



USE OF RED SEAWEEDS TO REDUCE *SALMONELLA* ENTERITIDIS IN LAYING HENS

Introduction

Food-borne *Salmonella* Enteritidis is one of a group of pathogenic bacteria that infects the intestinal tract of chickens, and can be transmitted to humans through the consumption of contaminated raw or undercooked eggs or meat products. Each year in Canada and United States, approximately 1.4 million people are infected with non-typhoid *Salmonella* serotype.

S. Enteritidis (SE) is transmitted in chickens through colonization of the gastrointestinal tract. It can extend into organs such as ovaries and oviduct subsequently infecting the inner contents of the egg. The ability of SE to establish persistent infection in the egg albumen and avian tissues is responsible for its invasion into the human food chain. Disinfectants are used to reduce the level of SE in the environment. However, pest and rodent carriers can reintroduce SE into these disinfected areas. Infection can be reduced with improved biosecurity and control practices. Vaccination is the most widely used preventive measure to control SE in layers. However other approaches incorporating natural antimicrobial products as feed additives have been widely investigated as methods to limit pathogen infections in poultry.

Red seaweeds are a rich source of bioactive compounds and secondary metabolites which impart several health benefits. In a previous study, feed supplementation of red seaweeds - *Sarcodiotheca gaudichaudii* and *Chondrus crispus* - reduced the prevalence of pathogenic bacteria in the gut of the chicken and increased the abundance of beneficial bacteria.

Objective

Determine the effect of dietary inclusion of red seaweeds on colonization of SE in laying hens and examine changes to intestinal bacteria and yolk fatty acid profiles.



Trial

Ninety-six end of cycle White Leghorns (78 weeks old) were placed into 6 treatment groups. These birds were fed a diet containing one of the following; 2% or 4% *Chondrus crispus* (CC2, and CC4) or *Sarcodiotheca gaudichaudii* (SG2 and SG4), an antibiotic or no additive for 5 weeks. On day 24 of the trial, 48 birds were orally challenged with SE using 2,000,000,000 bacteria/mL. Eggs and fecal samples were collected 1, 3, 5 and 7 days post inoculation and SE present was cultured. Seven days after inoculation, blood samples were collected, birds were euthanized and organs were evaluated for the presence of SE. DNA was extracted from the ceca samples of the birds to determine the changes in bacteria within the gut. Three samples of eggs from each treatment were randomly collected after week 1, 2 and 3 of the trial. Frozen yolk samples were pooled and analyzed for cholesterol and fatty acids.

Results

Dietary inclusion of two red seaweeds in feed resulted in a significant reduction of SE and increase in beneficial bacteria in the ceca for some treatments. Egg production and body weight did not drop for treated groups as it did for unsupplemented controls. An increased blood serum immunoglobulin (IgA) indicated improved immune function. Surprisingly, SE was not recovered from any of the uninoculated hens in the trial. The stocking density was 1 bird/ cage and feed troughs and fecal trays were constantly cleaned post inoculation. These conditions might have lowered the bacterial shedding into the environment.

The CC supplemented feed was effective in reducing SE count in the feces and cecal contents. This could be due to the ability of seaweed to block the initial attachment of the bacteria. Furthermore, none of the egg yolk samples were positive for SE in the trial. This could be due to the protective effect of egg's complex system of antimicrobial components.

The relative abundance of probiotic bacteria increased compared to pathogenic bacteria (SE) in the birds supplemented with CC (4%) which is the treatment group that showed maximum protection against colonization of SE. The short chain fatty acid analysis of cecal contents revealed increased gut microbe fermentation, suggesting another possible reason for the reduced SE counts in the CC fed birds.

Birds fed red seaweeds (CC and SG, 4%) showed increases in omega-6 and omega-3 fatty acids in the yolk. Previous reports suggest that n-3 series fatty acids are essential for the regulation of immune system and functioning of nervous and optic tissues. Hence, an increase in omega-6 and omega-3 in the yolk of red seaweed-fed birds (CC and SG, 4%) shows the immune modulating effect of red seaweeds, essential to combating bacterial pathogens.

Industry Impact

This work highlights the antimicrobial activity of red seaweed in layer hens. Since red seaweeds response was comparable to that of the antibiotic (Aureomycin) to combat *Salmonella* Enteritidis infection in laying hens, seaweeds can be used as an alternative or in combination with other forms of SE control.

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