ETH zürich

Coop Research Program

Image: Igor Ovsyannykov

Application of *Lactobacillus reuteri* to naturally prevent *Campylobacter* colonization of chicken

Final project fact sheet

***Campylobacter* species, mainly *C. jejuni* and *C. coli*, are the most commonly reported foodborne pathogens in the European Union, with contaminated chicken meat considered a major source of human infections. Among alternative strategies to prevent *Campylobacter* occurrence in poultry and poultry products, biocontrol approaches that involve the use of naturally produced compounds are receiving increased attention. The project showed the remarkable antimicrobial activity of reuterin, a broad-spectrum antimicrobial system produced by specific strains of *Lactobacillus reuteri (L. reuteri)*. A novel caecum fermentation model was developed and validated with a broad range of applications to investigate factors such as diet, feed digestion efficiency, enteropathogen contamination, drugs and natural biopreservation systems. The production of reuterin in the modelled chicken caecum microbiota supplemented with *L. reuteri* strains and glycerol indicate high potential for *Campylobacter* inhibition in the chicken gut *in vivo*.**

Motivation

Chicken meat is a good source of high-quality lean protein. However, consumption of chicken meat is the main source of bacterial *Campylobacter* infection in humans. Campylobacteriosis is currently the most frequently reported foodborne illness in the European Union, causing large economic losses for chicken farmers. The use of probiotics in animal feeding represents a sustainable strategy to control dangerous pathogens causing Campylobacteriosis. *Lactobacillus reuteri* (*L. reuteri*) is a bacteria commonly found in chickens' gastrointestinal tract that is able to produce reuterin, a potent antimicrobial compound. The use of *L. reuteri* supplementation in poultry farming could thus serve as an effective intervention to combat *Campylobacter* infection and to increase food safety.

Objective

The main objective of the research was to investigate a novel microbial-based approach to naturally reduce *Campylobacter* contamination of chicken flocks and meat using the probiotic *L. reuteri*. The project aimed at evaluating the *in vitro* antimicrobial efficacy of reuterin produced against *Campyloacter spp.* and thus to evaluate the potential of its use to control human foodborne infections resulting from chicken consumption.

Research Highlights

The results of the project showed the occurrence of reuterin-producing *L. reuteri* strains in the chicken gastrointestinal tract. The study also demonstrated the high inhibition efficacy and bactericidal effect of reuterin on *Campylobacter* using a large panel of strains isolated from human and chicken gut and meat.

Figure 1: Poultry farming (Image: Zoe Schaeffer)

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Results showed very low minimum inhibitory (MIC) and minimum bactericidal concentrations (MBC) against all tested 71 strains of *C. jejuni* and *C. coli*, which represent the two most commonly reported foodborne *Campylobacter* species. MIC and MBC concentration values were much lower compared to the high sensitivity indicator strain used to test reuterin, *E. coli K12*, indicating a unique potential of this compound as anti- *Campylobacter* agent. The project also developed and validated a novel *in vitro* chicken gut fermentation model of the chicken cecum. The model was used to simultaneously test *L. reuteri*, glycerol and reuterin production on the composition and activity of the chicken caecum microbiota. In the presence of a complex microbiota, the study found that glycerol and reuterin-producing *L. reuteri* strains induced the production of reuterin in the gut model. Furthermore, the supplementation of glycerol increased the production of short chain fatty acids, especially butyrate, which has been associated with several beneficial effects on intestinal cells and barrier, as well as an improved gut and host health.

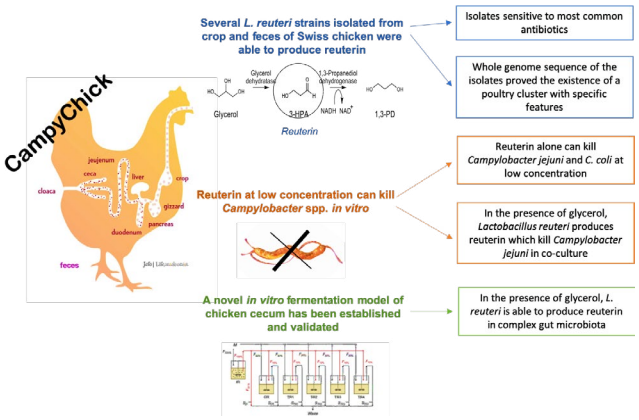

Figure 2: Main findings of the project

Relevance to Stakeholders

In this project, seventy *L. reuteri* strains have been successfully isolated from the gastrointestinal tract of chicken, and their physiological and genomic attributes have been extensively characterized. For the first time, the whole genome of a number of *L. reuteri* chicken isolates able to produce the bactericidal reuterin has been correctly assembled, annotated, and deposited in public database (NCBI). The availability of this whole genomic data significantly contributes to scientific knowledge on important *Lactobacillus* species in chicken.

Data from this study are important to understand how poultry diet can be modulated to optimize the chicken gut microbiota, prevent *Campylobacter* colonization and promote gut health. The next step will focus on testing the efficacy *in vivo*.

Selected Publications

Asare, P.T.; Zurfluh, K.; Greppi, A.; Lynch, D.; Schwab, C.; Stephan, R. and Lacroix, C. Reuterin Demonstrates Potent Antimicrobial Activity Against a Broad Panel of Human and Poultry Meat Campylobacter spp. Isolates. ***Microorganisms***. **2020**. 8(1), p.78.

Greppi A.; Asare T.P.; Schwab C.; Zemp N.; Stephan R. and Lacroix C. Isolation and comparative genomic analysis of reuterin-producing Lactobacillus reuteri from the chicken gastrointestinal tract. ***Front. Microbiol.*** **2020**. 11:1166.

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Project Duration 2017-2019

Funding WFSC Coop Research Program

https://worldfoodsystem.ethz.ch/research/research-programs/CRP/CampyChick.html

The WFSC would like to thank the Coop Sustainability Fund and the ETH Zurich Foundation for supporting this project.

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