Xyloooligosaccharides reduce protein-induced faecal water genotoxicity and alter bacterial populations in a two-stage continuous fermenter

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Introduction
Western diets high in meat and fat, but low in fibre, are linked to increased risk of colorectal disease. High protein diets can increase colonic DNA damage in animals but addition of resistant starch to the diet reduces the damage1. We wish to understand the relationship between fermentable dietary carbohydrates with potential to protect against colonic DNA damage and the growth of particular gut bacteria. In this study we use a two-stage continuous fermenter system to determine if incubating human faeces with inulin or xyloooligosaccharides (XOS) lowers faecal water genotoxicity induced by protein fermentation. The quantities of some species and groups of bacteria considered important for human gut health were determined in the fermenters and related to faecal water genotoxicity.

Methods
The two-stage continuous fermenter system and basal media was used as described by Bruck et al.2 with minor changes: Proximal fermenter, pH 5.5 and 220 ml; distal fermenter, pH 6.8 and 320 ml. Human faecal slurry (20%), obtained from five healthy volunteers, was used as inoculum. In all fermenters 3% soya protein was present but the type of carbohydrate added with the soya protein varied. In one fermentation run, 1% low amylose cornstarch was fermented with soya protein for 10 days followed by 10 days of 1% XOS with soya protein. In a second run, 1% low amylose cornstarch was fermented with soya protein for 10 days and this was followed by 1% inulin with soya protein for 10 days. Faecal water from days 8-10 of each fermentation was combined. HT-29 human colonocytes were incubated with 1 ml of 20% faecal water for 30 min and the DNA damage (single-strand breaks) assessed using the comet assay3;4. Quantitative real time PCR (QPCR) was performed to quantify bacteria numbers.

Results
Inulin had no significant effects on faecal water genotoxicity. XOS significantly reduced faecal water genotoxicity (relative to the low amylose starch) in the proximal fermenter but increased genotoxicity in the distal fermenter. Butyrate levels in the proximal and distal fermenters increased when XOS was added. There was a significant reduction in F. prausnitzii in the proximal fermenter, but the populations of C.coccoides, B.fragilis, lactobacillus and sulphate-reducing bacteria (SRB) increased. In the distal fermenter there was a significant increase in C.coccoides, while a decline was detected for bifidobacterium, C. leptum, F. prausnitzii and SRB.

Discussion
These results suggest that XOS could protect against protein-induced DNA damage in the colon but that the protection is more likely to be restricted to the proximal colon. Our data also show that changes in the abundance of bifidobacterium, lactobacillus, and SRB, some of which have previously been associated with decreased faecal genotoxicity, are related to the changes in DNA damage observed, suggesting they could help mediate effects of XOS in the colon. The role of the SRB populations in gut health is poorly understood and requires further investigation.
Reference


