COMPARISON OF RESISTANT STARCH WITH SOLUBLE AND INSOLUBLE NON-STARCH POLYSACCHARIDES ON FAECAL OUTPUT AND FERMENTATION DEPENDENT EVENTS IN RATS

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There is evidence that undigested starch (ie resistant starch, RS) can reach the colon where it is fermented by anaerobic bacteria to produce short-chain fatty acids (SCFA) (Cummings and Englyst 1987). In reaching the colon undigested RS may act like 'dietary fibre' (non-starch polysaccharides, NSP). However, the physiological effects of RS in the gastrointestinal tract are largely unknown. In this study, the effects of RS was compared with that of guar gum (a highly fermentable soluble NSP) and cellulose (a slowly fermentable insoluble NSP) in rats. The four diets used in this study were: LRS diet (low resistant starch and fibre free diet); HRS diet (containing 12.5 % RS on dry weight basis from high amylose maize starch; GUAR diet (12.5% guar gum) and CELL diet (12.5 % cellulose). All diets were based on the AIN-76 purified rodent diet. The macronutrient compositions of all diets were standardised so that carbohydrate, protein and fat contibuted 70%, 20% and 10% of the energy. Each diet was fed to six male Sprague-Dawley rats (230g average body weight) for four weeks. Results are given in the Table below.

	LRS diet	HRS diet	Guar diet	CELL diet
Caecum				
Content wet wt (g)	1.71 ± 0.27a	3.27 ± 0.42b	8.54 ± 0.78c	2.11 ± 0.55a
pH	6.34 ± 0.11b	5.61 ± 0.09a	5.82 ± 0.22a	6.83 ± 0.11b
Faeces				
Starch excreted(mg/day)	9.0 ± 6.1a	318.1 ± 60^{b}	8.3 ± 5.2^{a}	8.8 ± 3.4a
Output (g wet wt/day)	0.78 ± 0.18a	2.97 ± 0.14b	2.08 ± 0.39b	4.90 ± 0.50c
pH	6.36 ± 0.18b	5.34 ± 0.05a	5.63 ± 0.1a	6.42 ± 0.21b
Acetate (mmol/day)	18.6 ± 4.2a	129.9 ± 17.2b	62.1 ± 25.0a	67.1 ± 6.0a
Propionate (mmol/day)	3.8 ± 1.0a	26.3 ± 10.3a	32.2 ± 12.5a	18.2 ± 2.5a
Butyrate (mmol/day)	2.5 ± 0.8a	47.5 ± 19.4b	14.5 ± 6.3a	12.2 ± 1.7a
Total SCFA (mmol/day)	24.9 ± 5.9a	207.9 ± 16.1c	108.7 ± 40.8b	97.4 ± 7.9ab

All results given as mean ± SEM (n=6). Results were analysed using one-way ANOVA and Tukey's multiple comparison. Different letters represent significant differences at $P<0.05$.

Both the GUAR and HRS diets caused an enlargement of the caecum, increased production of caecal-SCFA (data not shown) and produced a marked reduction in caecal pH. Analysis of faecal samples revealed that cellulose (ie CELL diet) was the most effective faecal bulking agent, but had no effect on faecal pH. Both the GUAR and HRS diets had a laxative effect, lowered faecal pH and resulted in the increased excretion of total SCFA. The HRS diet caused significant increases in the excretion of faecal acetate and butyrate. These results reveal that starch reaching the colon has a significant impact on putative markers of 'colonic' health, ie increased fecal bulk, lowered.pH, and increased SCFA (including butyrate), in rats. Similar results have recently been shown in humans (Phillips et al. 1995). The results also show that while RS had many effects in common with the rapidly fermented soluble NSP (ie GUAR diet), RS was a better substrate for acetate and butyrate production.

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