Antibodies:-are specific protein, produced by plasma cells as a result of a reaction between the B- -lymphocyte and specific antigen.

Plasma cells are found in bone marrow only and produce antibodies (proteins) in one case, which is cancer.

The injection of Ag in animals produces a specific antiserum which reacts selectively with Ag, this antiserum contains proteins which are responsible for this recognition and which said to possess an Ab function, this soluble protein belongs to this class of protein called Globulin.

Owing to the migratory properties of or in the electrophoresis field, they are called δ globulin because this is involved in immunity it is called Immunoglobulin (Ig) .

Functional duality of Ig:-

1- **Recognition function:- means that Ab (Ig) have specificity for certain types of Ag or has the ability to recognise specific Ag among hundreds or thousands of Ag.**

   Example:- Ab can discriminate between the chain of leucine and the chain of valine.

2- **Effecter function:- Ig are capable of many other functions that:-**

   a- **Complement Fixation (Complement Stimulation)**

   b- **Bind to certain cells**

   c- **Placental transfer**

   d- **Catabolic function**

Classification Criteria:- Ig classification according to their physicochemical characters which are:-

1- **Molecular weight.**
2- **Sedimentation coefficient (by ultra centrifugation).**
3- **Electrophoresis mobility.**

It antigens properties to five classes of Ig:- IgG, IgM, IgA, IgD and IgE.

Structure of Ig molecule:-

Generally, it has a Y shape except for IgM and IgA, composed of 2 heavy H chains and 2 light chains that have a molecular weight of 50000 Daltons while the light chain is 250000 Dalton.

The heavy chain is connected to the light chain by a disulphide bond (s ….s) , and each H chain is connected by the same bond.

The H chain is composed of 440 amino acids.

The L chain is composed of 220 amino acids.

The immunoglobulin has two terminals, the first one ends by the NH_2 group and the other by the COOH group.

There are 2 different zones in the structure of Ig : constant zone (C zone) and variable zone (V zone).

Constant zone:- composed of 330 amino acids of the H chain (¾) and 110 amino acids of the L chain (½), the sequence of amino acids is stable in this area and controlled by genetic factors.

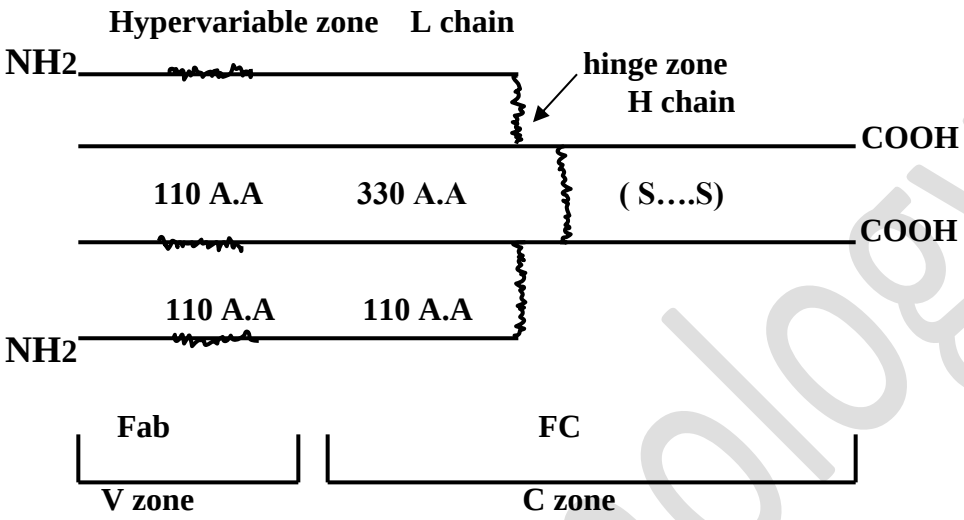
Variable Zone:- composed of 110 amino acids of both H and L chains, the sequence of amino acids in it is variable, it has a very variable zone called (Hypervariable zone) the Ag is bound to this zone.

Hinge Zone:- This part of Ig is rich with amino acids (especially praline) to give it more elasticity, located between the disulphide bonds that connect the H chain together and the H chain to the L chain.

FC:- complement fixing fragment or crystallizable fragment, located on the C zone of the H chain and it is the effecter functions of Ig which is

complement stimulation, placental transfer, catabolic function, and protein A toxicity.

Fab:- Fragment Ag binding, located on the V zone of both H and L chains. (NH_2 end) .



The heavy chain is different from one class of immunoglobulin to another:-

1- δ ⟶ IgG.

2- M ⟶ IgM

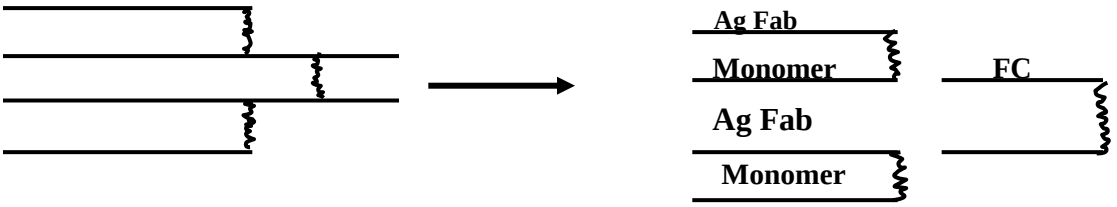
3- α ⟶ IgA

4- δ ⟶ IgD

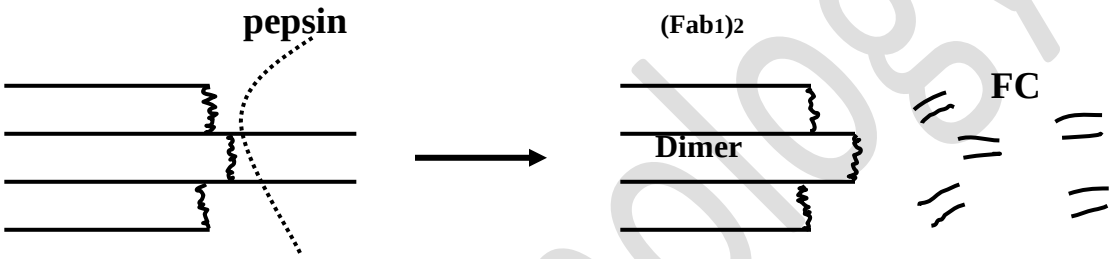
5- E ⟶ IgE

The effect of the proteolytic enzyme on IgG molecule:-

1- The Papain:- will breakdown the molecule and act just behind the hinge zone, so it will divide the molecule of IgG into three parts or fractions, each having 50000-dalton molecular weight, the two identical parts fix the Ag (Fab) while the other part has same molecular weight but do not fix the Ag (FC) which composed of half part of heavy chain (H) only.



2- **Pepsin:- it strikes at a different point, it cleaves the Fc fragment from the remainder of the molecule, leaving the hinge zone intact it breaks the molecule to (Fab1)2 which is a large molecule (H and L chain) and to a small fragment of FC.**



Classes of Ig:-

1- **IgG:- Have molecular weight of 150000- 180000 Dalton with a sedimentation coefficient of 7S, it is found in serum and in extravascular fluids like peritoneal and ascites fluid, this Ig is responsible for a defensive mechanism against viral, parasitic and microbial infection.**

It is produced in high quantities, the concentration of IgG in serum is 1600 mg/dl this Ig is produced during the secondary immune response and is found in different concentrations in body fluid. IgG is composed of 4 subunits.

2- **IgM:- is responsible for the primary immune response, found in blood only (intravascular) with sedimentation coefficient 90S and the molecular weight of is 900000 Dalton so it is called macroglobulin composed of pentamer (5 subunits) of the basic 4 chain subunit held**

together by disulphide bonds with 7S and molecular weight 180000 Dalton, the concentration of this Ig from 180-190 mg/dl.

This Ig produce during primary immune response , it is of limited defensive mechanism (capacity) . The function of IgM remain at least 3-4 day and then breakdown.

IgM is fixed the complement so it is effective agglutinating and cytolytic agent but it do not passing through placenta.

3- IgA:- present in intestinal secretion and bronchial secretion and nasal secretion , tears, saliva and colostrum .

It composed of 2 light chain and 2 heavy chain monomeric form is predominant in human serum , the dimmer 11S is the most common form in secretion in all species of animals .

Disulphide bond link 2 monomers of IgA to a J-chain refer as (secretory piece).

IgA provide new born with Abs which will protect him before the synthesis of his own Ig.

There are two types of IgA:-

1- serum IgA

2- secretary IGA

Why the IgA not digest by proteolytic enzymes?

Because presence of J- chain in structure of it, so prevent it lysis or digest while the other protein in colostrum digest by the proteolytic enzyme.

IgA not presence in so much concentration in serum as IgG.

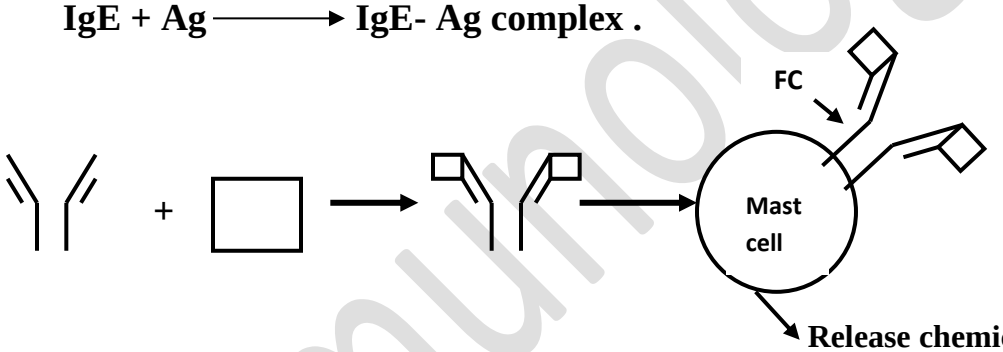
4- **IgD:- immunological function is unknown, it is found in serum and in the lymphocyte (on the surface of B- lymphocyte with IgM) and in chronic lymphatic leukemia.**

Operate as antigen receptor and control of lymphocytic activation and suppression.

5- **IgE:- important in immunopathology , is responsible for immediate type of hypersensitivity reaction . anaphylactic shock , asthma , hay fever , urticaria .**

IgE bind to basophil, mast cell and blood platelets this binding triggers the release of several mediators .

IgE + Ag ⟶ IgE- Ag complex .



Release chemical mediators:-

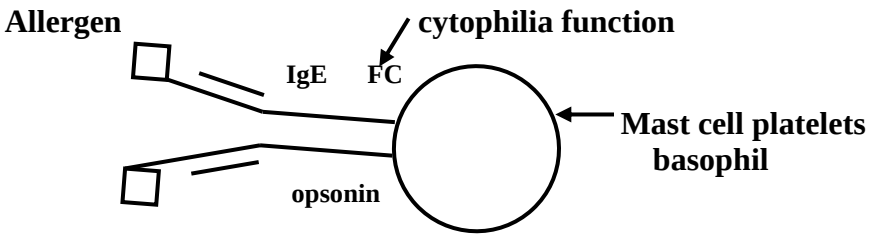
1- **histamine**
2- **serotonin**
3- **SRS anaphylaxis**
4- **Brady kinin**
5- **Heparin**

Because the Ag cause allergy , so it called Allergan

Allergy :- is reversible process , mean it does not cause death of mast cell (degranulation).

IgE increase in parasitic infection with eosinophil .

IgE act as opsonin which fix the ag by FC fragment on macrophage lead to phagocytosis



IgE called regain because induce allergy or hypersensitivity .

In parasitic infestation there is increase in IgE level in the blood.

Eosinophilia:- increase number of eosinophil in allergy status and parasitic infection.

If we have a case of allergy , who we can desensitize it ?

With the certain level of IgE antibody , we cannot prevent presence of allergen in atmosphere but we can prevent production of Ab of IgE type , either by production of Ab of other type of Ig then IgE for example production of IgG than IgE, IgG when conjugated to allergen .It will not induce case of allergy .

Or by induce specific immunological tolerance mean immunoparalysis or immune responsiveness , the body keep the capacity to respond to all other Ag but unresponsive to this allergen.

Repeated injection of very small doses or very large doses of allergen (pollen) we will get a specific immunological tolerance.

Characteristics of Immunoglobulin class

Ig	IgG	IgA	IgM	IgD	IgE
M.W	150000	6600	900000	180000	200000
Additional subunits	------	J chain Secretary piece	J chain Secretary piece	------	------
Concentration mg / dl	1600	130	180	0.002	0.2
Half life in day	23	6.5	3	------	2
Placental transfer	cross	------	------	------	------
Presence in secretion	------	+	------	------	------
In milk	+	+	------	------	------
Activation of complement	+	------	++	------	------
Binding to cell and macrophage	+	------	------	------	------
agglutination	++	++	++	------	------
Anti viral activity	+	+	+	------	------
antibacterial	+	+	+	------	------
allergy	------	------	------	------	+