



Gastrointestinal health

The role of pro- and pre-biotics in standard foods



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BACKGROUND

Diarrhoea is a common symptom of gastrointestinal illness, ranking among the 20 most frequent reasons for patient encounters in general practice in Australia. Children under 5 years of age are especially vulnerable to bacterial gastroenteritis such as infections with *Campylobacter jejuni*. Everyday diet, in particular the regular consumption of pro- and pre-biotics, can help with the maintenance of a healthy gastrointestinal system.

OBJECTIVE

This article outlines the potential of 'everyday standard' food items such as cheese to promote healthy gastrointestinal microflora and to prevent gastrointestinal illness such as diarrhoea.

DISCUSSION

Some common food items such as yoghurt, sauerkraut, garlic and cheese contain probiotics in the form of live lactic acid bacteria, and/or prebiotics in the form of fructans, a dietary fibre. Cheese contains both probiotic bacteria and the prebiotic dietary fibre inulin. The regular consumption of cheese has been associated with a reduction in the risk of *Campylobacter* enteritis.

The 2003 Australian Health Care Summit¹ and the 2003 South Australian Generational Health Review² have identified a clear need for the Australian health care system to shift the current focus on treatment of disease toward illness prevention, health promotion, and early intervention. The move toward a stronger focus on prevention aims to reduce the high economic and social costs associated with the treatment of disease. The Commonwealth Department of Health and Ageing allocated \$17.3 million of the 2003-2004 health budget to support preventive activities such as enhancing the quality use of medicine, building community awareness for prevention, and improving the communication between various primary health care providers.³

A healthy diet plays a pivotal role in disease prevention and health promotion. The concept of 'functional foods' (Table 1) has evolved together with the recognition that some foods, or food ingredients, may improve the state of health and wellbeing and/or reduce the risk of disease.⁴

The functional food category of the pro- and pre-biotics (Table 1) has generated interest regarding their potential influence on human microflora and consequently on the maintenance of a healthy gastrointestinal system.⁵

Gastrointestinal illness

General practitioners frequently deal with patients suffering from diarrhoea. Reasons

for diarrhoea can be due to viral or bacterial infections, or other causes such as antibiotic associated or traveller's diarrhoea, inflammatory bowel diseases (eg. ulcerative colitis, Crohn disease), necrotising enterocolitis, or colon cancer. Approximately 1% of patients seen by a GP in Australia complain about diarrhoeal symptoms, as reported in the Bettering the Evaluation and Care of Health (BEACH) surveys from 1998 to 2002.⁶ This places diarrhoea among the 20 most frequent patient complaints in general practice, alongside nasal congestion (1.0%) or headache (1.4%).⁶ Presumed infectious gastroenteritis generally accounts for 0.7% of all patient problems managed by GPs.⁶

Campylobacter infection has been the most common cause of bacterial gastroenteritis in Australia since it became notifiable in 1991 to the National Notifiable Disease Surveillance System in all states except New South Wales.⁷ Rates of campylobacteriosis are as high as 125 per 100 000 persons per year or 16 124 reported cases in Australia in 2001.⁸ Rates in children under 5 years of age are especially high, accounting for about 20% of all notifications.^{9,10}

Standard foods

To date, few studies have investigated the relationship between the consumption of standard

Table 1. Functional foods

Functional foods are described as foods or food ingredients that may provide health benefits and prevent disease, and can be categorised into 5 groups: dietary fibres, vitamins and minerals, bioactive substances, fatty acids and pro-, pre- and syn-biotics

Probiotics are live micro-organisms which, when administered in adequate amounts, confer a health benefit to the host.²⁸ The lactic acid bacteria *Lactobacillus*, *Bifidobacterium*, and *Streptococcus* are examples. The sterile gut of the fetus is initially colonised by bifidobacteria.²⁵ The adult gut is colonised by a large number of lactobacilli from fermented dairy and plant products^{13,17}

Prebiotics are nondigestible substances that beneficially affect the host by selectively stimulating the growth or activity of a limited number of resident bacterial species in the colon.²⁶ The fructans oligofructose, also known as fructo-oligosaccharides, and inulin can be regarded as dietary fibres with prebiotic properties²⁷

foods items and the risk of gastrointestinal illness. Two case control studies comparing the incidence of *Campylobacter* gastroenteritis in relation to food intake, found that some dairy products, in particular cheese, were associated with a lower risk of infectious diarrhoea. Cameron et al¹⁰ showed the consumption of hard (block) cheeses such as cheddar, or processed soft cheese, was strongly associated with a 45–64% risk reduction in *Campylobacter* diarrhoea in young children, while Schorr et al¹¹ found the consumption of curd or cottage cheese lowered the risk by 50%. Full cream and acidified milk (lactic acid bacteria inoculated cow's milk) and processed meat (eg. salami) were also associated with a protective affect against gastroenteritis (Table 2).¹²

Probiotics

The fermentation of foods by lactic acid bac-

Table 2. Standard foods associated with a risk reduction of diarrhoea

	Food item	Odds ratio	95% CI	p value <	Study design
Dairy	Cheese slices	0.33	0.15–0.71	0.003 ¹⁰	Case control
	Block cheese	0.38	0.19–0.76	0.005 ¹⁰	Case control
	Acidified milk	0.41*	0.28–0.60*	0.001 ¹²	Prospective case control
	Cottage/curd cheese	0.5	0.3–0.9	not given ¹¹	Case control
	Full cream milk	0.53	0.29–0.97	0.036 ¹⁰	Case control
	Cheese spread	0.55	0.32–0.97	0.035 ¹⁰	Case control
Nondairy	Processed meat	0.52	0.32–0.83	0.006 ¹⁰	Case control

* The rate ratio and 95% confidence interval based on the incidence of acute diarrhoea

Table 3. Mechanisms of probiotic activity

Mechanism	Condition benefit
Production of inhibitory substances	Rotavirus
Organic acids (eg. acetate, butyrate), hydrogen peroxide	Bacterial enteritis
Bacteriocins (exotoxins, eg. nisin kill other bacteria but not eukaryotic cells)	Traveller's diarrhoea
	Inflammatory bowel disease (eg. ulcerative colitis, Crohn disease)
Stimulation of the immune system	Necrotising enterocolitis
Intestinal humoral response (eg. IgA)	Irritable bowel disease
Cellular response (eg. T and B cells and cytokine production)	Colon cancer
Nonspecific immunity (eg. phagocytosis)	Lactose intolerance
	Infantile allergic dermatitis
Competitive inhibition of bacterial adhesion sites on the intestinal epithelial surfaces	Helicobacter pylori gastritis
	Candida vaginitis

teria has long been used by humans for food preservation, as it was the simplest way to avoid food spoilage before the industrial revolution. Therefore, the human gastrointestinal tract may have adapted to a daily supply of live lactic acid bacteria.¹³ Bacteria are an important part of the human gut which hosts an estimated 10¹⁴ resident micro-organisms, or 10 times more bacteria than there are cells in the body.^{5,14}

Fermented foods containing probiotic lactic acid bacteria include yoghurt, butter-milk, cheese, gherkins, sauerkraut, brined olives and soy sauce.^{13,15–17}

Although marketing and research attention has focussed on yoghurts and fermented milk drinks as food carriers for probiotic micro-organisms, these products are not the only sources and may not be the optimal delivery system of probiotics to the gastrointestinal tract.¹⁸ For example, the lactic acid bacteria in a 9–15 month old cheddar cheese originate from the environment and are typically lactobacilli in numbers similar to those found in fresh cheeses and yoghurt (10⁷-10⁸ viable cells/g).^{17,19}

Probiotic functions/health benefits

Lactic acid bacteria can normalise intestinal

microflora composition, strengthen host immunity, restore metabolic processes, and inhibit the growth of pathogens such as *Salmonella*, *Campylobacter*, and *Clostridium*.^{20,21} Table 3 lists some biochemical and/or cellular effects of probiotics and the potential benefits of probiotic therapy.

Prebiotics

Prebiotics represent a second strategy to improve the balance of intestinal bacteria. Prebiotic fructans are found in vegetables such as garlic, artichokes, onions, and leeks, and in comparable amounts, in cheese and other dairy products.^{22,23} Gibson et al²⁴ showed that small alterations in the intake of the fructans oligofructose or inulin could lead to significant changes in the balance of the intestinal microflora. In their study, the numbers of lactic acid bacteria increased in both absolute terms and as proportion of anaerobes.

The role of cheese

Cheese has been strongly associated with the prevention of bacterial gastroenteritis.^{10,11} It contains the probiotic lactic acid bacteria and the prebiotic inulin as stimulant for probiotic growth. While some foods contain more fresh weight inulin than cheese, eg. onion, garlic and leek, it may be easier to obtain a higher amount of inulin from cheese. Furthermore, fructans degrade during cooking,²² and uncooked cheese is more likely to be consumed than raw garlic or onion. Cheese also contains a high percentage of other health promoting ingredients including fatty acids, vitamins A, B and D, calcium, magnesium and zinc.

Conclusion

Current food marketing strategies often promote the development of new 'functional' food products rather than highlighting the health benefits of some everyday standard food items. However, there is a growing body of evidence that judicious consumption of some traditional foods can have strong positive effects on gastrointestinal health.

Acknowledgments

The author would like to thank the 'PHCRED writing group', especially Liz Farmer, Raechel Waters, Ann Alfred, Kath Weston and Karen Salisbury for their advice and support during preparation of the manuscript. The writing group thankfully acknowledges financial support from the Commonwealth Department of Health and Ageing, Primary Health Care Research Evaluation and Development (PHCRED) Program.

Conflict of interest: none.

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