



Lactose

The unsung hero



The first thought that springs to mind when thinking about lactose, is lactose intolerance. This is such a pity because lactose has so much more to offer. This article aims to explore what lactose is and how it contributes to better health in ways you have never imagined.

Firstly, what is lactose?

Lactose is an intrinsic sugar, naturally found in milk. It is a disaccharide made up of two monosaccharides, glucose and galactose and is colloquially referred to as ‘milk sugar’.¹ Typically, 4% of full-cream cow’s milk is made up of lactose² and it is also the main source of energy in full-cream milk, followed by fat and then protein.

Does low-fat milk have more lactose than full-cream milk?

Before discussing how much lactose is present in milk, it is important to point out that according to law, all milk must have 3% protein/100 ml. The fat varies according to the prescribed fat classes. When the milk arrives at the dairy, all milk offered for human consumption is processed and the cream is skimmed to the legal limit through a process called ‘standardisation’ after which the milk is homogenised, heat treated and packed. During packaging, the percentage of fat is then added back. The fat percentages in milk according to regulations are:

- >3.3%–4.5% for full-cream
- >1.5%–3.3% for medium-fat
- >0.5%–1.5% for low-fat
- ≤ 0.5% for fat-free.³

This means that the only potential variant is the carbohydrate (lactose) portion. Due to the slight change in volume of milk versus fat, there is a negligible increase in lactose in low-fat or fat-free milk versus full-cream milk. In other words, low-fat and fat-free milk by proportion have more ‘milk’ due to

their lower fat content. If in doubt, a good place to look is on the list of ingredients. If there is no sugar on the ingredients list, it means that no sugar has been added to the milk.³

What about dairy products?

The lactose content of dairy products varies according to their composition or the production process. Therefore, some dairy products are lower in lactose.

A starter culture (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*) converts some lactose in fermented dairy products to lactic acid (hence the sour taste), making these products lower in lactose.⁴ When cheese is made, the curds and whey (containing the lactose) are separated from each other. The curd is what is used to make cheese and the whey is usually strained off. The amount of whey remaining in the cheese product depends on the type of cheese. Soft cheeses typically contain more whey and thus are also slightly higher in lactose. Hard and semi-hard cheeses contain a small amount of entrapped whey, which helps to aid the ripening process. During ripening, the starter bacteria continue to ferment some of the remaining lactose, which also adds to the texture and flavour development of various cheese types.⁴ As a result, hard and semi-hard cheeses contain almost no lactose. Table 1 illustrates this point:

Table 1:
Typical lactose content of a variety of dairy products²

DAIRY PRODUCT	TYPE	g/100 g
Milk		
Full-cream		4.8
Low-fat		4.87
Fat-free		5.09
Yoghurt		
Low-fat		3.3
Full-cream		3.3
Double cream (Greek-style)		3.3
Cream		
Cream (35% fat)		3.3
Cheese		
Cream curd (mascarpone, quark, cream cheese like Philadelphia)		3.6
Fresh (ricotta, soft mozzarella, crumbly feta)		0.7–4.6
Cottage		1.8
Mozzarella		0.7
Soft (Brie, Camembert, chèvre, Roquefort, Gorgonzola)		traces
Semi-hard (Cheddar, Gouda)		traces
Hard (e.g., Parmesan, pecorino, Grana-Padano)		traces

Total sugars

But wait, should one even be talking about lactose as a sugar?

Consumers may be led to think that lactose is comparable to free sugar or sucrose because they have the same 'last name' (i.e. sugar).² This could not be further from the truth because free sugars are different from intrinsic sugars regarding outcomes like non-communicable diseases (NCDs), obesity, and even dental health.⁵ Let us explore the difference between these two distinct groups.

According to the World Health Organization (WHO), the term 'total sugars', or 'sugars', include:⁵

Intrinsic/inherent sugars

Intrinsic sugars are naturally present in the structure of intact fruits and vegetables (fructose) and in plain milk (lactose). In other words, they form part of the food matrix, which is the 'physical domain that contains and/or interacts with specific constituents of a food (e.g. a nutrient). It provides functionalities and behaviours which are different from those exhibited by the components in isolation or a free state'.⁶ This means that, whereas these foods do contain various forms of naturally occurring sugars, they also contain many other beneficial nutrients. Not only do these additional nutrients create a nutrient-dense profile, but they also alter how the sugar is absorbed by the body. In dairy products these beneficial nutrients include high-quality protein, fats, various bioactive peptides and important micronutrients like calcium, magnesium, potassium, phosphates and vitamins A, B2, and B12.⁴ There is no evidence linking intrinsic sugars, including lactose in dairy products, with NCDs.⁵

Lactose is actually the least sweet of all the sugars and is the only sugar of animal origin (excluding honey, which is made by bees, that technically are not animals).⁷ When lactose is compared to sucrose, it's relative sweetness is only 15%. Due to this low relative sweetness, it can be used in many commercial applications such as a commercial food thickener. It can also serve as an additive to improve the texture and appearance of food without having a notable impact on taste or caloric value.⁴

But heated milk is sweeter

Have you ever wondered why ultra-high temperature (UHT) processed milk tastes sweeter than fresh milk? When milk is heated above 100 °C, the glucose part of lactose is converted to fructose,⁸ which has a relative sweetness of 170% compared to sucrose.² Lactose comes to the rescue if you are trying to reduce your added sugar intake. Using long-life milk (or heating your milk in a milk frother or the microwave) may sweeten your cup of tea or coffee. It can help you reduce the number of sugars you add to each cup. Ultimately, every small step in the right direction can make an impact.

Free sugars

Free sugars are defined as monosaccharides and disaccharides that are added to foods and beverages by the manufacturer, cook, or consumer. These include

table/white sugar, brown sugar, beet sugar, cane sugar, and raw sugar.⁵ Free sugars also typically include other concentrated forms of sugar present in honey, syrups, fruit juices, and fruit juice concentrate.⁵

Free sugars are not only a concentrated source of energy that, if over-consumed, can lead to unwanted weight gain, but they are also low in or devoid of beneficial nutrients. Eating foods high in free sugars can displace more nutritious options and can lead to hidden hunger or micronutrient deficiencies. Weight gain and micronutrient deficiencies can increase the risk for developing a variety of NCDs like cardiovascular disease, diabetes, and even cancer.⁵

Chocolate milk is better tolerated than plain milk

What may surprise you is that chocolate milk may be tolerated better than unflavoured milk. The reason for this can be attributed to the cocoa, which slows gastric emptying, meaning that the lactose is reaching the large intestine more slowly. The more slowly this happens, the less lactose reaches the large intestine at any given time and less by-products are made (i.e. a smaller, lower stream of gas, instead of a big uncomfortable one). Always read the nutrition label to check if the chocolate milk you are using contains real cocoa. Some flavoured milks only contain chocolate flavouring and will unfortunately not have the same effect. One can also make homemade chocolate milk using cocoa powder and your choice of sweetener. This is a healthy, easy, and delicious way to add an extra serving of dairy to your day.^{10,11}

Know the difference between lactose intolerance and milk allergy

It is very important to distinguish between lactose intolerance and a milk protein allergy. Many consumers do not know the difference and wrongly avoid milk and dairy products when they have lactose intolerance. Milk protein allergy is an immunoglobulin E (IgE) -mediated allergy, which is quite rare in adults. This is an acute allergic, systemic, and sometimes fatal immune reaction that usually happens within a limited period after being exposed to the food antigen (i.e. cow's milk protein).¹ Lactose intolerance, on the other hand, is not a disease or allergy, it is simply an inability to effectively break down lactose.^{1,4}



What about lactose-free milk?

Lactose-free cow's milk is milk that has had lactase added to it. The lactase then breaks most of the lactose into glucose and galactose (which remains in the milk and gives it a sweeter taste). This means that when the consumer drinks the milk, the monosaccharides can be absorbed directly, with no enzymatic action needed. For those who are sensitive to lactose, this is a viable option, because one will still be getting all the beneficial nutrients from milk, without worrying about the lactose load. One can also try yoghurt or cheese, which, as was shown earlier, are naturally lower in lactose.⁴

One may ask why not simply add lactase to all milk and dairy products. Firstly, this would increase the price of the product, which may make it inaccessible to some, and secondly, lactose may actually offer us some health benefits. Unfortunately, much of the research has been focused on lactose maldigestion, and the general role of lactose in health and nutrition is not so well understood.⁴

Lactose can function as a prebiotic

Diet plays a significant role in shaping the microbiome (the community of microbes that lives in the gut). In turn, the microbiome has a complex relationship with health and risk of disease.² Its job is to ferment any substances that have bypassed digestion and absorption. There are substances (known as prebiotics) that humans are unable to digest, including fibre, resistant starch, and in some cases, lactose. The formal definition of a prebiotic is: 'A selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal microflora that benefits host well-being and health'.¹² They can be described as a microbiome fertiliser.

Interestingly, it is not just the microbes themselves that affect health, but also the products of their metabolism. Some of these products include short chain fatty acids (SCFAs) like acetate, propionate, and butyrate, as well as gases.² SCFAs have numerous health benefits, most notably metabolising by colonocytes that promote colon motility, reduce inflammation, increase visceral irrigation, induce apoptosis, and inhibit tumour cell progression. SCFAs can also be absorbed into the portal circulation and transported to the liver, where they could have beneficial systemic effects.²

Can lactose help with weight loss?

A number of studies have shown that an increased intake of dairy may be protective against weight gain and obesity, but it is difficult to know which component of dairy is helping.⁴ It may be related to

lactose as a prebiotic because prebiotics encourage the growth of beneficial microbes in the gut, promoting their growth and diversity. This change may influence energy homeostasis and metabolism as well as insulin sensitivity and fat storage. Beyond this, the SCFAs produced by lactose fermentation may also influence hormone-based satiety and appetite regulation.²

Lactose has a low glycaemic index (GI)

GI describes the postprandial response compared to a reference value (usually white bread or glucose). This reference value is equal to 100 and the comparison is then classified as low (55 or less), medium (56–69) or high (> 70). There is evidence to show that the consumption of low GI diets and the glycaemic load of a meal can improve glycaemic control in Type 1 and Type 2 diabetes. These diets are also associated with a reduced risk of Type 2 diabetes, which may be helpful in the reduction of total body fat and in weight management.¹³ Postprandial glycaemia is recognised as a relevant factor in overall health.²

Lactose has a low GI of 46² and, as shown in the table below, dairy products like milk and yoghurt are all considered to have a low GI.

In terms of diabetes management, lactose is a more acceptable carbohydrate than sucrose, glucose, or fructose. Along with lactose having a low GI, the presence of fat and protein in the food matrix of dairy products also slows postprandial absorption and lowers the glycaemic load. Milk and dairy products are therefore tolerated well by diabetic patients.² Furthermore, there is growing evidence that dairy significantly reduces the risk of developing Type 2 diabetes.

Table 2:

Glycaemic index (GI) of sugars and dairy foods²

Nutrient/food	GI
Glucose	99 ± 3
Fructose	19 ± 2
Lactose	46 ± 2
Maltose	0.5–1.5 g
Sucrose	68 ± 5
Milk (full-cream)	27 ± 4
Fat-free milk	32 ± 5
Yoghurt	36 ± 4
Low-fat fruit yoghurt with added sugar	33 ± 7

Lactose may improve calcium absorption

Most people are not consuming enough calcium-containing foods, a practice that is detrimental to health. Chronic low intake of calcium is related to diseases like osteoporosis, hypertension, and even some forms of cancer. The gastrointestinal tract (GIT) is the only port of entry for calcium, but unfortunately it is not always well absorbed.²

Whereas some animal studies have shown that lactose has a positive effect on intestinal calcium absorption, the effect on humans is inconclusive but probable.⁴ This has been tested in a number of situations:

- When one compares the effect of lactose against glucose or galactose, there is no enhanced calcium absorption. But this may be because glucose and galactose are constituents of lactose.⁴
- When one compares lactose to non-absorbable sugars, like mannitol, lactitol or corn starch, then lactose does improve absorption.⁴

Lactose may help with calcium absorption in a number of ways. These include an increase in passive transport of calcium in the GIT, and its prebiotic effect, which may promote the growth of calcium-absorbing microbes (directly or through the production of SCFAs).¹⁴

Lactose is the best ‘sugar’ for dental health

Sugars and starches are partly fermented in the mouth and feed bacteria, leading to plaque formation. As a by-product, these bacteria then produce acid that can demineralise teeth and lead to dental caries. The more fermentable the sugar or starch, the more likely it is to cause caries. Lactose is not rapidly fermented, and it also does not serve as a substrate for plaque formation. The most cariogenic sugars include sucrose, glucose, fructose, and maltose.²

Together with this, milk and dairy products also contain a variety of nutrients that are beneficial for dental health, including protein, calcium, and phosphorus.² Milk intake should therefore be encouraged to promote good dental health and will have a low probability of causing dental caries when compared to other calorie-containing drinks like soft drinks.



Conclusion

The effect of the food matrix should never be underestimated. We do not consume nutrients in isolation, and this includes lactose. Although it is defined as a sugar, it is an intrinsic sugar that is consumed together with a variety of very important nutrients, and because of that, cannot be compared to added sugars.

In terms of nutrition, it is important to take a food-centric approach. Patients should be encouraged to consume nutritious and healthy whole foods regularly and be educated to identify fear-mongering that targets specific nutrients. This is one of the reasons why the South African Food-based Dietary Guidelines focus on food and not nutrients. These guidelines encourage all South Africans to consume milk, maas, or yoghurt every day.¹⁵ The average South African's diet quality would improve significantly by adding these foods because they contain three of the four nutrients that most of our population are lacking: calcium, potassium, and vitamin A. The nutritional importance of dairy products in the context of a balanced diet and the key role that dairy plays in helping to reduce NCDs cannot be denied.

To wrap up, remember that the collective, synergistic health effect of consuming milk and dairy products in their whole form is stronger than that of individual nutrients. In other words, the ‘whole is greater than the sum of its parts’.



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