

LACTOSE INTOLERANCE

Lactose is the *sugar* in milk.

Lactose intolerance results from the lack of the enzyme that is necessary to digest lactose

Lactose intolerance is not an allergy.

An allergic reaction to milk involves a response of the immune system to the *proteins* in milk

A lactose intolerant person can consume milk and milk products if the lactose is removed before consumption

What is Lactose?

Lactose is actually two sugar molecules joined together: it is known as a disaccharide (di = two; saccharide = sugar). The digestive enzyme called **lactase** splits lactose into its two constituent sugars: glucose and galactose. These are single sugars, called monosaccharides (mono = one; saccharide = sugar). Monosaccharides are small enough to be transported across the cells that line the digestive tract and into circulation, where they are an important source of energy for many body functions. Lactose, being a disaccharide, cannot pass across the lining of the digestive tract.

What is Lactase?

Lactase, the enzyme that digests lactose, is made within the epithelial cells lining the digestive tract. If these cells are damaged, they are unable to produce adequate amounts of lactase. As a result, lactose is incompletely broken down into glucose and galactose. The undigested lactose remains in the intestines and eventually finds its way into the large bowel. Here millions of bacteria use any undigested food for their own nourishment, multiplying rapidly, and producing a large number of by-products. Usually a variety of gases, organic acids, and other irritating chemicals result from the activity of these micro-organisms. We feel the effects as excessive flatus, abdominal bloating, pain, loose stool, or diarrhea, and general distress in the lower intestines.

Incidence of Lactase Deficiency

In babies and young children

Virtually every baby has adequate supplies of lactase at birth to digest the lactose in its mother's milk. Lactase deficiency in infants is uncommon because lactose is the principal sugar in human milk and the baby needs lactase in order to digest it and provide the developing body with a crucial source of energy. There is a medical condition known as congenital alactasia, or primary lactase deficiency, in which the baby is born without the ability to produce the enzyme, but *this is an extremely rare event.*

A temporary lactase deficiency can develop in babies when there is inflammation in the digestive tract that damages the cells that produce the enzyme. The inflammation may be caused by a bacterial or viral infection, or a food allergy. This is known as secondary lactase deficiency, to distinguish it from primary congenital alactasia. Happily, in secondary lactose intolerance the cells rapidly return to normal when the infection subsides, or the food allergen is removed from the child's diet, and the usual level of lactase production is quickly re-established.

In Older Children and Adults

The majority of adults lose some degree of lactase activity after puberty. In certain ethnic groups, such as the Oriental races, African blacks, people of Middle Eastern origin, aboriginal peoples of North and South America and the Arctic, and Mediterranean people, lactose intolerance may be as high as 80% of the population. In contrast, only about 20% of people of northern European origin lose the ability to produce lactase. In most cases complete loss of lactase does not occur, but the enzyme is produced at such a low level that consumption of large quantities of milk and milk products containing lactose leads to the uncomfortable symptoms of lactose intolerance.

Secondary lactase deficiency can occur in adults as well as children. Bacterial and viral infections, and sometimes the use of strong drugs and medications taken by mouth, such as antibiotics, may cause damage to the fragile digestive tract epithelial cells. If lactose was tolerated prior to the epithelial damage, regular lactase activity will be resumed as soon as the cells return to normal.

Distinguishing Between Milk Allergy and Lactose Intolerance:

It is frequently very difficult to distinguish milk allergy from lactose intolerance on the basis of clinical symptoms alone, because some of the symptoms such as abdominal pain, diarrhea, nausea, vomiting, gas, and bloating, are common to both conditions. However, milk allergy often results in symptoms in other organs, such as the upper respiratory tract (for example, a stuffy, runny nose), pain, itching, fluid drainage from the ears, or skin reactions (such as eczema or hives), which lactose intolerance does not.

Since secondary lactase deficiency is a consequence of inflammation in the digestive tract, the intestinal inflammation caused by milk allergy can sometimes result in lactase deficiency. Thus, both milk allergy and lactose intolerance can exist together. Because milk is the only source of lactose in the normal diet, eliminating milk from the diet will cure both conditions, but will not distinguish which was the cause of the symptoms. It is important to determine which condition is causing the problem, because milk and milk products are a significant source of nutrients, especially for infants and young children, and should not be eliminated unless it is absolutely necessary to do so. Furthermore, eliminating milk from the diet entirely is not easy, because so many different foods, such as baked goods, soups, salad dressings, gravies, desserts, and so on, contain milk, and avoiding them can make meal planning very difficult.

Laboratory tests for lactose intolerance

There are a number of laboratory tests that are often used to identify lactose intolerance:

The **Fecal Reducing Substances Test** is considered by many clinicians as the most reliable. After a drink containing lactose, the feces are collected and Fehling's solution added. The presence of undigested lactose in the stool will be indicated by a change in colour, indicating that lactose has not been digested, and thus suggesting a deficiency in lactase production.

The **Hydrogen Breath Test** is a more common test for lactose intolerance. In this test the patient ingests a quantity of lactose and after a prescribed interval, a breath sample is analysed for the presence of hydrogen. If hydrogen is detected, it indicates that bacteria in the digestive tract have acted on undigested lactose and produced hydrogen as one of their metabolic by-products. Unfortunately, this test is not specific for lactase deficiency, because any sugar remaining in the digestive tract will be metabolized by bacteria with the production of hydrogen. Undigested sucrose, maltose, or a starch will give a similar result.

The **Blood glucose test** involves measurement of the level of glucose in the blood after taking a drink containing 50 g of lactose. An increase in blood glucose indicates that lactose has been broken down to glucose and galactose, the levels of which rise in the blood when the body is producing an adequate amount of lactase. Measuring the level of galactose would be equally informative. If there is no increase in the level of glucose in the blood, lactose intolerance is confirmed.

If the feces collected after the above lactose drink are acidic, with a pH of 6 or lower (the **fecal pH test**), it is an indication that microorganisms in the large bowel have fermented the undigested lactose. The microbial activity results in the production of acids, which lower the pH of the stool. Thus the diagnosis of lactose intolerance is further reinforced.

Management of Lactose Intolerance

Lactase deficiency is easier to manage than cow's milk protein allergy, because any milk or milk product free from lactose can be consumed with impunity. Lactose-free milk is available as

products such as Lacteeze or Lactaid . Alternatively, a commercial form of lactase (sold as Lactaid liquid) can be added to the milk before consumption. After 24 hours in the fridge, the lactose is split into its two component sugars, glucose and galactose, which the body can absorb and use without harm. Alternatively, a lactose-intolerant person can take Lactaid pills before consuming milk products containing lactose. The lactase in the pills will break down much of the lactose in the food or beverage while it is passing through the digestive tract. All of the nutrients and proteins in milk are thus available to the body, and the risk of nutritional deficiency as a result of long-time avoidance of milk can be avoided.

It is more difficult to avoid lactose in prepared foods; anything containing milk or milk solids is likely to contain lactose also. Some people find that they can consume lactose-containing foods with impunity if they take Lactaid tablets before eating.

Lactose intolerance is **dose-related**. Usually the cells are producing a limited amount of the enzyme lactase, and small doses of foods containing lactose can be processed. Problems occur when the amount of lactose in the food exceeds the capacity of the enzyme to digest it. The important thing is to determine individual tolerance levels. By remaining within personal limits, symptoms should not occur. Most people who are lactose intolerant can drink a 6 ounce glass of milk without symptoms, but experience abdominal discomfort if they exceed this amount.

When lactose intolerance has been diagnosed, the degree of lactase deficiency can be assessed by taking increasing quantities of lactose in a variety of dairy products (Table 1).

Feeding the Lactose-Intolerant Baby

The Breast-fed Baby

A breast-fed baby will ingest significant quantities of lactose in mother's milk. *The lactose composition of her milk will remain constant, regardless of whether or not mother consumes milk and dairy products.*

If the baby's lactose intolerance is secondary to a gastrointestinal tract infection or other condition that is expected to be transient, some authorities advise continuing breast-feeding and expect the diarrhea to gradually diminish as the underlying inflammation disappears.

Some practitioners recommend placing a few drops of Lactaid liquid directly into the baby's mouth before a feeding. This may provide enough of the enzyme to break down some of the lactose in mother's milk, and thus reduce the baby's digestive tract symptoms.

Alternatively, mother can pump her breast milk and treat the milk with Lactaid drops (4 drops per 250 ml milk), and allow the enzyme to act for 24 hours in the fridge. The baby is fed the lactose-free milk the next day. This is continued until the diarrhea abates, when the baby can be gradually put back to the breast.

The Formula-Fed Baby

Infant formulas that are lactose-free can be given to a lactose intolerant infant.

If the baby is not allergic to milk, the milk-based formulas Enfalac Lacto-Free (Mead Johnson), or Similac LF (Ross) which are free from lactose is suitable.

If the infant is allergic to cow's milk proteins, but tolerates soy, a soy-based formula such as Prosobee (Mead Johnson), Alsoy (Nestle) or Isomil (Ross) may be suitable.

If the infant is allergic to both cow's milk and soy proteins, a casein hydrolysate formula such as Alimentum (Ross), Enfalac Nutramigen (Mead Johnson) or Enfalac Pregestimil (Mead Johnson) may be tolerated. All are free from lactose.

THE LACTOSE-RESTRICTED DIET

Lactose Restrictions

Foods, medications and beverages containing milk and milk solids all contain lactose, unless specifically labelled "lactose-free".

Products labelled as containing lactose, milk, milk solids, milk powder, cheese and cheese flavour, curd, whey, cream, butter, and margarine containing milk solids should be avoided.

Products containing lactic acid, lactalbumin, lactate and casein **do not** contain lactose and can be consumed.

Acidophilus milk is milk to which a bacterium called *Lactobacillus acidophilus* has been added. These bacteria do not break down lactose to any great extent, so *the milk would not be tolerated by people with a lactose intolerance.*

Milk and Milk Products Suitable for a Lactose-Restricted Diet

Adding the enzyme lactase (commercially available as Lactaid) to liquid milk, and allowing the enzyme to act for a minimum of 24 hours in the refrigerator will make it digestible, and no substitutes are then necessary. The amount of the enzyme that needs to be added will depend on the degree of lactase deficiency. Instructions are provided with the product. Usually, 15 drops in 1 litre of milk will render it 99% lactose free; 10 drops reduces the lactose to 90%; 5 drops will produce a milk that is 70% lactose free.

Lactaid tablets may be taken before eating or drinking lactose-containing products and may be sufficient to break down the amount of lactose consumed in the following meal.

Lactaid milk or Lacteeze milk that are 99% lactose free are available in the dairy section of most grocery stores. These are tolerated by lactose-deficient individuals, but are more expensive than regular milk.

Hard, fermented cheeses are usually tolerated since most of the lactose is removed with the whey during their manufacture (refer to Table 2 for levels of lactose in individual products).

Fermented milks such as yogurt and buttermilk may be tolerated, because the level of lactose in these products is reduced (but not completely eliminated) by bacterial enzymes. Lactaid drops mixed in the yogurt in the doses indicated above, and the product refrigerated for 24 hours, may render it acceptable for the severely lactose-intolerant individual.

THE LACTOSE RESTRICTED DIET

Restriction of all lactose will be required initially.

Phase I should be followed until the digestive tract symptoms improve.

Subsequent liberalization of these restrictions, by gradually introducing increasing amounts of lactose-containing food, will determine each individual's limit of tolerance for lactose.

Phase II Lactose tolerance is determined by introducing milk and milk products in a dose-defined sequence.

Table 1

PHASE I: AVOIDANCE OF LACTOSE

Type of Food	Foods Allowed	Foods Restricted
Milk and Milk Products	<p>Milk treated with 15 drops of Lactaid per litre, and refrigerated for 24 hours before consumption</p> <p>Commercial Lactaid milk</p> <p>Milk-free substitutes: Soy beverages, such as SoGood SoNice</p> <p>Rice beverages, such as Rice Dream</p> <p>Potato-based beverages such as Darifree</p> <p>Coffee-Rich</p> <p>Many hard cheeses (see Table 2)</p>	Avoid all except those on “allowed” list

Type of Food	Foods Allowed	Foods Restricted
BREADS AND CEREALS	<p>Breads and baked goods without milk, *milk derivatives or milk products</p> <p>Some breads (read labels!) Most French or Italian bread Some Whole Wheat Bread Some Rye Bread Soda Crackers Bagels Pasta</p> <p>Plain cooked or ready to eat breakfast cereals All plain grains</p>	<p>Baked goods containing milk, milk derivatives or milk products</p> <p>Breakfast cereals and pablum containing milk, milk solids, milk products, or milk derivatives</p>
VEGETABLES	<p>All pure vegetables (raw or cooked) and their juices</p>	<p>All prepared with milk or milk derivatives, such as: Creamed Scalloped Mashed with milk, cream or any milk derivative Breaded or battered with milk-containing breading or batter All cream sauces Instant potatoes</p>
FRUIT	<p>All fresh, frozen fruits and their juices, raw or cooked Canned fruits without added milk-derived ingredients</p>	<p>Any fruit dishes with milk-containing toppings or sauces, such as: Custard Blancmange Cream Ice cream Any manufactured fruit dishes, packaged, canned or frozen, with milk ingredients</p>
MEAT, POULTRY, FISH	<p>All pure fresh, frozen or canned meat, poultry or fish without added ingredients All processed meat, poultry, and fish without milk, milk</p>	<p>Any meat, poultry or fish that is: Breaded Battered Creamed</p>

Type of Food	Foods Allowed	Foods Restricted
	products or milk derivatives	Served with a cream or milk-based sauce
EGGS	Plain boiled, fried, poached Scrambled without milk Omelette without milk, cheese, or any milk derived ingredient	Any egg dish prepared with: Milk Cream Cheese Butter Milk-containing margarine
LEGUMES	All plain legumes without added milk and milk-derived ingredients, such as: Beans and dried beans Peas and dried peas Lentils Dals Peanuts Peanut butter	Any with milk or milk-derived ingredients, such as: Milk Cheese Butter Milk-containing margarine
NUTS AND SEEDS	All plain nuts and seeds without added ingredients	Any nuts and seed mixtures or dishes containing milk or milk-derived ingredients such as: Butter Milk-containing margarine Cheese
FATS AND OILS	All pure fats and oils such as: Vegetable oils (e.g. corn, sunflower, safflower, olive, canola, grape seed, peanut, soy) Lard Meat dripping Shortening Milk-free margarines, such as: Parkay Diet Spread Fleischmann's low sodium Milk-free real Mayonnaise	Butter Margarines with whey or milk solids Salad dressings with milk or milk-derived ingredients
HERBS AND SPICES	All	None
SWEETENERS	All that are lactose-free	Any containing lactose (read labels!)

*** Milk derivatives include:**
Milk solids

Casein
Hydrolysed casein
Whey
Hydrolysed whey
Lactose

Table 2**Levels Of Lactose In Normal Serving Sizes Of Common Foods And Beverages**

PRODUCT	SERVING SIZE	LACTOSE (Grams)
Sweetened condensed milk	125 mL (½ cup)	15
Evaporated milk	125 mL (½ cup)	12
Whole milk	250 mL (1 cup)	11
2% milk	250 mL (1 cup)	11
1% milk	250 mL (1 cup)	11
Skim milk	250 mL (1 cup)	11
Buttermilk	250 mL (1 cup)	10
Ice milk	125 mL (½ cup)	9
Ice cream	125 mL (½ cup)	6
Half-and-half light cream	125 mL (½ cup)	5
Yogurt, low fat	250 mL (1 cup)	5
Sour cream	125 mL (½ cup)	4
Cottage cheese, creamed	125 mL (½ cup)	3
Whipping cream	125 mL (½ cup)	3
Cottage cheese, uncreamed	125 mL (½ cup)	2
Sherbet (sorbet), orange	125 mL (½ cup)	2
American (Jack) cheese	30 g (1 oz)	2
Swiss cheese	30 g (1 oz)	1
Blue cheese	30 g (1 oz)	1
Cheddar cheese	30 g (1 oz)	1
Parmesan cheese	30 g (1 oz)	1
Cream cheese (e.g. Philadelphia)	30 g (1 oz)	1
Lactaid (lactase-treated) milk	125 ml (½ cup)	0.025
Butter	5 ml (1 tsp)	trace

Phase II

DETERMINING LACTOSE TOLERANCE LEVELS

Lactose intolerance is **dose related**. Usually, a certain amount of the lactase enzyme is being produced, and some lactose can be processed. It is important to establish how much lactose can be broken down at one time (Step 1) and how much lactose can be processed over the day (Step 2)

Step 1:

Day 1: Morning (Breakfast)

Eat a portion of food containing 1 gram lactose, for example:
1 oz or 2 tbsp cream cheese

If there are no symptoms of intolerance double the amount of lactose the next day.

Day 2: Morning (Breakfast)

Eat a portion of food containing 2 grams of lactose, for example:
2 ounces or ¼ cup cream cheese or
½ cup of uncreamed cottage cheese

If there are no symptoms of intolerance increase the amount of lactose on day 3.

Day 3: Morning (Breakfast)

Eat a portion of food containing 5 grams of lactose, for example:
1 cup of yogurt (regular or low fat)

If there are no symptoms of intolerance increase the amount of lactose on day 4.

Day 4: Morning (Breakfast)

Eat a portion of food containing 10 grams lactose, for example:
1 cup (250 mL) of milk (homogenized; fat-reduced 2%; 1% or skim)

Step 2:

To establish how much lactose may be tolerated over the day, go back to the amount last tolerated. (For example, on day 2, 2 grams of lactose were tolerated, but on day 3, there was bloating, cramping and diarrhea following one cup of yogurt)

Day 1: Morning (Breakfast)

Eat a portion of food containing the amount of lactose tolerated in step 1 (for example 2 grams lactose)

Evening (Dinner)

Repeat the morning procedure.

If there are no symptoms of intolerance increase the number of servings on day 2.

Day 2: Morning (Breakfast)

Eat a portion of food containing the amount of lactose tolerated in step 1.

Repeat the process at lunch and dinner.

A Few Ideas for Milk Substitutes on a Lactose-Reduced Diet

Beverages

Lactaid Milk and Lactaid Hot Chocolate

Combine 1 Tbsp (15 mL) of pure cocoa with 1 Tbsp sugar.
Mix in 1 Tbsp cold water until smooth.
Stir in 1 cup of hot Lactaid milk.

Fruit and Vegetable Juices

All pure vegetable and fruit juices without added ingredients

Coffee and Tea

Clear coffee, tea and herbal tea

In place of milk add:

Lactaid milk

Rich's Coffee Rich

Soya beverages (SoGood, SoNice, EdenSoy, etc) without milk-derived additives (read labels)

Others

Soft drinks and mineral water

Alcoholic beverages except cream-based liqueurs

Liquid meal replacers

Liquid nutritional supplements such as Boost, Enercal, Ensure, Resource

Soup

For a soup base:

Clear stock

Clear broth or bouillon

Defatted meat drippings

Tomato or vegetable juice

Read labels on canned stock based soups, and avoid milk or cream-based soups.

Desserts

All desserts and baked goods made without milk or milk products, for example:

Angel food cakes
Gelatin fruit desserts (Jello)
Rice Dream desert
Milk-free soy ice desserts
Fruit ices
Popsicles
Fresh, frozen or canned fruit

Sorbet made in a food processor

1 banana
A dash of lemon juice
1-1½ cups of frozen berries
Add sugar or Sugar Twin to taste

Condiments and Snacks

Salt and pepper
Tabasco, Worcestershire sauce, soy sauce
Ketchup, mustard, relish, pickles
Air popped popcorn
Potato chips
Tortilla or nacho chips and salsa
Hard and gelatin candy in moderation.

Avoid milk chocolate and candies made with restricted ingredients, such as:

Toffee
Caramels
Chocolates

Dining in Restaurants:

Dining in regular restaurants should pose no difficulty, as many milk-free foods are included on all restaurant menu
Check with the server to ensure that the dish is milk-free
Most fast food restaurants will have lists of the ingredients in all their menu items; avoid those that contain milk or its derivative