork, Cork, Ireland*

Abstract
Prebiotics are considered beneficial to health owing to positive effects upon the gut microbiota (GM). These effects on the GM include stimulating the growth of beneficial species and increasing short chain fatty acid (SCFA) production (1). Accumulating evidence suggests that the putative health benefits associated with seaweed consumption may be, in part, owing to their effects on the GM(2). The red seaweed *Palmaria palmata* is a source of xylan, a β(1–3) and β(1–4) D-xylose polysaccharide. Given that xylo-oligosaccharides are a recently accepted prebiotic (3), the aim of this investigation was to assess the prebiotic potential of xylan from *Palmaria palmata* using an in-vitro fermentation gut model. Fibres were subjected to an in-vitro digestion and underwent in-vitro batch culture fermentation (MicroMatrix) over 24 hours. Fermentation vessels were inoculated using a pooled faecal slurry (5% v/v), prepared from six healthy volunteers. Xylan fibre (n = 4) was compared to Cellulose (negative control, n = 8) and Synergy 1 (positive control, n = 8). Changes to GM composition was determined using qPCR (total bacteria, Lactobacilli, and Bifidobacteria), and MiSeq 16S rRNA sequencing. Short chain fatty acid analysis was conducted using gas chromatography-mass spectrometry. The differential abundance of taxa between fermentation substrates was determined using linear discriminant analysis (LDA) effect size (LEfSe). A permutational multivariate analysis of variance (PerMANOVA) was used to determine statistical differences of beta diversity whilst treatment associated differences of short chain fatty acids were determined using an unpaired Mann-Whitney U Test. Xylan altered GM composition at Phylum, Family and Genus taxonomic levels, notably a significant reduction in the Firmicutes/Bacteroides ratio ($p = 0.004$). Both 16S sequencing data and qPCR analysis revealed a significant increase in Bifidobacteria relative to cellulose, where the effect was comparable to Synergy 1. No significant differences in microbiota diversity were noted for either Xylan or Synergy 1 in comparison to the cellulose control. Xylan was shown to significantly modulate GM activity through increased short chain fatty acid production with increased acetate, propionate and butyrate. The evidence gained from this study suggests that Xylan from *Palmaria palmata* is a fermentable fibre with potential prebiotic characteristics, and therefore warrants further investigation in humans.

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Conflict of Interest
No