

Modest increases in dietary resistant starch favourably alter the in vitro fermentation of undigested carbohydrate and protein in human ileal effluent

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Incorporation of resistant starch (RS) into diets has beneficial effects on human colonic events (eg faecal bulking, increased butyrate concentration, lowered pH, and reduced concentrations of ammonia and phenol) (1). Previous studies showed these effects by using levels of RS about ten times higher than the estimated mean intake of Australians. In this study we fed diets with more modest and acceptable levels of RS to ileostomate subjects, and investigated bacterial metabolite production following an in vitro fermentation of ileal effluent.

Three diets were used: an Australian diet with a low starch (20% E) and low NSP content ("typical" diet); the same diet with added starch (37% E) and added NSP ("high starch" diet); and the Australian diet with added starch (40% E), RS and NSP ("RS" diet). RS was increased by including rice, reducing meat and adding red kidney beans, and by replacing commercial bread and breakfast cereal with whole grain bread and muesli. Each diet was consumed by five ileostomate volunteers for 48 h, with ileal effluent collected during the second 24 h period. The effluent was dried, ground, and 100 mg fermented in vitro with 10 ml of a faecal slurry (16% in 0.1 M phosphate buffer pH 7) (2). Results presented were measured after a 24 h fermentation.

			Typical diet ¹	High starch diet ¹	RS diet ¹
dietary intake:	starch	g/d	86 ± 6	154 ± 14 ²	192 ± 24 ³
	NSP	g/d	12 ± 1	21 ± 2 ²	23 ± 3 ³
ileal effluent excretion:	starch (RS)	g/d	3.5 ± 0.6	6.7 ± 0.5	16.6 ± 4.8 ³
	NSP	g/d	14.5 ± 1.1	22.7 ± 1.5	26.0 ± 3.8 ³
in vitro fermentation:	pH		6.25 ± 0.09	6.09 ± 0.07	6.12 ± 0.06
	butyrate	molar %	15.8 ± 0.5	17.0 ± 0.5	17.8 ± 0.5 ³
	ammonia	mg/L	406 ± 29	334 ± 27	347 ± 23
	phenol	mg/L	7.2 ± 1.7	3.1 ± 0.9	2.4 ± 0.5 ³

¹ n=5 for each diet; mean ± SEM

²⁻³ significant difference (ANOVA); ² P<0.05 high starch diet, typical diet; ³ P<0.05 RS diet, typical diet

The ratio of RS/NSP in the ileal effluent was highest on the RS diet, which also produced the most butyrate relative to other short chain fatty acids and the least phenol. The RS content of the fermentation substrate related positively to butyrate concentration (r=0.66, P<0.01) and negatively with phenol concentration (r=-0.52, P<0.05); while NSP showed only a negative relationship with ammonia concentration (r=-0.71, P<0.01).

This study has shown that minor modifications to a Western-type diet to increase the RS content, where in the main changes were made to the relative amounts of foods rather than the type, can produce acceptable diets with potential beneficial effects on colonic fermentation.

1. Birkett AM, Muir JG, Jones GP, O'Dea K. Resistant starch lowers fecal concentrations of ammonia and phenols in humans. *Am J Clin Nutr* 1996;63:766-72.
2. Edwards CA, Gibson GR, Champ M, Jensen BB, Mathers J, Nagengast F, Rumney C, Quehl A. In vitro method for quantification of the fermentation of starch by human faecal bacteria. *J Sci Food Agric* 1996;71:209-17.