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Gastrointestinal or Simulated *In Vitro* Digestion Changes Dietary Fibre Properties and their Fermentation

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Abstract: This study evaluated the effect of digestion on the chemical and physicochemical characteristics of dietary fibre and on its behaviour during fermentation. Three dietary fibre sources (wheat bran, barley bran and beet fibre) were recovered from ileal cannulated pigs after *in vivo* digestion and prepared by *in vitro* enzymatic treatment simulating digestion. Raw substrates and fibre residues were analysed for their chemical and physicochemical properties as well as their potential fermentation by human colonic bacteria. *In vitro* and *in vivo* treatments led to insoluble residues, enriched in cell wall polysaccharides, with similar cell wall sugar composition and physicochemical properties. Degradations of cell wall polysaccharides with losses of sugar residues occurred mainly after *in vivo* digestion, especially for pectins from beet fibre and β-glucans from barley bran. Solubilisation of β-glucans removed highly fermentable substrates for further fermentation. For beet fibre, removal of pectins led to increased hydration properties and faster fermentation of cell-wall polysaccharides. Enzymatic treatment simulated correctly the passage of fibre through the digestive tract, modifying the cell-wall matrix and predisposing the fibre to further fermentation. © 1998 SCI.

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Key words: dietary fibre; cell-wall polysaccharides; particle size; hydration properties; digestion; fermentation

INTRODUCTION

The physiological effects of dietary fibre depend largely on its fermentation in the colon (Cherbut *et al* 1991; Cummings and Macfarlane 1991; Scheppach 1994). Many factors can affect the extent of fibre fermentation and the production of short-chain fatty acids (SCFA), some of which relate to the host (Michel and MacFarlane 1996) and colonic flora (Barry *et al* 1995), while others depend on fibre properties. Fermentation of dietary fibre has been widely studied using *in vitro* batch systems, which seem to provide accurate evaluation of the fermentability of a large number of substrates and allow the role of their physicochemical properties to be determined (Mortensen *et al* 1988; Bourquin *et al* 1992; Auffret *et al* 1993; Salvador *et al* 1993; Barry *et al* 1995). These systems are based on incubation of fibres with human faecal inoculum in anaerobic conditions (Barry *et al* 1989). However, before their arrival in the hindgut, fibres are subjected to the peculiar luminal environment (enzymes, pH, temperature, water activity, minerals, bile acids, etc) of the upper digestive tract. These conditions can lead to irreversible changes in the intrinsic characteristics of dietary fibre (chemical composition, particle size) or reversible modifications of physicochemical properties. During intestinal digestion, starch and proteins are hydrolysed and removed from raw materials. The acidic or neutral conditions prevailing in the digestive tract can partially solubilise pectic substances (arabinose, galactose, uronic acid) Millard and Chesson 1984; Graham *et al* 1986; McBurney *et al* 1988). Non-starch glucose losses are also observed, pre-

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