

Six ways to limit lactose whilst consuming dairy

Supporting dairy intake while managing the symptoms of lactose intolerance.

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Introduction

In this White Paper, Fonterra Nutrition Research Scientist, Dr Merrin Quilter outlines how low-lactose options can help support continued dairy consumption while managing the symptoms of lactose intolerance.

"Low-lactose products offer the ability for consumers with real or perceived lactose intolerance to continue to enjoy milk and dairy products and the important nutrients they provide, such as highquality protein, and the micronutrients calcium, phosphorous, potassium, magnesium, and vitamins A, B2 (riboflavin) and B12, without exceeding their body's ability to digest the lactose" says Dr Quilter.

MILK AND DAIRY PRODUCTS ARE RECOMMENDED IN DIETARY GUIDELINES THROUGHOUT THE WORLD AND ARE CENTRAL IN THE DIET OF MANY POPULATIONS WITH ONE TO THREE SERVINGS GENERALLY RECOMMENDED PER DAY (FAO, 2013).

Lactose is the main sugar naturally present in milk and dairy products, making up approximately 98% of the total carbohydrate content. It plays an important role in the absorption of calcium, magnesium and phosphorous, and the utilization of vitamin D. It also provides a fast source of energy for newborns; is needed for the development of nerves, providing galactose to help build nerve structures; and supports the development of the microbiota in the intestine to protect newborns from infection. It is a nutrientdense food option for adults which is flexible in the way it can be concentrated and fortified into a variety of formats; however, it is not always tolerated well by adults. Lactose intolerance refers to a combination of symptoms including stomach discomfort, bloating, flatulence, and diarrhoea, following consumption of foods containing lactose. It should not be confused with a dairy protein allergy which is a serious and life-threatening condition in some individuals. Whilst adults with a diagnosed dairy protein allergy are recommended to avoid dairy altogether, amongst those with lactose intolerance it is not necessary to completely avoid dairy, or even lactose - there are several strategies to help manage lactose intolerance and most people can safely consume up to 12 g of lactose (one glass of whole milk) at one time without experiencing gastric symptoms of intolerance (Suchy et al 2010). While the symptoms of lactose intolerance can be debilitating and have a negative impact on quality of life, they are transient and not associated with any long-term damage to the digestive tract.





Lactose is a disaccharide made up of two monosaccharides (individual sugar units): glucose and galactose. Its digestion requires a special enzyme in the intestine called lactase. Lactose maldigestion occurs when the amount of lactose consumed exceeds the amount that is able to be processed by the lactase enzyme. The remaining undigested lactose reaches the colon and is fermented by the gut microbiota, creating short chain fatty acids, hydrogen, methane and carbon dioxide. An excessive amount of these products can lead to the symptoms of lactose intolerance (He et al., 2006).

Lactose maldigestion is not a disease and it is not a reliable indicator of lactose intolerance. Lactase production is genetically controlled, and all mammals lose some degree of lactase activity after weaning. Low lactase activity is normal and occurs in around 75% of adults globally (Silanikove, Leitner & Merin, 2015); however, most people with low lactose activity do not experience any symptoms. The other 25% of the population maintain a high level of lactase activity throughout their life, due to a genetic mutation of several genes relating to lactase persistence. This gives an evolutionary advantage amongst populations that are reliant on milk and dairy products as part of their normal diet (Brown-Esters, Mc Namara & Savaiano, 2012). Those with a long history of dairy consumption and who continue to consume dairy throughout their life appear to maintain their ability to tolerate lactose throughout adulthood.

Lactose maldigestion occurs as a result of primary, secondary, or congenital lactase deficiency (Swagerty, Walling & Klein 2002). Primary maldigestion, also known as lactose maldigestion, lactase non-persistence, or hypolactasia, is the most common form and is caused by the normal loss of lactase activity upon weaning. Secondary maldigestion is transient and occurs as a result of damage to the gastrointestinal tract caused by disease, surgery, medication or radiation therapy. Congenital maldigestion is a rare condition where infants are born with complete lactase deficiency (Matthews et al., 2005).

The prevalence of lactose intolerance is reported to vary widely between populations worldwide, from 1% in some European countries, to almost 100% of adults in South East Asia (Silanikove, Leitner & Merin, 2015). However, the majority of cases are self-reported with medical diagnosis remaining relatively rare. Removing lactose from the diet in self-reported symptomatic individuals does not always result in improved symptoms, suggesting alternate causes of discomfort for some individuals e.g., irritable bowel syndrome, celiac disease, colitis, or enteritis (Vernia et al., 1995; Swagerty et al., 2002; Jankowiak & Ludwig, 2008). The symptoms are common to many food intolerances and gastric conditions, making accurate self-diagnosis difficult. However, whether real or perceived, lactose intolerance affects a number of people worldwide and there is an increasing global trend for health and wellness products, and a demand for low-lactose options.



Whether lactose maldigestion results in the symptoms of intolerance depends on many factors including: the amount of lactose consumed, how quickly it moves through the gut, and how well the gut microbiota is able to ferment lactose. While the most common approach to addressing lactose intolerance is to exclude lactose-containing foods from the diet (Montalo et al., 2006), eliminating milk and dairy products from the diet can have detrimental nutritional consequences. There are several key strategies that can help in the management of lactose intolerance:

1. LIMITING THE AMOUNT OF LACTOSE-CONTAINING FOODS CONSUMED AT ONE TIME

Limiting lactose intake to small amounts by spreading the intake throughout the day can alleviate the symptoms of lactose intolerance. Studies have shown that up to 12 g of lactose (one cup of whole milk) in a single dose can be tolerated without major symptoms in most people with lactose intolerance – particularly if consumed in conjunction with other foods (Suchy et al 2010).

2. CONSUMING LACTOSE-CONTAINING FOODS WITH OTHER FOODS

The consumption of milk and dairy products with other foods can aid tolerance as it slows gastric emptying (how quickly foods are emptied from the stomach) and subsequently the release of lactose into the small intestine: less lactose has to be digested at any one time (Heyman, 2006; Heaney, 2013). Furthermore, the food matrix and structure can alter lactose digestion. For example, yoghurt has a semisolid structure which slows how quickly food moves through the gut, leaving more time available for lactose digestion (Heyman, 2006; Bailey et al., 2013).

3. CHOOSING DAIRY PRODUCTS THAT ARE NATURALLY LOWER IN LACTOSE

Some dairy products are naturally lower in lactose. For example, yoghurt and cheese production involves the fermentation of milk by lactic acid bacteria, converting a large amount of lactose into lactic acid. Yoghurts, particularly those with live cultures, are often well tolerated in those with lactose intolerance (Rabot et al., 2010; Zaitlin et al., 2013). Hard cheeses are also naturally lower in lactose including Gouda, Swiss, Mozzarella, Parmesan, and Cheddar (Suchy et al., 2010; Bailey et al., 2013).



4. CHOOSING LACTOSE-FREE OR LOW-LACTOSE PRODUCTS

Lactose-free dairy products are considered the ideal replacement for regular dairy products for those with lactose intolerance, as they continue to offer the beneficial nutrients associated with dairy consumption (Bailey al., 2013). Alternative "milk" beverages are not a nutritionally equivalent replacement for cow's milk as despite variable levels of fortification, they are lacking in some of the essential nutrients present in milk. Consumption of these beverages can lead to suboptimal intakes of some of the key nutrients found in milk including protein, magnesium, potassium, B2 (riboflavin) and vitamin B12 (Bailey et al., 2013).

5. TAKING ADDITIONAL LACTASE TO INCREASE ENZYME ACTIVITY IN THE SMALL INTESTINE

A relatively new addition to the choices available for those with lactose intolerance is to take a lactase enzyme pill. These are designed to be ingested with the lactose-containing food and have been shown to improve lactose digestion (Suchy et al., 2010; Bailey et al., 2013).

6. MODIFYING THE ABILITY OF COLONIC BACTERIA TO DIGEST LACTOSE

There is some evidence that regular consumption of lactose-containing foods may improve the ability of the bacteria in the colon to digest lactose (Briet et al., 1997; Savaiano et al., 2001; Szilagyi, 2015). Furthermore, galacto-oligosaccharides (GOS) may help these bacteria to more effectively ferment lactose and may be a novel way to improve lactose digestion and lactose tolerance (Savaiano et al., 2013).



Low Lactose for Medical and Healthy Ageing Populations

The symptoms of lactose intolerance may be more common amongst older adults due to the accumulation of damage to the gastrointestinal tract over a lifetime. This leads to reduced stomach acid secretion, altered enzyme activity, poorer protein digestion, an altered gut microbiota, and inflammation. When combined with an ageing immune system, a greater prevalence of chronic diseases and multiple medications, this creates a higher likelihood of secondary maldigestion, even amongst those with the lactase-persistence genetic mutation. This supports an increased need for low-lactose products for medical nutrition and healthy ageing applications.

Small quantities of lactose are present in many foods—not only in milk and dairy products, but also foods containing: milk solids, whey, curds, milk powders, milk protein concentrates, whey protein concentrates, whey protein isolates, and whey permeates. NZMP[™] offers low-lactose ingredient options. Whether through hydrolysis, microfiltration, or simple separation, many of our ingredients have low lactose content, or can be formulated to enable low lactose final products whilst offering functional benefits. The claims "low-lactose", and "lactose-free" are not well defined and regulations vary widely between countries. "Low-lactose" requirements often range from <0.5% to <0.1%, while "lactosefree" is commonly <0.01%. To put this in context, whole milk contains approximately 5% lactose (5.2 g per 100 ml). Obtaining such low levels of lactose to enable "low lactose" claims is technically difficult, particularly in powders, and also requires highly sensitive analytical methods to determine the low levels present. These requirements set a much lower threshold than what is required from a nutritional standpoint to manage the symptoms of lactose intolerance.

Low lactose powders can be highly functional and impactful in a range of formats. These products offer greater optionality, particularly for the medical nutrition and healthy ageing market.







From a nutritional perspective, there are three key benefits of low-lactose products: 1) they allow lactose intolerant people to consume milk and dairy products without gastric discomfort, 2) they support the continued consumption of dairy and the valuable nutrients it provides for a healthy balanced diet, and 3) they provide a naturally sweeter taste due to the free sugars released following lactose-hydrolysis. Depending on the product, this may mean that less added sugar, maltodextrin or sweeteners are required to achieve the preferred level of sweetness, reducing the additional calories. The ability to make a "no added sugar" content claim will depend on the final formulation and relevant local food regulations. There is no evidence that low-lactose products affect the body any differently (e.g., gastric emptying rate or glycaemic response) compared to normal dairy products (Dekker, Koenders & Bruins, 2019).

Lactose intolerance, whether real or perceived, should not be a barrier to consuming dairy products. Among older adults with lactose intolerance, low-lactose products offer an approach to maintaining consumption of milk and dairy products as part of a healthy well-balanced diet.

Table 1: Hero products in our medical nutrition portfolio, enabling a range of formats, textures, and protein levels whilst achieving low lactose status in a variety of regulatory jurisdictions.

	WPI 8855	WPI 895	CaCas 380	MPI 4900
Calories kcal/100g	385	385	385	366
Protein g/100g	93.5 (as is)	93.9 (as is)	92.6	85.3
Carbohydrate g/100g	0.4	0.4	0.1	1.4
Fat g/100g	0.3	0.3	1.0	1.5
Lactose g/100g	0.4	0.4	0.1	1.4

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