Spectrum

Milk for the lactose-intolerant

An enzyme derived from a selected strain of fungus is being used by a milk factory at Drouin, Vic., to produce milk powder suitable for the Asian market, where lactose intolerance is a widespread problem.

The lactase enzyme involved was produced in Japan from the fungus *Aspergillus oryzae*, purified, and chemically bonded (or 'immobilized') onto particles of ion-exchange resin. Letting milk pass for a few minutes through a bed of the resin causes the bulk of the lactose (milk sugar) in the milk to split or, more technically, hydrolyse into the simple sugars glucose and galactose — the same process that happens normally with lactase enzymes in the stomachs of those not intolerant.

About 10% of Australians cannot easily digest lactose because their intestines produce little lactase enzyme. Instead, bacteria in the gut ferment the lactose. The resulting gas and increase in osmotic pressure cause discomfort, distention of the abdomen, flatulence, and even vomiting and diarrhoea.

Lactose intolerance is an inherited characteristic, and it mainly affects Asians and Aborigines. As infants, these people produce sufficient lactase enzymes, but for some reason they lose this ability shortly after infancy.

The immobilized-enzyme technique was developed by researchers from the Sumitomo Chemical Company, who worked with Dr Greig Zadow of the Dairy Research Laboratory of the CSIRO Division of Food Research, and a consortium of Australian companies, to commercialize the process.

Lactose hydrolysis has been known for many years, but the cost of the enzyme, when added in soluble form, inhibited commercial use of the process. Immobilizing the enzyme on resin particles means that the enzyme is not consumed, so it can be re-used day after day for many months, and off-flavours are avoided.

World-wide, a small number of immobilized enzymes have been developed, but these have been generally restricted to use at low pH, making them suitable for hydrolysing lactose in whey but not in milk. The Japanese product is capable of hydrolysing lactose over a wide pH range, making it suitable for both milk and whey. The Drouin plant is the first unit in the world to apply it commercially.

The Drouin factory's equipment for splitting lactose.

The role of CSIRO was to design a suitable reactor system for the immobilized particles. A most important aspect was bacteriology, since the reaction operates at a temperature at which bacteria can quickly proliferate. How to clean the system and keep it free of bacteria for 10 or 20 hours of continuous operation posed further problems that required a number of ingenious answers.

With an increase in Australia's Asian population, health professionals can expect to come across more cases of lactose intolerance. Lactose-hydrolysed products will offer these people a source of dairy products in an easily digested form, with all the nutritional components fully intact.

The Australian Dairy Corporation is working with other members of the consortium towards the eventual production and marketing of a whole range of lactose-hydrolysed products, including whole and skim milk, skim milk powder, glucose/galactose syrup, yogurt, ice cream, and iced confections.

Besides the Corporation, the consortium includes, as mentioned, CSIRO and Sumitomo, together with Miles Laboratories, Hydrolysed Products, and APV–Bell Bryant.

Hydrolysed skim milk powder has been well received during trials in South-east Asia, where the product could become part of school milk programs in the region.

Another aspect is international aid. In 1977, Dr John Mitchell and colleagues published a paper on how lactose intolerance inhibited weight-gain in Aboriginal children. In it they also noted that 'Our findings should re-emphasize the global implications of aid programmes which use milk produced by a basically lactose tolerant Western world. Since large scale hydrolysis of lactose in milk is practicable, the modification of all milk

Lactose hydrolysis converts two-thirds to three-quarters of the lactose into its components, glucose and galactose. This is sufficient to allow lactose-intolerant people to consume dairy products in normal quantities.

Lactose in dairy products

product	lactose content (g per 100 g)
ice cream	8·1
cow's milk, skim	4·8
cow's milk, whole	4·6
yogurt, natural	4·6
cream	3·0
cottage cheese, creamed	2·4
processed cheddar cheese	1·0
firm cheese	0

before it is used in international aid programmes should be seriously considered.'

Dr Zadow says that, as the World Health Organization distributes about 200 000 tonnes of skim milk powder annually, adoption of such a recommendation would have a profound effect on the demand for hydrolysed skim milk powder.

Lactose-hydrolysed milk tastes sweeter than ordinary milk. In fact, lactose hydrolysis is equivalent to adding about 2% sucrose, which means that less sugar is needed to obtain the same sweetness. This should allow development of products for the diet-conscious, such as flavoured milks, yogurts, and ice confections with little or no added sucrose.

When applied to whey, the process produces a concentrate — a syrup of glucose and galactose — which can be used as a sweetener in its own right.

The Drouin milk factory was finding whey disposal to be a serious problem, and saw the hydrolysis process as a way of turning a waste stream with a high pollution potential into a valuable sweetener.

Whey, the by-product of cheese and casein manufacture, contains minerals and high-quality proteins, as well as its main constituent lactose. Dr Zadow reckons that 40 000 tonnes of lactose is made available annually in Australia from the manufacture of 120 000 tonnes of cheese. At present, most of this is discarded.

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