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Dietary fibre reduced phenolic acid production from rutin in an ex vivo fermentation model

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The health effects of foods rich in polyphenols and fibre are well established but the mechanisms of action are not fully understood. Fibre and polyphenols are usually eaten as part of a meal or even in the same food, but their bioavailability and metabolism have up until now been studied separately. It is therefore important to understand their interactions when combined. Most polyphenols have low bioavailability in the upper gut and fibres are undigested in the small intestine. Both food components reach the colon, where they are metabolised by the colonic bacteria into bioactive compounds e.g. phenolic acids (PA) and short chain fatty acids (SCFA). Raftiline, pectin and ispaghula are dietary fibres with different physicochemical properties, which may modulate colonic bacteria in different ways. Rutin, a polyphenol ubiquitous in plant foods, escapes absorption in the small intestine due to its rhamlose-containing glycosidic moiety. We aimed to study the effect of the interaction between the fibres raftiline, pectin and ispaghula and the polyphenol rutin on PA and SCFA production.

In an *ex-vivo* fermentation model, 24 h batch cultures of human faecal samples from volunteers ($n = 10$, 19–33y old) following a 3-day low polyphenol diet were investigated. The cultures were incubated with different combinations of fibres (raftiline, pectin and ispaghula; 1 g/50mL) and rutin (28 μmol/L)[1]. Samples were obtained at 0, 2, 4, 6 and 24 h and stored at −80 °C. PA analysis was carried out using GC-MS[2] and SCFA by GC-FID[3].

The faecal fermentation of rutin resulted in the production of phenylacetic acid (PAA), 4-hydroxybenzoic acid (4-OHBA), 3-hydroxyphenylacetic acid (3-OHPAA), 4-hydroxyphenylacetic acid (4-OHPAA), 3,4-dihydroxyphenylacetic acid (3,4-diOHPAA), 3-hydroxyphenylpropionic acid (3-OHPPA) and 4-hydroxyphenylpropionic acid (4-OHPPA). At 24 h, fermentation with raftiline and pectin inhibited the total phenolic acid formation $p = 0{\cdot}0001$ to the same extent (85·5% and 78·3% respectively while fermentation with ispaghula led to a lesser inhibition of PA formation (33·7%, $p = 0{\cdot}03$). After 24 h, all fibres significantly reduced PAA and 3,4-diOHPAA formation (Table) as well as the inhibition of 3-OHPAA and 4-OHPAA by pectin and raftiline. There was no impact of rutin on SCFA production.

	Rutin (μg/mL)		Rutin & Raftiline (μg/mL)		Rutin & Ispaghula (μg/mL)		Rutin & Pectin (μg/mL)	
Phenolic acid	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Phenyl acetic acid (PAA)	5·60	3·35	0·49*	1·0	2·94*	2·6	0·29*	0·54
3,4-Dihydroxy phenyl acetic acid (3,4-DHPAA)	3·11	4·28	0·57*	0·92	2·25*	2·96	1·03*	1·61

Values are expressed as mean (SD) for duplicates ($n = 10$). * Values are significantly different at $p < 0{\cdot}05$ (paired t-test for each fibre against rutin).

Dietary fibres inhibit the release of PA from rutin, which is related to the fermentation related mechanisms. This needs to be taken into account when considering the potential health benefits of foods rich in polyphenolics and fibre.

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