Resistant starch, large bowel fermentation and a broader perspective of prebiotics and probiotics

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Abstract

The metabolic end products of the large bowel microbiota contribute significantly to human health. After weaning to solid foods, some of the most important of these are the short chain fatty acids (SCFA) produced by the fermentation of undigested dietary components and endogenous secretions. The main SCFA are acetate, propionate and butyrate which have numerous documented effects promoting large bowel function. Of the major acids, butyrate seems especially important. It is a major metabolic fuel for colonocytes and promotes a normal phenotype in these cells, potentially lowering the risk of diseases such as colo-rectal cancer. Imbalances in the microbiota are thought to predispose to large bowel dysfunction and probiotics are being developed to correct this. However, most commercial products contain bacteria (lactobacilli and bifidobacteria) which are dominant species in milk-fed infants but have limited roles in adults. Prebiotics are defined usually by the specific stimulation of these bacteria. However, the end products of most probiotics do not include butyrate or propionate which raises questions about their effectiveness in promoting bowel health in adults. Resistant starch (RS) is a dietary fibre component and its fermentation generally favours butyrate production. Dietary RS intakes and faecal butyrate levels are high in populations at low risk of diet-related large bowel diseases. Conversely, RS intakes and faecal butyrate levels are very low in high risk groups. This raises the possibility that greater RS consumption could be of health benefit. RS is not regarded widely as a prebiotic but (according to the accepted definition) most forms show the requisite features in stimulating specific bacteria, giving raised total SCFA and butyrate levels and a consequent benefit to the host. Current efforts to improve public health through increasing RS consumption could be facilitated by greater recognition of its prebiotic role.

Keywords: microbiota, short chain fatty acids, colon, fibre, human health

1. Introduction

The key role of the numerically large and taxonomically diverse population of the (mostly) anaerobic large bowel microbiota on human health is well-accepted. It presents a formidable barrier against host colonisation by microbial pathogens and its substantial metabolic activity, expressed both as total reactive capacity and the range of biochemical transformations, has led to it being described as a functional organ, equal in magnitude to the liver (Hill, 1995; Macfarlane and McBain, 1999). The metabolic products of the adult large bowel microbiota promote the optimal function of the whole body as well as the viscera. These products include vitamins as well as fermentation products that salvage metabolisable energy for the host from undigested food and endogenous secretions (e.g. mucus) that would otherwise be lost in the faeces (Bergman, 1990).

The host gut-microbial relationship is dynamic and highly susceptible to numerous environmental factors, especially diet, which determines both the overall taxonomic composition and metabolic activity of the large bowel ecosystem. Dietary effects can be both positive and detrimental to health and may be manifested directly or
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