Development of the LAFTI™ range of probiotic cultures

Introduction
Probiotics are mono or mixed cultures of live microorganisms which, when applied to man or animal, beneficially affect the host by improving the properties of the indigenous microflora. Some of the beneficial effects that a probiotic culture can have on its host include improved digestion and absorption of various nutrients (e.g. lactose, starch), production of vitamins and growth factors, protection against pathogens, stimulation of the immune response, reduction of cholesterol levels and reduction of diarrhoea.

In addition to the culture having a proven health benefit, there are many other important criteria to consider when developing a probiotic culture to commercial reality. It needs to survive and preferably colonise the gastrointestinal tract. It needs to have good technological properties, such as satisfactory growth in production media, and to survive not only processing conditions but also final applications, such as yoghurt or other foods.

The selection of probiotic cultures therefore requires extensive screening to meet all these criteria and, after several years of R&D by the CRC for Food Industry and Innovation in collaboration with DSM Food Specialties, a range of potential probiotic cultures were identified. Three of these cultures – Bifidobacterium lactis LAFTI™ B94, Lactobacillus acidophilus LAFTI™ L10 and Lactobacillus paracasei LAFTI™ L26 – were found to meet the functional and technological requirements for use as probiotic cultures in the food industry.

Functional properties
The initial target was to select for strains that inhibit food-borne pathogens such as Salmonella, Listeria and Escherichia coli O111. In vitro screening, followed by some in vivo animal studies and food application studies demonstrated that a number of cultures were effective in protecting against these pathogens. For example, Figure 1 illustrates the in vivo inhibitory effect of L10 against Listeria monocytogenes. All three cultures contributed towards inhibition of E. coli O111 and L. monocytogenes during manufacture of salami, thereby contributing towards improved safety of foods that occasionally may contain pathogens such as these.

Other important probiotic properties have since been reported for these three LAFTI™ cultures including inhibition of tumour formation by L10® and production of folate by B94®.

These three strains have also been demonstrated by in vitro screening to survive conditions of the human gastrointestinal tract, including acid and bile tolerance. Recent in vivo studies have demonstrated that all three strains survive in the human gastrointestinal tract. All strains can be detected in stool samples during and after feeding with the cultures. In some subjects given B94, this strain was detectable for at least 4 weeks after termination of feeding [Su et al., unpublished observations]. It is known that other related probiotic strains may be detected for a week after terminating oral administration. This indicates that B94 is doing well in the human gastrointestinal tract, and survives better than most other related strains.

Technological properties
The ability to grow and yield well in production media and to survive the downstream processing required to provide highly concentrated frozen or freeze dried forms were investigated for these three cultures. Unlike some of the other cultures investigated, they were all demonstrated to be highly robust. This robustness carried through to survival in many food applications such as yoghurt, cheese, couvertures, ice-cream and meat products.

Probiotic cultures are most commonly marketed in yoghurt products where they need to be able to survive a low pH over a shelf-life of 4-6 weeks. Figure 2 demonstrates the survival of the three LAFTI™ cultures in yoghurt stored at 4°C over 6 weeks.

Conclusion
Research on the three LAFTI™ strains L10, B94 and L26 clearly shows that they all possess appropriate technological and probiotic properties that make them suitable for application in the food industry.

Future research
Research on these LAFTI™ probiotic cultures continues, with studies and clinical trials being conducted to
demonstrate further their beneficial health effects and food application prospects. Probiotic studies include investigation on their effect on vitamin metabolism and mineral uptake. Other studies include investigation on the effect of these cultures in irritable bowel syndrome (IBS) which is a common problem in the western world. Preliminary data from ongoing studies are encouraging and indicate that B94 in particular alleviates IBS related symptoms. The addition of these cultures into other foodstuffs such as fruit juice, health drinks, cheese and infant formula is being investigated with promising results. These probiotic cultures are part of the second generation of probiotic cultures that are being introduced worldwide.

Figure 1. Effect of fermentation of salami with traditional meat starter culture (FloraCarn) or NTMS cultures (LAFTI™ B94, B22, L10, L26, B74 and L24), on faecal Listeria. Control mice were fed salami batter containing no other added cultures than LM3. Faecal Listeria was monitored 16 (■), 20 (■) and 23 (■) hours after feeding fermented batter. Animals of all groups consumed approximately 1 x 10⁸ – 3 x 10⁸ cfu LM3. Results are expressed as the mean ± S.D. for 6 animals per group. *Significantly different to the control (P < 0.001), **Statistically different from the control (P < 0.02). Presented results are typical of three independent experiments.

Figure 2. Survival of LAFTI™ L26 (▲), L10 (◆) and B94 (■) in yoghurt. Initial count (at T₀) was 10⁶ CFU/ml of each strain.