

CSIR NET Life Science Unit 4

Antibodies

Antibody (Ab) is also known as an immunoglobulin (Ig). These are large, Y-shaped blood proteins produced by plasma cells. They bind to foreign particles and invade them. These particles are foreign bodies that get attacked by Antibody.

Antigens are foreign pathogens that invade the body and have the capability to give rise to a response from our immunity system either by grouping up with a larger molecule or alone after binding with antibodies for a particular immune response. Hence, antigens stimulate the production of antibodies by the immune system.

Antibody Structure

An antibody has a Y-shaped structure, made up of four polypeptide subunits. Each subunit has two identical light and heavy chains.

The N-terminus of each heavy chain forms an antigen-binding domain with a light chain. There are two antigen-binding domains forming the arms of the “Y” shape. They are known as ‘fragment antigen-binding’ (Fab) domains.

The C-terminus of the heavy chains forms ‘fragment crystallization’ (Fc) domain, which helps in the interaction with the effector cells.

All four polypeptide subunits are held together by disulfide and non-covalent bonds.

The heavy chains of the antibodies contain a variable region and three constant regions. Each antibody has two identical antigen-binding sites and they differ in the antibodies.

Types Of Antibodies

Antibodies or immunoglobulins(Ig) are of five different isotypes. This classification is on the basis of their H chains. Let’s look at the different types of immunoglobulins and their functions.

IgM

IgM is the first antibody produced in response to a microbial attack by B cells.

It is the largest antibody and is found in a pentameric form.

It circulates in the blood and lymph and constitutes 6% of the total antibody content in the serum.

It is involved in agglutination and opsonization.

It has a large number of antigenic sites on its surface and therefore facilitates efficient activation of the immune system.

IgG

Most abundant isotype in the plasma, and comprises 80% of the total antibody content in the serum. It detoxifies substances that are harmful and recognizes the antibody-antigen complex.

It is transferred to the placenta through the foetus and protects the infant until its birth.

IgG is divided into four subclasses- IgG1, IgG2, IgG3, and IgG4. Among these, only IgG3 and IgG4 possess the ability to cross the placenta.

The heavy chains of IgG have two antigen-binding sites and are of the sub-class gamma.

It facilitates the process of phagocytosis and provides immunity to the developing foetus. It neutralizes the toxins and pathogens and offers protection to the body.

IgA

Usually found in liquids such as breast milk, serum, saliva, fluids of the intestine. IgA in breast milk protects an infant's gastrointestinal tract from microbial activity.

It constitutes 13% of the total antibody content in the serum and is divided into 2 sub-classes- IgA1 and IgA2. Among these, IgA1 is highly found in the secretions and is also called the secretory immunoglobulin.

It exists in both monomeric as well as dimeric forms.

It provides the first line of defence against the pathogens and limits inflammation. It also activates the complement pathway and participates in the immune response.

IgD

It is involved in the production of the antibody by B cells.

It is present as a monomer and weighs around 1,80,000 dalton.

It comprises less than 1% of the total antibody content in serum.

It acts as a receptor on B cell surface and participates in B cell activation and differentiation.

IgE

IgE is present in the least amounts, around 0.02% of the antibody content in the serum.

These are present in the linings of the respiratory and intestinal tracts and respond to allergic reactions.

This is found as a monomer in the body and weighs about 200,000 Dalton.

Functions of Antibody

Following are some of the key functions of antibody:

- Binds to pathogens
- Activates the immune system in case of bacterial pathogens
- Directly attacks viral pathogens
- Assists in phagocytosis
- Antibody provides long-term protection against pathogens because it persists for years after the presence of the antigen.
- It neutralizes the bacterial toxins and binds the antigen to enhance its efficiency.
- They also act as the first line of defence for mucosal surfaces.
- They ingest cells by phagocytosis.
- Few antibodies bind the antigen present on the pathogens. These aggregates the pathogen and they remain in secretions. When the secretion is expelled out, the antigen is also expelled.

Production And Mechanism Of Antibody

Whenever an organism's immune system encounters a foreign particle for the first time, macrophages interfere and capture to break them down so as to pass

them to B cells. Once these antigens are presented, B cells begin production of a new antibody which would contain a unique paratope (site at which antibody binds with antigen) to bind with a specific epitope (site in the antigen that binds with antibody). Each lymphocyte of B cells generates a unique antibody against a unique epitope. Once the encoding is done by B cells, it releases antibodies which then bind with specific pathogens resulting in their elimination from our bodies.

This is achieved either by direct attack of antibody on pathogens (usually when pathogens are viruses) or by binding to pathogen's surface (when the pathogen is a bacteria) and sending signals to the rest of the immune system to eliminate the pathogen. These cells remain in the body forever, ready to attack, should they re-enter the body.

Difference Between Antigen And Antibody

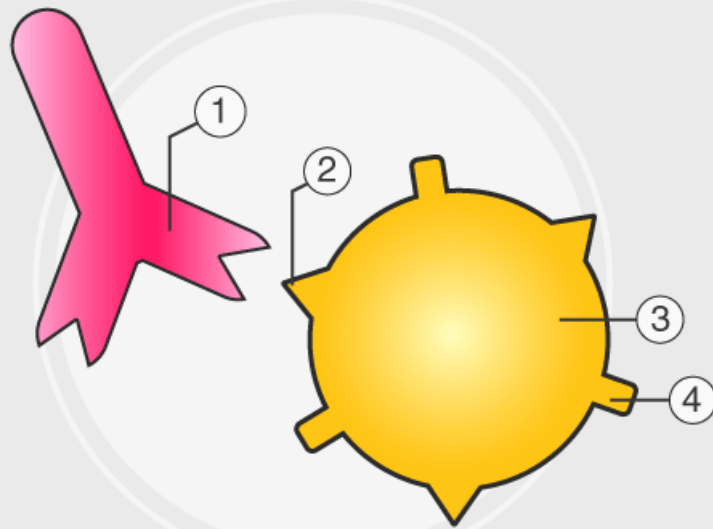
Antigen	Antibody
These molecules interact with antibodies or by T-cell receptors when complexed with major histocompatibility complex	Synthesized by plasma cells of B cells that react with antigens who invoked their production
Includes components of viral proteins, cell walls, capsules, and other microbes	Consists of 4 polypeptide chains, two light chains(L chain) and two heavy chains(H chain) forming a Y shape
These are proteins but can be nucleic acids, carbohydrates and lipids	These are glycoproteins made up of carbohydrates and amino acids
Highly complex in structure and composition	Simpler in structure

Causes diseases or allergic reactions

Protects the body against diseases

The pathogen has many epitopes. Epitopes are regions on antigens that interact with antibodies

The region of an antibody that binds with an epitope is called a paratope. Typically, a Y shaped antibody has 2 identical paratopes



- 1 Antibody
- 2 Antigen
- 3 Pathogen
- 4 A different antibody will be made for this antigen