

# Chicken Antibodies (IgY)

## A revolution in the fight against antibiotic-resistant bacteria

As bacteria become resistant to antibiotics, the old established way to fight infections with antibiotics is in the process of creating a serious global problem. Hard to treat, pathogenic bacteria are replacing beneficial bacteria that over thousands of years have lived in symbiosis with humans and animals. A new anti-microbial, which does not create resistant bacteria is therefore very high on humanity's wish list.



IgY, immunoglobulin from egg yolk, has great potential to meet a substantial part of this wish. The most important application of IgY technology is the control of antibiotic-resistant microorganisms and as well as preventing the emergence of new ones.

## What is IgY?

Chicken egg yolk contains immunoglobulins (IgY), whose function is to protect chickens against harmful bacteria, viruses and fungi (i.e. pathogens). Since the immunological communication between the hen and the fetus ceases when the egg leaves the ovary, the concentration of IgY in the yolk, which builds up the chicken's initial immune system, is very high.

Egg yolks have proven to be a practical and inexpensive source from which it is possible to obtain specific immunoglobulins. Hens that have been vaccinated against specific microorganisms (e.g. bacterium, virus or fungus) produce specific antibodies against these. In vitro experiments have shown that specific IgY prevents growth of the microorganisms to which they are directed and animal experiments have shown that IgY can prevent infections from these microorganisms. Also in humans specific IgY are effective against infections by specific bacteria.

One can distinguish a range of applications for several of the substances found in eggs, mainly in the food, pharmaceutical and biotech industry. The most interesting application of the IgY technology is the control of antibiotic-resistant microorganisms and to prevent the emergence of new ones.

To better understand the importance of IgY research, it can be mentioned that IgY has all the properties of an active anti-infective, especially against infections by bacteria and fungi resistant to many antibiotics. Since IgY is an alternative to antibiotics in humans and animals IgY may prevent the emergence of new multidrug-resistant bacteria, which now represents a serious global threat.

The uses of IgY are many. IgY could be used in the treatment of various infectious diseases such as cystic fibrosis, pneumonia, peptic ulcers, flu and diarrhea diseases, anthrax, tonsillitis, burns, ulcers, ear infections and urinary tract infections etc. IgY can also be used to treat severe fungal infections in immunocompromised patients (e.g. AIDS, cancer and transplant patients).

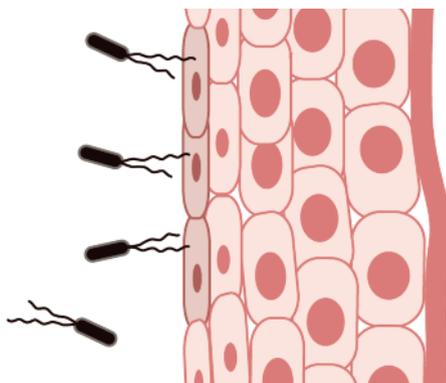
The IgY technology is an environmentally friendly and economical alternative to the more chemistry-based pharmaceutical industry. It is also a gentle biological system without environmentally hazardous waste. Eggs have for millennia been part of man's staple food. Side effects of IgY treatments are not to be expected and so far no such indications have been observed.

### Antibodies

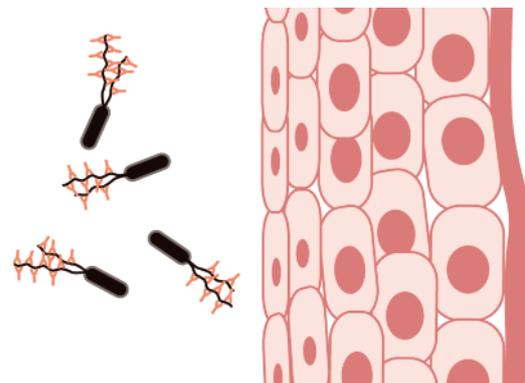
are Y-shaped proteins that are produced by certain white blood cells. The Y-shaped part of an antibody fits exactly together with a specific structure on the surface of a microorganism such as a bacterium, a virus or some other harmful substance. Chicken IgY antibodies differs in several respects from the human antibody, but can nevertheless attach and disarm microorganisms in humans.



### How do IgY antibodies work



In an infection, bacteria attaches to cells by using a tail-shaped structure.



The IgY binds to these tail-shaped structures of the bacteria, preventing them from attaching to cells.

## *Production of antibodies for the treatment of patients with cystic fibrosis*



The chicken is injected with bacteria. The hen begins to produce antibodies against bacteria, antibodies that are transferred to the eggs.

The antibodies are separated from the eggs and purified.

The patient gargles with the substance.

Research carried out so far has shown that IgY has many interesting applications that can be developed through continued research and be commercialized by industry. Clinical applications of IgY includes both humans and animals. IgY is also a very useful tool for precision measurement and analysis in biochemical laboratories. In the food industry IgY technology is also interesting (e.g. in terms of functional foods).

### **The use of IgY in humans**

Research has shown that specific IgY is effective against a range of bacteria, viruses and fungi, both in experiments in vitro and in experiments in animals. These results could be directly applicable to humans, especially since IgY can be produced as a pure and sterile water extract from the egg yolk, and do not have toxic or harmful side effects, unless the patient is allergic to eggs.

The largest clinical IgY study in humans, with specific IgY antibodies for prophylaxis and therapy against *Pseudomonas aeruginosa* bacteria in patients with cystic fibrosis, has been conducted by a research group within the company Immunsystem IMS AB, Uppsala (Per-Erik Wejåker, Anders Larsson, and Hans Kollberg). In this study IgY has been demonstrated to be effective against *Pseudomonas aeruginosa* infections in Cystic fibrosis patients. It is therefore expected that IgY will also be active against other *Pseudomonas aeruginosa* infections, such as in leg ulcers, ear and urinary tract infections, which are difficult to treat and often are at risk of becoming chronic infections.

Other bacteria, viruses and fungi that could be treated with specific IgY are e.g. hemolytic streptococcus ("killer bacteria"), multidrug-resistant pneumococcus, tuberculosis, salmonella, *E. coli*, rotavirus and *Helicobacter pylori*.

### **Use of IgY in animals**

Antibiotics are used in very large scale in the animal feed industry. A large part is not used to treat diseases but is given for preventive reasons and growth promotion. This has resulted in a development of bacteria resistant to many antibiotics. In the long run this runs the risk that the antibiotics we use today will become ineffective. It is therefore essential to reduce the use of antibiotics by using alternative methods.

IgY can be an alternative to antibiotics in animal feed. IgY can be used as an additive to animal feed or added to the drinking water. Animals that are deemed of particular interest are chickens, pigs, cows and horses. There is a huge potential for IgY applications in the veterinary and food sector.

### **Use of IgY in analytical testing**

The most common causes of inaccurate test results when measuring components of human blood is that IgG antibodies (produced from by mammalian serum) are affected by the complement factors in the blood to be tested, since the differences between different mammalian IgG is small. Most of the tests performed in clinical laboratories are on serum samples. There are reports indicating that up to 40 percent of all serum samples give rise to false-positive results and consequently uncertainty in diagnosis and treatment.

By using IgY analytical tests can be developed that provide more accurate results. Chickens are developmentally distant from mammals and therefore IgY antibodies react very well with mammalian antigens. IgY antibodies are therefore the easiest way to eliminate the errors that arise due reactions from the use of mammalian IgG.

It is also ethically more attractive to produce chicken antibodies, as they are purified from the yolk. Unlike the production of mammalian IgG antibodies, IgY production does not require bleeding of animals. The amount of IgY that can be obtained from a hen is also much larger than from e.g. a similar sized rabbit. Research studies made on IgY can produce a new generation of tests for our clinical laboratories.

The international market for diagnostics of antibody-based tests exceeds 100 billion annually and is growing continuously. Most of the diagnostic market products are intended for testing on human material. Since there is a demand to solve the above problems with inaccurate test results, the market for chicken antibodies in the diagnostic market is very large.

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