EPIDEMIOLOGICAL APPROACHES FOR FOOD SAFETY

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Epidemiological studies are important in identifying the multiple factors involved in food safety and providing the science-based data for policy decisions. The Epidemiological Approaches to Food Safety Program was initiated in FY99 to provide funds for interdisciplinary research on the epidemiology of foodborne pathogens. Projects focus on the identification of sources and reservoirs of pathogenic organisms and their toxins in food, animal feed, and the environment; determination of the levels of microbial contamination in finished food products; identification of risk factors and possible intervention or management strategies; identification of farm-based solutions that contribute to decreased prevalence of foodborne pathogens; development of outcome measures for the impact of intervention or management strategies on microbial contamination; and identification of potential sites of contamination in the processing, transportation, retail setting, and consumer use of food products.

2000-02499 Epidemiology and Ecology of Antibiotic Resistance Determinants on Dairy Farms

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The increasing rate of development of bacterial resistance to antibiotics has been well-documented, and this has major consequences for human and animal health. There is a considerable lack of data regarding the ecologic and epidemiologic forces that drive the spread and persistence of antibiotic resistance genes in agricultural settings. Therefore, through a 3-year prospective study in 6 Illinois dairies, we have the following specific objectives: 1) To evaluate antibiotic resistance profiles of commensal and pathogenic bacteria over time in order to assess factors that influence changes in antimicrobial susceptibility; 2) To study the bacterial genes that confer antimicrobial resistance in order to elucidate the ecology of these genes in the natural environment; and 3) To develop and validate quantitative sampling methods for monitoring antimicrobial resistance and to build mathematical models that predict the spread and persistence of resistance genes on the dairy. Feces from all cows in the study will be cultured for bacterial organisms in the genera *E. coli*, *Salmonella*, *Enterococcus*, and *Prevotella*. Milk samples will also be cultured. The results of this study, descriptive and analytical, will greatly increase our understanding of the epidemiology and ecology of antibiotic resistance. On the dairy farm, critical points for controlling resistance will be identified. Efficient monitoring and sampling strategies will be identified. The risk of gene transfer between commensal and pathogenic bacteria will be estimated.

2000-2501 A Novel Strategy to Test and Monitor Beef Feedlot Food-Safety Control Points

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The goal of this project is to improve food safety by developing efficient, effective methods to determine the *Escherichia coli* O157:H7 and *Salmonella* status of pens of feedlot cattle and to reduce the potential that these foodborne pathogens leave the feedlot. Pen testing will reduce time, cost, and labor and avoid detrimental animal welfare effects of handling finished cattle prior to shipping (shrink, dark cutters, and bruising). Additionally, most conceivable interventions to reduce human foodborne pathogens in feedlot cattle are directed towards pens. Based on preliminary data, a pen-testing protocol has been identified that shows promise as a monitoring tool for feedlot production HACCP programs and as a research tool to identify and test potential HACCP control points. Objectives of this project are to

complete validation of this pen-test for *E. coli* O157:H7 and *Salmonella* shedding; determine what a positive (or negative) pen test means in terms of length of time cattle may be shedding *E. coli* O157:H7 or *Salmonella* in commercial feedlots; identify potential control points using risk factor analyses; and disseminate results to researchers, industry partners and consumers. This research will provide the beef production industry with effective monitoring tools to be used in HACCP programs to reduce the risk of cattle leaving the feedlot carrying foodborne pathogens.

2000-02492 National Pediatric Diarrhea Surveillance Study

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The major goals of this project are to gain a better understanding of the causes, risk factors and outcomes of foodborne disease related diarrhea in children under the age of 3 in the United States. The first goal of this proposal is to determine a) the prevalence of specific bacterial, viral and protozoal pathogens in the stools of 1000 healthy children between 6 months and 3 years of age who are representative of U.S. children with respect to geography, family income, and ethnicity, b) the incidence of acute diarrheal illness occurring among these children and c) the incidence of infection with specific bacterial, viral and protozoal foodborne pathogens associated with clinical illness. The second goal is to characterize the type of gastrointestinal illnesses that occur in these children, the duration, treatment, and sequelae occurring within two months of acute illness. The third goal is to identify risk factors for diarrheal illness and infection with specific foodborne pathogens in these children. Risk factors to be studied include consumer practices related to food (and water) purchasing, handling, storage, and cooking in the home. This study we will obtain unique data on the causes and outcomes of diarrheal disease in young children in relation to foodborne pathogens. Consumer data will define potential sites and routes of contamination within the home environment. These data will be of great value in understanding foodborne disease in relation to agricultural products in a vulnerable section of the population that is thoroughly under investigated.

2000-02491 Epidemiological Aspects of Combining *E. coli* O157:H7 Control Programs and Feedlot Performance

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Escherichia coli O157:H7 has emerged as a significant public health concern over the past decade. The source of this pathogen in cases of human illness is usually related to contaminated feeds, including beef products. Control of *E. coli* O157:H7 in the beef industry will require a concerted effort from all segments of the industry, including the farm level. The goal of the current project is to determine the extent to which specific management practices concomitantly affect cattle performance and fecal shedding of *E. coli* O157:H7 in feedlot cattle. Our hypothesis is that inappropriate management practices, such as poor pen hygiene and feed and water management, not only predispose cattle to shed *E. coli* O157:H7, but that these same management practices reduce performance in feedlot cattle, thereby affecting feedlot revenues. We will use an observational study design to identify specific management factors which are associated with *E. coli* O157:H7, providing the factual information required to design on-farm control programs. We will also investigate the relationship between these management factors and average daily gain and feed efficiency, thereby providing the motivation for feedlot producers to implement control schemes. Our specific research objectives are as follows: 1) To determine which management practices are related to fecal shedding of *E. coli* O157:H7 in feedlot cattle; 2) To quantify the relations between management practices that foster the shedding of *E. coli* O157:H7 and feedlot cattle performance, as defined by average daily gain and feed efficiency.

2000-02489 Food-borne Antibiotic-Resistant and Extraintestinal Pathogenic *E. coli*

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Antibiotic-resistant Escherichia coli (ABREC) and extraintestinal pathogenic *E. coli* (ExPEC) are significant health threats and may be transmitted through the food supply. However, little is known regarding the prevalence or distribution of ABREC or ExPEC in retail foods. We will conduct a 2-year prospective microbiological survey of diverse food items from diverse retail markets to determine: (1) whether the commercial food supply constitutes a significant reservoir of ABREC and ExPEC for potential acquisition by humans and their household pets; (2) which types of foods and stores are associated with the highest prevalence and concentration of such organisms; (3) whether the prevalence of ABREC or ExPEC in retail foods varies according to season or increases over time; and (4) what proportion of food-borne ABREC strains exhibit multiple or transferable antimicrobial resistance. Retail foods will be selectively cultured to isolate and enumerate total *E. coli* and ABREC. ABREC and ExPEC will be detected and extensively characterized using state-of-the-art methods. Statistical analyses will be performed by an experienced statistician with input from a public health epidemiologist. The project will (a) identify sources and reservoirs of pathogenic organisms in food, and (b) determine the levels of microbial contamination in finished food products. This will allow consumers to modify their shopping or food preparation practices, and will identify for producers and the food safety community specific foods or types of markets deserving of further investigation, regulation, and/or modifications in food production and handling practices.