

CPRC Update - Maintaining broiler health through microbiome manipulations

During the course of the past six decades, the poultry industry has achieved a remarkable increase in production efficiency, largely driven through intensive breeding programs. However, this is in part at the expense of a decrease in reproductive performance and altered immune function. Consequently, a major challenge for the poultry industry is in controlling disease outbreaks caused by infectious agents. Growth promoting antibiotics (GPAs) promote the birds growth in addition to reducing pathogen burden. Removal of GPAs from Canadian livestock feeds is promoting interest in the identification of feed supplements that improve the immune system of industrial broilers and reduce pathogen burden. Although the mode of action of GPAs has yet to be elucidated, it is believed that they mediate growth through their antimicrobial activity on the gut microbiota of the birds; particularly pathogens and bacteria that cause growth depression.

Hundreds of species of microorganisms reside within the gastrointestinal (GI) tract of chickens, which confer a mutually beneficial relationship. A major contribution of these microorganisms is their ability to extract key nutrients in addition to limiting colonization by pathogenic species. Such benefits may be particularly significant for birds with compromised immune systems and thus there is much interest in identifying approaches to manipulate and maintain a healthy microbiome. While recent studies have demonstrated the potential of probiotics to reduce pathogen burden in the GI tract, it is not clear how they work or which formulations are most efficacious.

The Approach and Experiments

Dr. John Parkinson, from the University of Toronto and his research team aim to systematically study the precise mechanism through which probiotics operate by elucidation of active biochemical pathways. In addition, they aim to identify which probiotic species (or combination of species) provide the most beneficial effects. They will rely on next generation sequencing to both understand the dynamics of microbial populations in the chicken GI tract, as well as identify microbial and host factors that minimize pathogen burden. The overall strategy is to examine how the microbiome of specific locations of the chicken GI tract respond to dietary regimes over the lifetime of broiler birds, and how such changes impact the abundance of *Eimeria* and *Clostridium perfringens*. To ensure that these findings may be translated across poultry lines, the researchers will examine the role of genetics on pathogen burden and how modern breeding practices may have compromised host immune pathways and the host's ability to reduce pathogen burden.

In the first phase of experimentation, commercial diets in the presence and absence of GPA on commensal abundance and pathogen burden will be investigated. In the second phase, commercial diets will be supplemented with varying probiotic formulations. In the final phase, commercial diets supplemented with the three best performing formulations will be applied.

Preliminary Findings and Anticipated Outcomes

The first phase of the experiments have been completed and results are currently being analyzed. Preliminary findings suggest that significant changes occur in the gut microbiome over intestinal sites and bird ages, but the diet and the use of antibiotics had a modest effect. The second phase is currently underway and results will lead to the initiation of phase three.

Anticipated outcomes of this research will provide validation of defined probiotic formulations that minimize the colonization of the chicken GI tract by *Eimeria* and *C. perfringens*, in addition to a systematic framework for microbiome interventions that could be readily applied in the short term to the egg laying industry. Findings will ultimately assist in the elimination of GPAs from the poultry supply chain whilst maintaining consumer confidence in the safe consumption of poultry meat.

This research is funded by the Canadian Poultry Research Council (CPRC), ALMA, NSERC Discovery, Lallemand Animal Nutrition, Pitblado Chair, Hospital for Sick Children, University of Toronto, University of Alberta, New Life Mills and Aviagen.

CPRC, its Board of Directors and member organizations are committed to supporting and enhancing Canada's poultry sector through research and related activities. For more details on these or any other CPRC activities, please contact The Canadian Poultry Research Council, 350 Sparks Street, Suite 1007, Ottawa, Ontario, K1R 7S8, phone: [\(613\) 566-5916](tel:(613)566-5916), fax: [\(613\) 241-5999](tel:(613)241-5999), email: info@cp-rc.ca, or visit us at www.cp-rc.ca.

The membership of the CPRC consists of Chicken Farmers of Canada, Canadian Hatching Egg Producers, Turkey Farmers of Canada, Egg Farmers of Canada, and the Canadian Poultry and Egg Processors' Council. CPRC's mission is to address its members' needs through dynamic leadership in the creation and implementation of programs for poultry research in Canada, which may also include societal concerns.