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IBS or intolerance?

Background
The contribution of specific foods to the genesis of symptoms in irritable bowel syndrome (IBS) has been increasingly recognised in recent years.

Objective
This article discusses the dietary triggers for IBS and the role of diagnostic testing in patients with IBS.

Discussion
In addition to the long standing implication of lactose in lactase deficient patients, fermentable dietary oligosaccharides, disaccharides, monosaccharides and polyols, together with very low carbohydrate diets, have been increasingly recognised as important in the causation and treatment of irritable bowel syndrome. Understanding their role and utilising the services of a practising dietician have become additional important tools for general practitioners managing this common complaint.

Irritable bowel syndrome is a chronic illness of disordered bowel function and abdominal pain or discomfort, and is frequently accompanied by abdominal bloating. Irritable bowel syndrome affects patients physically, psychologically, socially and economically.[1] This assumes great importance both in terms of quality of life and the economic burden of disease.

One of the more consistent clinical features of irritable bowel syndrome (IBS) is an association between the development of symptoms and the ingestion of food.[2–5] Nearly two-thirds of patients with IBS associate symptoms with eating a meal.[2] Despite this practical observation, surprisingly little attention is paid to the role of specific foods in the genesis of IBS.

The contribution of lactose and fructose intolerance to abdominal symptoms is particularly important in people who suffer with IBS.

Lactose intolerance

Lactose intolerance is an established condition in its own right, and lactose was the first carbohydrate to be recognised as important in IBS.[6–14] The enzyme lactase is required in the brush border of the small bowel mucosa to split the disaccharide, lactose, into its component monosaccharides, glucose and galactose. Lactase deficiency occurs in approximately 6% of caucasian Australians[12] and is particularly prevalent in those of Asian[7] or African background, and to a lesser extent, those from a Middle Eastern and southern European background. It should be emphasised that there is a deficiency rather than an absence of the enzyme and therefore lactose can be tolerated in varying amounts.

Symptoms of lactose intolerance include:

- abdominal discomfort
- bloating
- wind, and
- diarrhoea.

These symptoms may present some time after the ingestion of lactose when the undigested lactose reaches the colon for fermentation. Therefore the patient may not connect the symptoms to dietary factors.

This is true of all other carbohydrate malabsorption. Fermentation

produces hydrogen (H_2) methane, carbon dioxide and hydrogen sulphide gases. Hydrogen is absorbed from the colon and expired on the breath and this is the basis of all carbohydrate breath tests.

Most people with lactose intolerance can consume up to 12.5 g of lactose per sitting without showing any symptoms, roughly the equivalent of a small glass of milk (200 mL or about 3/4 cup).[12–14] Therefore symptoms following the use of milk in tea and coffee are not due to lactose alone, but probably also due to caffeine or fat.

Many people describe themselves as lactose intolerant and exclude all dairy products from their diet on the assumption that lactose is present in significant amounts. Consequently these people miss out on excellent sources of calcium. *Table 1* illustrates the true lactose content of various dairy foods. Care should be taken in making a diagnosis of lactose intolerance using a lactose breath hydrogen test or duodenal biopsy with measurement of disaccharidase activities.

In fact, many symptoms may be induced by the fat in the dairy product rather lactose, and therefore cream, butter, cheese and ice-cream may be the major triggers, despite low lactose concentrations.

Other dietary triggers

Other dietary triggers are now widely recognised and many IBS patients report multiple food allergies with reasonable physiological basis.[5] The contrast between food allergy and food intolerance is indicated in *Table 2*.

Other important foods in IBS are those rich in lipids, together with poorly absorbed carbohydrates.[2,15] It is well established that foods high in fat affect gut motility and transit, and can trigger an exaggerated gastrocolic reflex, increase colonic hypersensitivity, and have effects on motility and visceral sensation.

Fructose and sorbitol malabsorption

Fructose and sorbitol malabsorption have previously been well recognised[16,17] and the role of fermentable carbohydrates has been highlighted in recent years.[5,18–20] These authors have emphasised the importance of fermentable dietary oligosaccharides, disaccharides, monosaccharides and polyols (FODMAPs) in patients with IBS.

Fructose, a monosaccharide, does not require an enzyme system. Rather it is absorbed across the villus epithelium via a low capacity carrier mediated facilitated diffusion. This low capacity results in fructose malabsorption in susceptible individuals if the fructose load is great enough. Absorption of free fructose is enhanced by luminal glucose, so foods containing fructose in excess of glucose are particularly important in the genesis of symptoms.[19] This occurs in honey, apples, pears and their juices. However, most ingested free fructose is from added sources as a sweetener and is frequently accompanied by sorbitol, especially in pear and apple juice. As fructose is the sweetest of sugars it is used as a commercial sweetener in foods for people with diabetes and in sweets, confectionary and soft drinks. Most of the fructose stems from added sources, particularly high fructose corn syrup. The fructose content can vary greatly between products.[8,21]

Table 1. Lactose content of dairy foods

Dairy food	Lactose content
Regular milk, 200 mL	9.4 g
Cheese, 35 g slice (edam, swiss, brie, cheddar)	0.0 g
Processed cheddar, feta	0.1 g
Cottage cheese, 100 g	1.4 g
Cream cheese, 100 g	3.2 g
Yoghurt, 200 g	7.8 g*
Ice-cream, 50 g	2.8 g
Butter, 20 g (1 tblsp)	0.2 g
Cream, 20 g (1 tblsp)	0.6 g

* The lactose content in yoghurt decreases each day (even while in the refrigerator) because its natural bacteria use lactose for energy

Source: Dairy Australia

Table 2. Food allergy versus food intolerance

Food allergy	Food intolerance
Mostly children	All ages
IgE mediated	Nonimmunological
Few foods	Many foods
Immediate	Delayed
Reproducible	Variable reactions
Diagnosis straightforward	Diagnosis often obscure

Sorbitol is widespread in plants, particularly in fruits and juices of the rosacea family (apples, pears, cherries, apricots, prunes, plums), often together with fructose.[9,21]

Rumessen and Gudmand-Hoyer[16] have shown malabsorption of a 5 g dose of sorbitol in IBS patients. When mixed with 25 g fructose there were significantly increased abdominal symptoms, indicating that fructose/sorbitol mixtures are particularly potent in patients with functional bowel disease. *Table 3* illustrates the content of fructose/sorbitol in various fruits and vegetables, which may be used for dietary advice. More comprehensive data is available.[21]

Fructans (D-fructose polymers) occur as storage carbohydrates in various plants, especially those of the Graminaceae (wheat, barley, oats), Liliaceae (onions, leeks, asparagus) and Compsitae (scorzonera, lettuce, artichokes, sunflowers, Jerusalem artichokes) families. Corn and rice are virtually devoid of fructans. Fructans have been developed as an alternative sweetener to fructose.[17]

Restrictive diets

Exclusion of foods high in FODMAPs[5] results in a very restricted diet. This includes: fruits containing fructose in excess of glucose (apples, pears, watermelon); vegetables containing fructans (onions, leeks, asparagus, artichokes); wheat products; foods containing sorbitol; and foods containing raffinose (legumes, lentils, cabbage, brussel

Table 3. Fructose/sorbitol content of some foods[17,21]

Fruit	Fructose*	Sorbitol
Apple/juice*	<5–10 g	**
Pear/juice*	<5–10 g	**
Cherry	<5–10 g	**
Grape	<5–10 g	**
Watermelon	<5–10 g	
Prune	>10 g	>10 g
Plum	>10 g	**
Honey	>40 g	<2 g
Berries	<5 g	<2 g
Legumes	<5 g	<2 g
Sucrose sweetened soft drinks	>10 g/375 mL	
Confectionary	>10 g/50 g sucrose	
Dried fruit bars	>10 g	
Chewing gum		>10 g

* Fructose load in g/100 g edible portion

** Most fructose is added to commercial foods and drinks. Variations in content occur with seasonal and area growing conditions

sprouts). Lactose containing foods may also be excluded if lactose deficiency coexists. Although restrictive, a low FODMAP diet has been shown to be successful in managing patients with IBS.[5,18,19]

Austin et al[4] also describe a very low carbohydrate diet being successful in diarrhoea predominant IBS. The exclusion of fermentable carbohydrates probably alleviates symptoms such as bloating, diarrhoea and pain. Distension but not bloating is included in the Rome II Criteria for diagnosing IBS.[22] As Quigley noted, bloating and distension 'should be accepted as valid components of the IBS spectrum and no longer dismissed as unworthy to be seen in the company of their supposedly illustrious fellow travellers, pain and bowel dysfunction'.[23]

The role of diagnostic testing

The diagnosis of IBS is often a matter or exclusion, particularly when diarrhoea is predominant. Routine diagnostic testing with a full blood count, serum chemistry, thyroid function studies, stool for ova and parasites and abdominal imaging is not always necessary in patients with typical IBS symptoms and no alarm features such as rectal bleeding, anaemia and weight loss.[24]

However, screening for coeliac disease is important by measuring serum immunoglobulin A (IgA) and transglutaminase antibody (tTGA). A lactose breath hydrogen test should be considered if symptoms are clearly related to lactose ingestion. Breath tests with glucose or lactulose to diagnose small bowel bacterial overgrowth remain insensitive.[25]

Patients with symptoms that develop after the age of 40 years always require exclusion of underlying colorectal cancer by colonoscopy and biopsies should be taken to exclude microscopic colitis. Alarm symptoms such as rectal bleeding, weight loss or anaemia clearly require prompt investigation including a colonoscopy.

As many patients perceive their food intolerance to be an allergy, there has been a vogue for skin prick testing and other antibody tests. In general these are largely unhelpful,[26] with one study showing that skin prick testing was positive to only a single antigen in five of 56 patients (although there were elevated IgG4 antibodies titres to wheat, beef, pork and lamb). Antibody titres were not elevated in the presence of potatoes, rice, fish, chicken, yeast, tomato and shrimp, and no significant difference in IgE titres was observed between IBS and controls.

Monsbakken, Vandut and Farup[3] concluded, 'Perceived food intolerance is a common problem with significant nutritional consequences in a population with IBS. The uselessness of current antibody tests and tests for malabsorption and the lack of correlation to psychiatric comorbidity make the aetiology obscure'. Despite this, there is much that can be achieved in relieving symptoms and improving quality of life with dietary awareness and modification. Consultation with a dietician is useful when contemplating FODMAPs and other significant dietary restrictions.

Summary of important points

- IBS symptoms are often exacerbated by diet and food intolerances.
- Often symptoms result from a mix of lactose, FODMAPs, fat and caffeine.
- Investigations must be tailored to the individual patient but may include coeliac serology and lactose hydrogen breath tests.
- Alarm symptoms such as anaemia, bleeding and weight loss require prompt investigation and referral.
- Patients with symptoms that develop after the age of 40 years require colonoscopy.
- Dietary modifications are the mainstay of management in food intolerance, but care should be taken with restrictive diets and dietician input may be required.

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References

1. Thompson WG, Longstreth GF, Drossman DA, et al. Functional bowel disorders and functional abdominal pain. Gut 1999;45(Suppl II):II43–7.
2. Simren M, Mansson A, Langkilde AM, et al. Food related gastrointestinal symptoms in the irritable bowel syndrome. Digestion 2001;63:108–15.
3. Monsbakken KW, Vandvik PO, Farup PG. Perceived food intolerance in subjects with irritable bowel syndrome – etiology, prevalence and consequences. Eur J Clin Nutr 2006;60:667–72.
4. Austin GL, Dalton CB, Hu Y, et al. A very low carbohydrate diet improves symptoms and quality of life in diarrhea-predominant irritable bowel syndrome. Clin Gastroenterol Hepatol 2009;7:706–8.
5. Shepherd SJ, Parker FC, Muir JG, Gibson PR. Dietary triggers of abdominal symptoms in patients with IBS: Randomized placebo-controlled evidence. Clin Gastroenterol Hepatol 2008;6:765–71.
6. Davis AE, Bolin TD. Lactose intolerance in Asians. Nature (London) 1967;216:1244–5.
7. Bolin TD, Crane CG, Davis AE. Lactose intolerance in various ethnic groups in south-east Asia. Australas Ann Med 1968;17:300–6.
8. Bolin TD, Davis AE. Asian lactose intolerance, and its relation to intake of lactose. Nature 1969;222:382–3.

9. Davis AE, Bolin TD. Milk intolerance in south-east Asia. Nat Hist 1969;78:54–5.
10. Bolin TD, Davis AE, Seah CS, et al. Lactose intolerance in Singapore. Gastroenterology 1970;59:76–84.
11. Bolin TD, Davis AE. Lactose intolerance in Australian born Chinese. Australas Ann Med 1970;19:40–1.
12. Bolin TD, Morrison RM, Steel JE, Davis AE. Lactose intolerance in Australia. Med J Aust 1970;1:1289–92.
13. Vesa TH, Korpela RA, Sahi T. Tolerance to small amounts of lactose in lactose maldigesters. Am J Clin Nutr 1996;64:107–201.
14. Parker TJ, Woolner JT, Prevost AT, Tuffnell Q, Shorthouse M, Hunter JO. Irritable bowel syndrome: Is the search for lactose intolerance justified? Eur J Gastroenterol Hepatol 2001;13:219–25.
15. Simren M, Abrahamsson H, Bjornsson E. Lipid-induced colonic hypersensitivity in the irritable bowel syndrome: The role of bowel habit, sex, and psychologic factors. Clin Gastroenterol Hepatol 2007;5:201–8.
16. Rumessen JJ, Gudmand-Hoyer E. Functional bowel disease: Malabsorption and abdominal distress after ingestion of fructose, sorbitol, and fructose-sorbitol mixtures. Gastroenterology 1988;95:694–700.
17. Rumessen JJ. Fructose and related food carbohydrates: Sources, intake, absorption and clinical implications. Scand J Gastroenterol 1992;27:819–28.
18. Shepherd SJ, Gibson PR. Fructose malabsorption and symptoms of irritable bowel syndrome: Guidelines for effective dietary management. J Am Diet Assoc 2006;106:1631–9.
19. Barrett JS, Gibson PR. Clinical ramifications of malabsorption of fructose and other short-chain carbohydrates. Pract Gastroenterol 2007;31:51–65.
20. Shepherd SJ, Parker FC, Muir JG, et al. The FODMAP diet for irritable bowel syndrome: Food fad or roadmap to a new treatment paradigm? Gastroenterology 1970;137:383–6.
21. Muir JG, Rose R, Rosella O, et al. J Agric Food Chem 2009;57:554–65.
22. Drossman DA. The functional gastrointestinal disorders and the Rome II process. Gut 1999;45(Suppl):II1–5.
23. Quigley EMM. Impact of bloating and distension in irritable bowel syndrome: Have we wandered too far from the Manning Creed? Clin Gastroenterol Hepatol 2009;7:7–8.
24. Brandt LJ, Chey WD, Foxx-Orenstein AE, et al. An evidence-based review on the management of irritable bowel syndrome. Am J Gastroenterol 2009;104(Suppl 1):S8–35.
25. Riordan SM, McIver CJ, Duncome VM, Bolin TD. Bacteriological analysis of mucosal biopsies for detecting small-intestinal bacterial overgrowth. Scan J Gastroenterol 1995;30:681–5.
26. Zar S, Benson MJ, Kumar D. Food-specific serum IgG4 and IgE titers to common food antigens in irritable bowel syndrome. Am J Gastroenterol 2005;100:1550–7.

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