The effect of in vitro fermentation of oats (Avena sativa) and barley (Hordeum vulgare) on the faecal gut microbiota

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The effect of *in vitro* fermentation of oats (Avena *sativa)* and barley (Hordeum *vulgare)* on the faecal gut microbiota

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Diets high in whole grain cereals may reduce the risk of cardiovascular disease (CVD) and colorectal cancer[1–2]. Mixed link β-glucans found within oats (*Avena sativa*) and barley (*Hordeum vulgare*) could be partly responsible for this. The cholesterol lowering effect of oat β-glucans currently has several endorsed health claims including the U.S Food and Drug Administration (FDA) and the European Food Safety Authority[3–4]. β-glucans may also reduce the risk of disease by increasing satiety, reducing body mass index, lowering blood glucose and increasing stool transit time. Little is known about how β-glucans influence the gut microbiota. However, the development of culture independent techniques using 16S rRNA-targeting arrays have demonstrated the importance of bacterial community composition, and bacterial metabolites, in health and disease. Prebiotics are defined as non-digestible plant derived carbohydrates that act as fermentation substrates that stimulate the preferential growth and activity of microbial species that confer health benefits to the host. Understanding how prebiotics the influence gut microbiota is a growing area of interest[5].

Here we investigated the effects of different cultivars of oats and barley on microbial activity and composition. Firstly a batch culture experiment was performed using faecal inocula from four different volunteers. Five cultivars were compared; pH and short chain fatty acid (SCFA) concentrations were measured at 0, 24, and 48 h. After 48 h, pH significantly decreased by at least 1·1 unit in all incubations, while SCFA concentrations significantly increased ($p < 0{\cdot}05$). No difference was observed between incubations. This was followed by a continuous flow fermentor, where two cultivars were compared. The fermentor produced a different SCFA profile compared with the batch experiment. Maintenance of the pH at 5·8 and the continuous flow could have contributed to this.

Fermentor Short Chain Fatty Acids at Day 15

	Concentrations mmol/l				Percentage of Total (%)			
	Acetate	Propionate	Butyrate	Lactate	Acetate	Propionate	Butyrate	Lactate
Belinda Oats	29·29[a]	12·36[a]	9·41[a]	3·40[a]	46·2[a]	19·5[a]	14·8[a]	5·4[a]
Bere Barley	24·44[a]	14·21[a]	11·23[a]	5·88[a]	37·6[b]	21·9[a]	17·3[a]	9·1[a]
Control	43·64[b]	41·24[b]	4·19[b]	1·42[a]	46·6[a]	44·1[b]	4·50[b]	1·5[a]

Control was a high mixed carbohydrate medium
Different letters within columns denote significant difference ($p < 0{\cdot}05$)

Microbial analysis of the fermentor samples by fluorescence in situ hybridisation (FISH) found a shift towards *Bacteroides* genus and a reduction in Firmicutes and Actinobacteria. The bacterial composition and SCFA ratios were very similar between the oats and barley cultivars. However, significantly more butyrate was produced compared to the high carbohydrate control. As butyrate may have anti-carcinogenic properties, increasing consumption of oats and barley could potentially provide important health benefits.

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