

**COVENANT UNIVERSITY
NIGERIA**

*TUTORIAL KIT
OMEGA SEMESTER*

PROGRAMME: BIOCHEMISTRY

COURSE: BCH 424

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BCH 424: Immunochemistry

CONTRIBUTORS: Dr. Oloyo R.A., Dr Rotimi S. O. and Miss. Okuboyejo T.M.

1. What is immunity

- The body's ability to resist foreign organisms and toxins (poisons) that damage tissues & organs

2. Distinguish between innate and adaptive immunity

Characteristic	Innate Branch	Adaptive Branch
Synonyms	Nonspecific, natural	Specific, acquired
Mode of activation	Not applicable, present at birth	Acquired response to antigens
Inducible	No	Yes
Memory	No	Yes
Reaction time	Rapid 0-6 hours	Slow initiation, rapid thereafter
Phagocytosis	Yes	No
Includes various leukocytes	PMNs, monocytes, macrophages, eosinophils, NK cells	Specific B cells, specific T cells
Specific antibodies	No	Yes
Includes the complement system	Yes	No
Includes physical barriers, e.g., skin and mucous membranes	Yes	No
Produces interferons	Yes	No
Lysozyme in secretions	Yes	No
Induces fever	Yes	No
Causes inflammation	Yes	No

3. Describe the Physiologic barriers involved in immunity

- Temperature Normal body temperature inhibits growth of some pathogens (chickenpox and anthrax).
- Fever response inhibits growth of some pathogens.
- Low pH Acidity of stomach contents kills most ingested microorganisms.
- A variety of soluble factors contribute to non specific immunity, more them the soluble proteins lysozyme , interferon, and complement .
- One of the reasons that newborns are susceptible to some diseases that do not affect adults is that their stomach contents are less acid than those of adults.

4. Discuss different patterns of infection

- Localized infection– microbes enters body & remains confined to a specific tissue
- Systemic infection– infection spreads to several sites and tissue fluids usually in the bloodstream
- Focal infection– when infectious agent breaks loose from a local infection and is carried to other tissues

5. Describe phagocytosis

- If cells are under attack they release histamine.
- Histamine plus chemicals from pathogens mean neutrophils are attracted to the site of attack.
- Pathogens are attached to antibodies and neutrophils have antibody receptors.
- Endocytosis of neutrophil membrane→phagocytic vacuole.
- Lysosomes attach to phagocytic vacuole→pathogen digested by proteases

6. What are lymphocytes?

7. Describe the activation β -lymphocytes

8. Describe the activation of T-lymphocytes

9. What is humoral immunity?

10. Describe hypersensitivity.

11. What are antibodies, how do they interact with antigens or foreign compounds

Antibodies are glycoprotein molecules produced by plasma cells (white blood cells) used for recognition of a unique part of the foreign target. They are specialized receptor protein that binds to a **specific** antigen, immune system identifies and neutralizes the foreign objects. The antibody develops into memory B cells after activation.

Antigens are usually proteins or polysaccharides or any foreign molecule e.g non-microbial exogenous (foreign tissue, pollen) that can be recognized by antigen receptors (B-cell receptor or T-cell receptor) of the adaptive immune system. Antigen are substances foreign to the body which attracts specific antibody that binds to it. For example, bacteria or viruses, fungi, parasites, cancer cells, or any health-damaging agents not normally present in the body.

Antibodies act as a critical part of the immune response by specifically recognizing and binding to particular antigens, facilitating their destruction. The tip of the antibody contains a **paratope** (a structure analogous to a lock), which binds specifically with a particular **epitope** (similarly analogous to a key) on an antigen.

12. What is an autoimmune disorder, mention 2 diseases caused by autoimmunedisorder?

13. Describe the structure of the antibody

Antibody has 4 four polypeptide chains :two identical light (L) chains and two identical heavy (H) chains, which are held together by disulfide bonds to form a flexible Y shape. Each chain is composed of a variable (V) region and a constant (C) region.

HEAVY CHAINS: The heavy chain serves to determine the functional activity of the antibody molecule.

LIGHT CHAINS: The variable region of the antibody allows millions of antibodies to exist with slightly different tip structures, or antigen-binding sites thud a of the variants binds different antigen. 2 types of light chain namely: lambda (λ) and kappa (κ), only one type of light chain, κ or λ , is present per antibody The variable and constant regions of both the light and the heavy chains are structurally folded into functional units called domains. Each light chain consists of one variable domain (V_L) and one constant domain (C_L). Each heavy chain has one variable domain (V_H) and three or four constant domains (C_{H1} , C_{H2} , C_{H3} , C_{H4}). Those domains that make up the "tail" of the basic Y-shaped molecule (in other words, all the H-chain constant domains except C_{H1}) are responsible for the special biological properties of immunoglobulins—for the capacity to bind to a specific antigenic determinant. The tail of the antibody determines the fate of the antigen once it becomes bound to the antibody.

The hinge region of the antibody is a short stretch of amino acids on the heavy chain located between the chain's C_{H1} and C_{H2} regions. It provides the molecule with flexibility, which is very useful in binding antigens. This flexibility can actually improve the efficiency with which an antigen binds to the antibody. It can also help in cross-linking antigens into a large lattice of antigen-antibody complexes, which are easily identified and destroyed by macrophages

14. What are immunnoglobulins, describe the functions and the different types

15. Define the complement cascade and its functioning

Complement cascade is a complex series of enzymatic proteins triggered in response to presence of a 'foreign' body. They also combine with antibody-antigen complexes, producing lysis when the antigen is an intact cell. Their activities include: antibody-mediated immune lysis, phagocytosis, opsonization and anaphylaxis. They are triggered in a sequence, and activated by the immunoglobulins IgM and IgG. One protein interacts with another in a specific sequence called a complement pathway. It is composed of the classical and alternate complement pathways.

Classical complement pathway involves all of the complement components C1 to C9, they participate and are triggered by antibody-antigen complexes. C1 first interacts with a bound immunoglobulin (at the nonspecific part of the antibody that does not bind antigen). C1 is then cleaved, and activates the next complement component in the series. C3 is the most abundant and biologically the most important component of the complement system—is activated

Alternate complement pathway is triggered by other invading pathogens or tumour cells. C3b molecules are deposited on the surface of an invading pathogen in a process called opsonization. Opsonization makes foreign bodies such as bacteria susceptible to destruction by blood cells by coating them with opsonin. Chemotaxis is cell movement response to the presence of a chemical agent. Anaphylatoxin is extreme sensitivity to a foreign substance. This makes the microorganism more attractive to phagocytic cells such as macrophages and neutrophils through some receptors. The microbe is then killed by digestive enzymes present in the phagocytes. If microbes are not immediately killed and are able to reach the bloodstream or the liver, spleen, or bone marrow, they can become coated with antibody and complement there and be ingested by phagocytes.

16. What is the function of the Major histocompatibility complex?

17. Describe processes in cell-mediated response?

When disease associated proteins (antigens) occur in a cell, they are broken into pieces by the cell's proteolytic machinery. Macrophages are activated to kill bacteria in intracellular vesicles while B cells are activated to produce antibodies that eliminate or neutralize extracellular pathogens. Cell proteins become attached to antigen fragments and transport them to the surface of the cell, where they are "presented" to the body's defence mechanisms. These transport molecules are called the Major Histocompatibility Complex (**MHC**) proteins.

MHC allows detection of cells such as macrophages, that have ingested infectious microorganisms by endocytosis or phagocytosis. The exogenous antigens are taken into the antigen-presenting cells (APCs) and processed into fragments. MHC binds these fragments and takes to the cell surface. APCs then present the fragments to T helper cells ($CD4^+$) by the use of class II histocompatibility molecules on their surface.

The T lymphocyte recognizes the foreign fragment attached to the MHC molecule and binds to it, stimulating an immune response. Specific T-cells for the peptide-MHC complex become activated and start to secrete cytokines. Cytokines are substances that can activate cytotoxic T lymphocytes (CTL), antibody-secreting B cells, macrophages, and other particles

18. Discuss antigen processing through the exogenous and the endogenous pathways.

19. Discuss the three types of MHC and their specific functioning

- Class I MHC molecules span the membrane of almost all cells, all nucleated cell surfaces in the body. They present endogenous antigens such as: self-proteins; Worn out proteins within the cell become ubiquitinated, marking them for proteasome degradation and foreign proteins produced within the cell, such as viral proteins, infected cells are recognized and destroyed
- Class II MHC molecules are present on specialised antigen-presenting immune cells, including macrophages that engulf foreign particles such as bacteria, dendritic cells that present antigen to T cells, and B cells that produce antibodies. Exogenous proteins that are endocytosed are degraded by acid-dependent proteases in endosomes. They present peptide antigens to **T-helper cells** (TH cells)
- Class III codes for complement proteins (such as C2, C4, and B factor), cytokines which are chemical messengers (such as TNF- α , LTA, LTB), heat shock proteins (hsp), and enzymes. This is called the cross-presentation pathway, peptides derived from extracellular proteins are presented in the context of MHC class I. The cell starts off with the exogenous pathway but diverts the antigens (cytosolic diversion) to the endogenous pathway.

20. Discuss the mechanisms of immune tolerance through which a mother can tolerate the foetus growing inside her.