Probiotics and Human Health

**The Need:** Consumers recognize the importance of probiotics and prebiotics: substances in foods that provide health benefits such as improved digestion, a stronger immune system and reduction of lactose intolerance symptoms. Dairy foods, notably yogurt, have long been recognized as a probiotics source. Drinkable yogurt sales rose 18.4 percent to $7.76 billion between 2005 and 2006, making it the fastest-growing food category, with sales of more than $1 billion worldwide.

**Serving the Need:** N.C. State University’s Food Science Department has a long history of probiotics research and product development, including the development of Sweet Acidophilous Milk. N.C. State’s Southeast Dairy Foods Research Center, led by Dr. Todd Klaenhammer, participated in a collaboration with the California Dairy Research Foundation, Dairy Management, Inc, and Danisco USA, Inc. to sequence, assemble and annotate the complete genomic sequence of *Lactobacillus acidophilus* NCFM, the probiotic culture used most widely in yogurt, yogurt drinks and Sweet Acidophilus Milk. Through this effort, Klaenhammer and colleagues identified genes important for the survival and activity of probiotic cultures in both yogurt and in the human gastrointestinal tract. The research group made the following key contributions.

- Genetic tools, now used internationally, were developed that allow the inactivation or deletion of key gene regions, to functionally investigate the metabolic, physiological and probiotic roles of the organism.
- Genetic regions were discovered that direct acid tolerance, bile tolerance, promote attachment to intestinal epithelial cells, antigen presenting cells and signal communication with immunomodulatory cells of the intestinal mucosa that help direct pro- or anti-inflammatory responses.
- The region responsible for the ability of *Lactobacillus acidophilus* to metabolize prebiotic compounds was identified and characterized.
- A genetic region involved in oxalate utilization and degradation was identified. Oxalate, a component of many foods, can cause calculi (stones) in the urinary tract. The discovery suggests that probiotics may be used to lower oxalate concentrations in the GT tract and minimize calculi, such as kidney stones.
- Over 10 provisional patent applications have been filed on various gene classes.

In addition, the program has produced six doctoral students who received the prestigious Kenneth R. Keller Award. The Keller Award, which carries a $1,000 prize, is given annually to the student in the College of Agriculture and Life Sciences with the most outstanding doctoral dissertation.

**Impact beyond North Carolina:** Sequencing the DNA of *Lactobacillus acidophilus* NCFM has provided the world’s dairy industry with knowledge to develop probiotic foods that help improve human health. As consumer demand for probiotic foods grows, research will help the industry develop new products to support new solutions.

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