Foodborne Salmonella Typhimurium Survival and Virulence Expression during Food Processing

**Issue**
Salmonellosis is one of the most common foodborne diseases in the United States. Given that *Salmonella* can originate from a wide variety of food production environments, reduction of this organism at all stages of food production is critical. This project has three components designed to address this problem. Our specific research program goal reflects an integrated approach for controlling *Salmonella* spp. and other foodborne pathogens at all stages of food production. The relative incidence of *Salmonella* spp. foodborne disease continues, despite the growing body of information regarding the most common contamination routes. During its life cycle *Salmonella enterica* serotype Typhimurium can encounter various environmental stress conditions which may have dramatic effect(s) on its survival and virulence. Although there is considerable information regarding environmental signals that control growth and pathogenesis in animals and humans, little is known about the biology of *Salmonella* during food processing. Research is needed to determine the environmental factors that are critical for survival of this pathogen and therefore must be modified to prevent the early establishment of *Salmonella* in food processing environments and virulence expression under these conditions.

**Action**
Our current food production *Salmonella* spp. research projects have emphasized studies on the growth, survival and pathogenesis of the organism under conditions encountered during poultry processing. However, the success of *Salmonella* spp. in becoming re-established in the gastrointestinal tract of food animals during certain phases of processing indicates that *Salmonella* spp. can competitively interact with the dynamics of the food matrix. Based on these observations, our plan is to continue to focus on salmonellae metabolism and genetic regulation of stress responses when grown under processing conditions and determine how these overlap with expression of virulence when foodborne *Salmonella* spp. become pathogenic. The outcome of this research has implications not only for persistence of foodborne salmonellae in processing, but raises practical issues regarding the choices of antimicrobials as intervention steps in processing. Issues we are now pursuing include whether thermal treatment predisposes salmonellae to be more resistant to particular antimicrobials and how these conditions might influence virulence and pathogenic characteristics of salmonellae. Molecular techniques will delineate some of the phenotypic responses we have observed thus far and examine virulence expression of *Salmonella* under typical food production and processing conditions.

**Impact**
Illness from *Salmonella* contaminated poultry is a huge problem. Despite the best efforts of the conventional poultry industry, the levels of *Salmonella* contamination are increasing. It is estimated that in the U.S., *Salmonella* causes more than 1.3 million persons to become ill, 553 deaths and economic losses of $2.4 billion annually. A total of 5,000 foodborne illness outbreaks with a known etiology and vehicle occurred from 1990-2004. Raw chicken and chicken products were linked to 214 outbreaks of foodborne illness and of these, 195 were caused by *Salmonella*. One of the objectives of the Healthy People 2010 Initiative (2000) established a goal of no more than 6.8 cases of salmonellosis/100,000 persons, which is half of the baseline rate of 13.6/100,000. Unfortunately, in 2006, a rate of 14.8 cases/100,000 was reported which was higher even than the baseline rate. Thus, *Salmonella*-mediated foodborne illness continues to be a serious problem. There are many potential foodborne vehicles, but contaminated poultry meat has been implicated as a major contributor to salmonellosis both in the U.S. and in Europe.

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