

## MicroRogue: Galli (*Gallibacterium anatis*)

(J. Frey)



### Claim to fame: reduces egg production in chickens

Chickens, and in particular their eggs, have a very high nutritional value and provide essential substances such as proteins, fatty acids, vitamins, and minerals for much of the human population of our world.

Over decades, humans have been breeding chickens with improved capacity to lay eggs. While the hens got better and better at laying eggs, Galli (*Gallibacterium anatis*), a mean bacterium sneaked into chicken farms infecting the animals making them sick and unable to produce eggs. Today, Galli causes severe losses in egg production worldwide.

*Galli: the sneaky aggressor of laying hens and its tissue tropism.* Galli is a bacterium that normally resides in the ovaries and sometimes in the respiratory tract of hens. Over many thousands of years, Galli had adapted to live in chickens by producing specific suckers (called adhesins) on its surface that bind to receptors on chicken cells. *Tissue tropism* is the term we use for the ability of microbes to target and grow in particular tissues and organs of their host, such as the ovaries, by means of specific homing mechanisms like adhesins.

*Evolution of Galli to Aggressor-Galli through gain of a haemolysin.* Galli mostly lives in chickens unnoticed and without causing health problems. However, more recently some individuals acquired the ability to becoming aggressors by producing a toxin that makes hens ill. These Aggressor-Gallis are named *Gallibacterium anatis* subspecies *haemolyticum* (microbiologists like complicated Latin names!). The toxin is called a haemolysin because it is able to dissolve red blood cells. But this haemolysin toxin can also destroy other cells, including the cells in the ovaries of hens that are destined to produce the eggs. This makes Aggressor-Galli grow faster to the detriment of the hens, and damage the ovaries, so the chickens stop laying eggs.

But it is not just the haemolysin which increases the susceptibility of chickens to Aggressor-Galli. This MicroRogue also profits from the fact that breeding hens to become champion egg layers has come at a health cost, namely they have a weaker and somewhat slower acting immune system.

*Aggressor-Galli not only reduces egg production.* Once the dangerous, toxin-producing Galli get into the hens via the air or possibly the feed, they do not content themselves with the egg cells, but they also attack the lung cells and cause difficulties in breathing. Occasionally hens die from this infection.

## A child-centric microbiology education framework

*How to deal with Aggressor-Galli: antibiotics.* In order to cure the hens from the disease and battle against the aggressor-Galli, chicken farmers use antibiotics that kill the invasive Galli. This approach was initially successful and seemed to be a strategy to protect hens against disease and against loss of egg production.

However, with time, Galli found a way to make antibiotics harmless for themselves by changing the entry points on the surface of the Galli bacteria by genetic modification. Once this was successfully achieved, Galli-offspring became antibiotic resistant. In consequence, the antibiotics used by the chicken farmers to fight against the disease-causing Galli became useless. Chicken farmers saw how their hens stopped laying eggs and got sick or died in spite of the antibiotic treatment.

*How to deal with Aggressor-Galli: vaccines.* Researchers now try to find another solution that prevents the dangerous aggressor-Galli from causing disease in chickens, rather than having to combat it with antibiotics once it has already attacked the hens (*prevention* is almost always better than *cure!*). The means are vaccines. Knowing that the haemolysin toxin is the main weapon of Aggressor-Galli to cause disease, vaccines are designed to disarm Galli by making the hens produce by their own immune systems antibodies that neutralise the toxin.

To be effective, chickens must have these anti-toxin antibodies before Galli attacks, so that they are prepared to inactivate the toxin as soon as they recognize it. To produce such anti-toxin antibodies chicken need to be vaccinated. Since it is difficult to vaccinate each chicken individually with a syringe, oral vaccines, which are vaccines that can be given to the chickens in their feed, would be the best solution to fight against the sneaky Aggressor-Galli.

### *Toxin-producing Gallis are beastly MicroRogues!*

#### **The importance of Galli for us.**

Chickens and eggs are important sources of food and protein for a large part of the world's population. Galli is a significant cause of reduction in chicken and egg production, and thus contributes to food insecurity and hence is relevant to Sustainable Development Goal 2: *End hunger, achieve food security and improved nutrition*. Vaccines are a smart way to disarm Galli as they make the hens resistant against disease because they can neutralize the toxins produced by Galli. If an effective and economic oral vaccine can be developed and deployed, food security will increase.

#### **Literature**

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