This research has allowed the opportunity to assess the potential for the application of biodegradable polymers as food protection systems.

# USE OF BIODEGRADABLE POLYMER SYSTEMS FOR FOOD PROTECTION

## Who cares and why?

Figure 1. Food sources of bacteria contamination.

Many health related cases due to the presence of foodborne pathogens, e.g., *Escherichia coli*, *Salmonella typhimurium* and *Clostridium difficile* are being reported daily and many are acquired during hospitalization. Other foodborne pathogens, e.g., *Listeria monocytogenes*, an invasive opportunistic and intracellular pathogen, remains one of the leading causes of mortality from food-borne infections. With a mortality rate of 24%, these pathogens are found mainly among immunocompromised persons. Most recently, highly infective strains of these pathogens have surfaced leaving investigators to speculate that these are associated with the consumption of certain foods, e.g., poultry, and milk products. Thus, new intervention strategies, involving the incorporation of biodegradable polymer systems and their derivatives into existing commercial management programs, are being investigated to reduce foodborne pathogen growth in the human food consumption chain. The overall impact of this project is to provide data on the use of biodegradable polymer systems to improve the quality of food and agricultural research. A large number of microbes from different ecological systems within the ceca of chicken were examined to determine requirements needed for optimal growth, production, and food safety. The focus of the aforementioned study complements current USDA-Agriculture Research Service (ARS) research laboratory in College Station, Texas, to develop cost effective means to prevent and/or control foodborne pathogens in poultry as causative agents of disease in consumers.

## What has the project done so far?

The present study has shown that *Salmonella typhimurium* which was grown in the presence of biodegradable polymers with molecular weights of 24, 86, and 298 kDa (laboratory adjusted), low molecular weight (LMW) at 50-190 kDa, medium molecular weight (MMW) at 190-310 kDa, and coarse molecular weight (CMW) at 310-375 kDa. Preliminary examination of the antibacterial activity of six chitosan preparations, three laboratory-adjusted molecular weight chitosans and three

Figure 2. A small drop of raw can cause severe illness.

broad-range commercial chitosans, on Gram-negative *Salmonella typhimurium* was performed in the presence of biodegradable polymer systems at 0.0025%, 0.005%, 0.01%, 0.02%, and 0.04% (w/v). The 0.04% level gave the best antibacterial activity as indicated by a decrease in Salmonella growth in *in vitro* studies. Additional studies have been performed with garlic and onion as a baseline for biodegradable polymer studies. These studies indicated that in the presence of garlic, the growth of *Listeria monocytogenes*, which was inoculated and incubated at room temperature, was completely eliminated while refrigeration temperature showed a favorable reduction of bacteria after 24 hours without its elimination. Further, in the presence of onion, the growth of *Listeria monocytogenes* which was inoculated and incubated at room temperature was completely inhibited at 24 hours and 192 hours at refrigeration temperature.

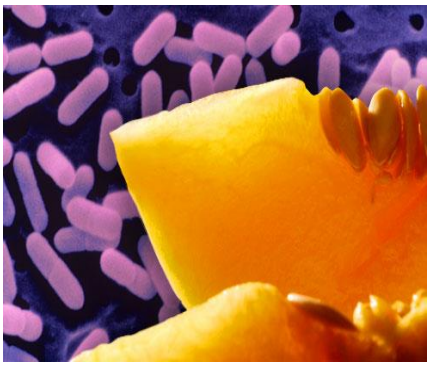

**Figure 3. Listeria bacteria can contaminate fresh produce.**

## Impact Statement

Approximately 9 million people per year become ill due to the ingestion of foodborne pathogens.

Many studies have been conducted to determine the anti-microbial properties of biodegradable materials. This study incorporates the use of modified biodegradable material as components in plastic wrappings to assist in reducing the growth of foodborne pathogens.

### What research is needed?

It is proposed to employ a plethora of techniques that range from chemistry, animal sciences, molecular biology, and phenomics. The quality of food and agricultural sciences research nationally will be greatly improved and would provide valuable information that could lead to major advances in new innovative strategies for managing the emergence of foodborne pathogens. Continuous studies will focus on determining the optimum conditions for inhibition of growth of *Salmonella Typhimurium* and *Listeria monocytogenes* using biodegradable polymer systems *in vitro*. *In vivo* studies will be performed whereby varied concentrations of biodegradable polymer systems will be introduced into broilers, the ceca will be removed and microbial activities in the chicken cecum will be assessed using phenomics. Phenomic profiling will determine if the bacteria microorganisms within microbiota isolated from chicken ceca were selectively enriched and if microbial metabolic activity was modulated.

### Want to know more?

Laura Carson, PhD, lecarson@pvamu.edu, 936-261-5010

**Additional links:** http://www.umes.edu/ard/Default.aspx?id=46285

**University and year:** Prairie View A&M University, 2014

This project is being supported by USDA Capacity Building Grant.