



Lab:4

Antigen and antibody

Antigen (Ag), or antibody generator, is any substance which provokes an adaptive immune response. That is to say, an antigen is a molecule that also induces an immune response in the body. An antigen is often foreign or toxic to the body (for example, a bacterium) which, once in the body, attracts and is bound to a respective and specific antibody.

Immunogen: is in analogy to the antigen a substance (or a mixture of substances) that is able to provoke an immune response if injected to the body. An immunogen is able to initiate an indispensable innate immune response first, later leading to the activation of the adaptive immune response, whereas an antigen is able to bind the highly variable immunoreceptor products (B-cell receptor or T-cell receptor) once these have been produced.

Immunogenicity : is the ability to induce a humoral and/or cell-mediated immune response

Antigenicity is the ability to combine specifically with the final products of the immune response (i.e. secreted antibodies and/or surface receptors on T-cells). Although all immunogenic molecules are also antigenic, the reverse is not true.

Property of antigens/ Factors Influencing Immunogenicity

1- **Molecular mass**: A smaller molecule does not provoke immune system. The antigens should possess an optimum molecular mass or large molecule which then binds with the receptors and provoke the immune response. The molecular weight should be between 1000 to 10,000.

2- **Antigenic determinant size**: Antigenic determinant or epitopes are the regions of antigen which specifically binds with the antibody molecule.

3- **Foreignness**: The immune system normally discriminates between self and non-self-components such that only foreign molecules are immunogenic.

4- **Chemical Composition**: In general, the more chemically complex substance is the more immunogenic it will be.

5- **Physical form** : In general particulate antigens are more immunogenic than soluble one and denatured antigens more immunogenic than the native form.

6- **Genetic Factors** : Some substances are immunogenic in one species but not in another . Similarly, some substances are immunogenic in one individual but not in others (i.e.

responders and non-responders). •The species or individuals may lack or have altered genes that code for the receptors for antigen on B-cells and T- cells . They may not have the appropriate genes needed for the APC to present antigen to the helper T cells.

7- Age: can also influence immunogenicity. Usually the very young and the very old have diminished ability to elicit and immune response in response to an immunogen.

epitope, also known as antigenic determinant, is the part of an antigen that is recognized by the immune system, specifically by antibodies, B cells, or T cells. For example, the epitope is the specific piece of the antigen that an antibody binds to. The part of an antibody that binds to the epitope is called a paratope.

Classification of antigen:

1-Complete antigens : When these antigens enters the body evokes the immune response without any assistant or carrier molecule. They possess both qualities Immunogenicity and Antigenicity.

2- Incomplete antigens or Haptens :These are the foreign substance they require carrier molecule to act as a complete antigen Such antigens are called as incomplete antigens or **Haptens**.

Haptens are low molecular weight compounds which are having antigenic property but lacks immunogenic property. The immunogenic property or production of antibody is governed by the carrier molecule. The carrier molecules a non-antigenic component and helps in provoking the immune response.

A hapten is equipped with chemically reactive side chains such as

- 1- Azide,
- 2- Sulphonates,
- 3- Arsinates and
- 4- Carboxylateetc.

•Antibodies are also raised against these groups also. Normally the adjuvant are used as a carrier compound for haptens and making it as complete antigens.

Adjuvants: It is a chemical, which when administered with the antigens, enhances or provokes the immunity. Adjuvants are chemical suspension or liquids suspension in which antigen or foreign proteins are dissolved. Since most of the antigens are proteinaceous in nature, they exhibit a maximum antigenicity if injected simultaneously with the suitable adjuvants

The commonly used adjuvants are:

- 1- Freund's complete adjuvants:** with lipid suspension with mycobacterium in it .
- 2- Freud's incomplete adjuvants:** are lipid suspensions or alum suspension without any mycobacterium particles.

•These adjuvants are enhances the activation of B and T lymphocytes and macrophages. Hence it has tremendous importance in the vaccine production and injection.

Adjuvants can react in Several Ways:

- 1- Alter the distribution and persistence of antigen within the positive host

- 2- Stimulate lymphocytes production non-specifically.
- 3- Activate macrophages.
- 4- Alter traffic of circulating lymphocytes

Types of antigens

- 1- Exogenous antigens: These antigens enter the body or system and start circulating in the body fluids and are trapped by the APCs (Antigen processing cells such as macrophages, dendritic cellsetc.). The uptake of these exogenous antigens by APCs is mainly mediated by phagocytosis. Ex: bacteria, viruses, Fungi etc
- 2- Endogenous antigens: These are the body's own cells or sub fragments or compounds or the antigenic products that are produced

Antibody (Ab) Structure: Antibodies are immune system-related proteins called immunoglobulins. They are specialized proteins that travel through the blood stream and are found in bodily fluids. They are utilized by the immune system to identify and defend against foreign intruders to the body. Antibodies recognize specific antigens by identifying certain areas on the surface of the antigen known as antigenic determinants. Once the specific antigenic determinant is recognized, the antibody will bind to the determinant. The antigen is tagged as an intruder and labeled for destruction by other immune cells.

Antibody consists of two short polypeptide chains called light chains and two longer polypeptide chains called heavy chains. The two light chains are identical to each other and the two heavy chains are identical to each other. At the ends of both the heavy and light chains, in the areas that form the arms of the Y-shaped structure, are regions known as antigen-binding sites. The antigen-binding site is the area of the antibody that recognizes the specific antigenic determinant and binds to the antigen. Since different antibodies recognize different antigens, antigen-binding sites are different for different antibodies. This area of the molecule is known as the variable region. This region, composed of 110-130 amino acids, gives the antibody its specificity for binding antigen. The stem of the Y-shaped molecule is formed by the longer region of the heavy chains. This region is called the constant region.

Antibodies are divided into five major classes, IgM, IgG, IgA, IgD, and IgE, based on their constant region structure and immune function.

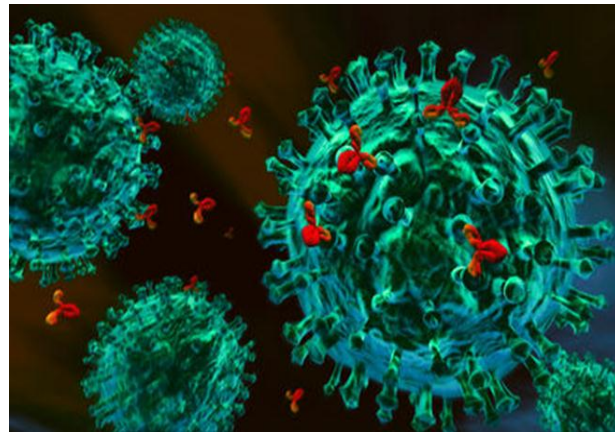
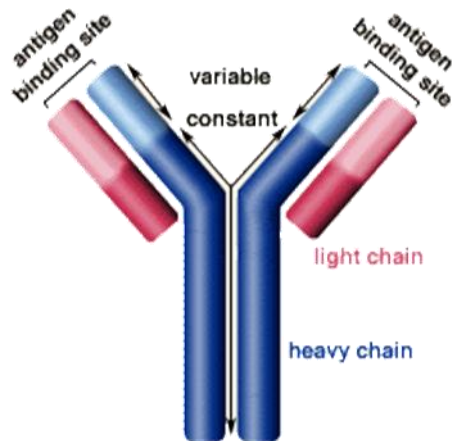
- IgG: These molecules are the most plentiful in circulation. They can cross blood vessels and even the placenta to provide protection to a fetus. The heavy chain type in IgG is a gamma chain.

- IgM: Of all of the immunoglobulins, these are the most massive. They contain five Y-shaped sections each with two light chains and two heavy chains. Each Y-shaped section is attached to a joining unit called a J chain. IgM molecules play a major role in the primary immune response as the initial respondents to new antigens in the body. The heavy chain type in IgM is a mu chain.

•IgA: Located mainly in body fluids such as sweat, saliva, and mucus, these antibodies prevent antigens from infecting cells and entering the circulatory system. The heavy chain type in IgA is an alpha chain.

•IgD: The role of these antibodies in the immune response is currently unknown. IgD molecules are located on the surface membranes of mature B cells. The heavy chain type in IgD is a delta chain.

IgE: Found mostly in saliva and mucus, these antibodies are involved in allergic responses to antigens. The heavy chain type in IgE is an epsilon chain.



IgM

- Structure

- Pentamer (19S)
- Extra domain (C_{H4})
- J chain

