

Antibodies

This is how we know we will defeat COVID19 because we have an amazing system which will eventually deal with the virus.

A vital ingredient that is a part of every person's immune system is its **antibodies**. They are large Y-shaped proteins, also called immunoglobulins, found in the blood or other body fluids of humans and other vertebrates, animals with backbones. They are the key element in the immune system.

As the immune system works to keep the body healthy, an antibody will recognize unique parts of foreign invaders called **antigens**. The tip of the 'Y' of an antibody includes a structure that matches one specific key-like structure of an antigen, which binds the two structures together.

The mechanism then tags a microbe or an infected cell for an attack using the other parts of the immune system, or it can neutralize the target directly without assistance. The production of the antibodies is the main function of the immune system.

The body contains a wide variety of antibodies and each one is different, and they are all designed to take only one kind of antigen, which is usually a virus or bacteria. For example, an antibody that targets and destroys an antigen related to smallpox is unable to attack an antigen for the common cold.

The structure of all antibodies is generally the same, the small region of the tips of the protein is extremely variable. This allows millions of antibodies with different tip structures to exist in the body. Each can then bind to a different antigen when necessary. The diversity of the antibodies allows the immune system to recognize the wide variety of antigens it must constantly attack.

A huge variety of different antibodies is made in a single person, the number of genes available to make the proteins is limited by the size of the **genome**, which is the sum of all the DNA in an organism.

Vertebrates need millions of different antibodies because there are a large number of microbe strains. Humans generate about 10 billion different antibodies and each is capable of binding a distinct antigen site. However, this must be done with a much smaller number of genes, since the total human genome has only about 20,000 genes.

Genetic mechanisms have evolved that are complex, but they allow vertebrate B cells to generate a huge pool of antibodies from a small number of antibody genes. This occurs by combining segments from a pool of genes in many different ways. Hyper-mutations then occur in the binding site area of the antibody gene creating more diversity.

The terms antibodies and immunoglobulin are often used interchangeably and are typically made of basic structural units. They each have two large heavy chains and two small light chains. There are several different types of antibody heavy chains and several different kinds of antibodies. They are grouped together into different **isotypes** (causes the production of antibodies) based on which heavy chain they possess. There are five different antibody isotypes known in mammals which help direct the appropriate immune response for each different type of foreign object encountered.

The region where variants can bind to a different antigen is known as the **hypervariable** region. It is here where the enormous diversity of antibodies allows the immune system to recognize an equally wide variety of antigens. Antibody genes can also reorganize in a process called **class switching** allowing a single antibody to be used by several different parts of the immune system.

In summary, the immune system helps keep an organism healthy, but it would not be possible without the large number of antibodies that can attack antigens which can lead to a virus or bacteria causing the body to become unhealthy.