The confectionery industry is one of the fastest growing segments in the global food market. It represents a broad array of products that can be divided into four categories: jellied candies; aerated and/or grained confections; caramels, fudge and toffees; and chocolate and compound coatings. Of these, chocolates and chocolate-coated products account for nearly 50 percent of U.S. confectionery sales. Retail forecast sales for U.S. confections are expected to reach $29 billion. With the growing demand for confectionery products worldwide, it is critical for manufacturers to take concerted actions to improve product quality and ensure product safety.

The confectionery industry, both here and abroad, boasts an outstanding safety record. From 1999–2003, less than 11 percent of 1,146 Food and Drug Administration food recalls were due to chocolates and non-chocolate candy products (Figure 1). Less than five percent of these recalls were microbial in nature.

Highly proficient processing systems, which employ high roasting temperatures (221°F to 302°F) to kill virtually all microbes on raw cocoa beans, and the low moisture content of chocolate products discourage the growth of pathogenic and spoilage organisms.

Although rare, serious microbial problems, most notably *Salmonella* spp., can occur when water is introduced into the processing environment, and contaminated ingredients that are not exposed to lethal temperatures beyond the roasting step are incorporated into products during postprocessing. *Salmonella* is most commonly identified as a pathogen of concern in chocolate products and cocoa powders, as illustrated in Figure 2. In a highly publicized 2001 incident involving chocolate and chocolate bars, 373 cases of *Salmonella* infections were reported in Germany and other European countries. Furthermore, only small numbers of the organism (estimated at 11 to 28 cells per 10 g) were recovered from the chocolates.

To further advance this safety achievement, confectioners must remain vigilant in their safety efforts.

### UNDERSTANDING MICROBIAL ECOLOGY

Understanding the nature of microorganisms (including their sources and growth characteristics) is key to microbial control in confectionery plants. Microorganisms gain access to food-processing areas through multiple routes (e.g., raw materials, personnel and equipment traffic, water leaks and pests). Failure to implement appropriate and effective process and sanitation controls could allow these microbes, including pathogens, to become established in the processing environment where they may be able to survive for extended periods of time and recontaminate product.

Food residues that accumulate in hard-to-clean and difficult-to-reach areas can harbor these microorganisms. Given the proper conditions of time, water and temperature (Figure 3), microbes that are not removed via dry cleaning can multiply, leading to microbial growth niches or “hot spots.” Confectionery plants provide optimum tem-