Whey

Little Miss Muffet ate her whey, but in Australia vast amounts of this by-product of the manufacture of cheese and other dairy products go to waste and can cause serious pollution. Research by scientists in CSIRO and the Victorian Department of Agriculture now shows promise of putting the valuable nutrients it contains to good use in food for stock and people. If this can be done, the effluent disposal problems of dairy factories should be greatly reduced.

Between 1400 and 1800 million litres of whey are produced in Australia each year, containing about 8000 tonnes of high-quality protein, 70 000 tonnes of lactose (milk sugar), and large amounts of vitamins and minerals. A low ratio of protein to carbohydrate (1:6) and a high ash content (10–12% of the dried solids) are the factors that have so far left pigs as virtually its only users for food.

The seriousness of the disposal problem has grown greatly since World War II, with big increases in whey production and a strong tendency for small, local factories to be replaced by fewer, much larger ones. In fact the position is such that the Secretary of the Australian Institute of Dairy Factory Managers and Secretaries, Mr A. E. Hacquoil, predicted in 1972 that within the foreseeable future any factory that had not found a solution would be forced to close or switch to a product not involving whey.

A survey was made in 1970 of member factories of the Victorian Whey Utilization Association, formed by manufacturers to encourage the development of uses. This found that, although 60% of the whey was utilized (42% as pig feed and 18% to irrigate pastures), 40% was dumped on land or put into watercourses or sewage systems. Changes in product range and improvements to disposal facilities have since eased the situation, but it remains serious.

The main problem with discharging it into streams and sewage plants is its great capacity to absorb oxygen dissolved in water. This high biological oxygen demand, about 100 times greater than that of municipal sewage, is due to the protein and carbohydrate whey contains. It takes the oxygen dissolved in 20 million litres of water to satisfy the demands of 4500 litres of whey.

Scientists at the CSIRO Division of Chemical Engineering began work on the separation of wanted from unwanted portions in 1969, using the techniques of reverse osmosis and ultrafiltration. Reverse osmosis can be used to remove the water and some salts and acids from whey; these pass through a membrane, while most of the dissolved solids are trapped and concentrated. In ultrafiltration more dissolved solids pass through the membrane, but the proteins, because they are large molecules, are trapped. By removing different amounts of lactose, the protein: carbohydrate ratio can be increased to any chosen level. This opens up a wide vairety of possible uses.

Development work has been undertaken by groups led by Mr Lawrie Muller at the CSIRO Dairy Research Laboratory, Dr Allan Griffin at the Department of Agriculture's Gilbert Chandler Institute of Dairy Technology at Werribee, Dr Russell Smith at the Division of Chemical Engineering, and Mr John Stewart at the Department of Agriculture's Ellinbank Dairy Research Station.

Whey Products Australia Limited, a company formed by four member companies

of the Whey Utilization Association, arranged for the installation of three types of ultrafiltration plant at the Cororooke factory of the Colac Dairying Company. A whey product with a protein concentration judged suitable for animal nutrition has been made there.

The researchers conducted trials at the Ellinbank Research Station, comparing the progress of calves fed commercial skim-milk-based products with that of others fed experimental mixtures with 35, 50, and 100% of their protein derived from the whey product. The calves did equally well with all feeds. The most practical product was judged to be a 50:50 mixture of skim milk and protein concentrate made from the whey produced during casein manufacture. Trials that followed on 16 commercial farms were equally successful, and large-scale production of the mixture appears economically feasible.

The CSIRO Dairy Research Laboratory is looking at uses for whey protein products in fizzy drinks, baked foods, and sweetened condensed milk. The Gilbert Chandler Institute is working on a process for making yoghurt.

Widespread use in calf feed would take up much of the whey protein now causing pollution. If research on uses in food for people is successful, much more is likely to be put to use. The whey disposal problem in Australia may well be on the road to solution.

Tackling the whey problem. *Rural Research* No. 84, 1974, 2–6.

The role of the dairy industry in environmental pollution control. I. Control of pollution. A. E. Hacquoil. II. Whey utilization. L. L. Muller. *Australian Journal of Dairy Technology*, 1972, **27**, 123–8.