

Carbohydrates

الكاربو هيدرات

Is defined as the aldehydic and ketonic derivative of poly hydroxyl alcohols and their polymers having hemiacetal glycosidic linkages .

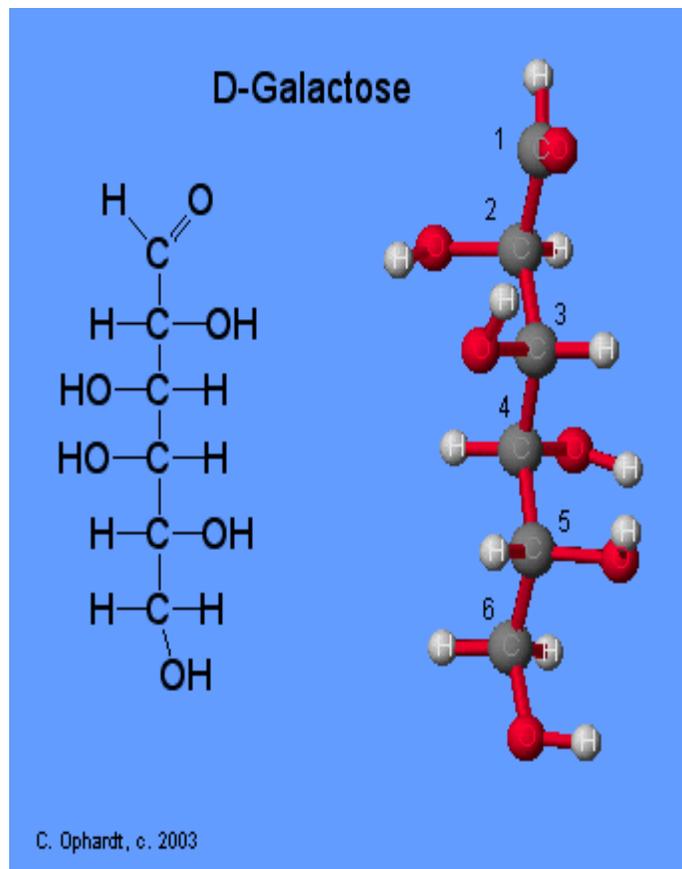
The structure or chemical formulas ($C_x(H_2O)_y$) .

Classification of CHO

- 1- **Mono saccharides** : like glucose – fructose , galactose , ribose deoxeribose .
- 2- **Disaccharides** : like sucrose – Maltose – Lactose .
- 3- **Poly saccharides** : like starch – glycogen .

Glucose $C_6H_{12}O_6$

The most important sugar in binding taken particularly with diet . it gives energy which necessary for the activity of different tissue in the body

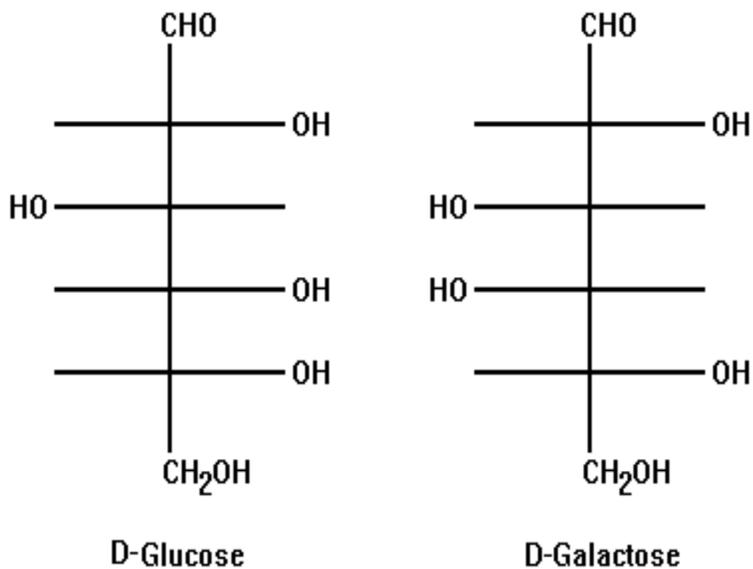


,stored as glycogen in the liver and muscles .

Galactose

- Excess galactose (from diet) can't be stored but its convert into glucose and then store in liver .
- Small amount of galactose is used in the formation of glycolipids in the nervous tissue .
- Small amount of galactose and derivative is used in building the cell membrane .
- Some of the galactose used in the formatio

Linear Models comparing Glucose with Galactose



Note that $\text{---} \perp \text{---}$ represent non-rotatable carbons.

Source of glucose in the body

- 1- From the dietary food .
- 2- Form the stored glycogen .
- 3- From amino acid .
- 4- From Lipid inside the body .
- 5- From lactic acid .

The storage of glycogen in the body

a- In the liver

Liver glycogen can be broken into glucose That is released in the blood and can reach different sites in the body to be metabolized for the production of energy

b- Skeletal muscle

The lactic acid produced goes to the blood and can be converted to glucose by the liver .

a- Heart muscle

It is only used by the heart muscle in case of need when there is no out supply of energy to the heart muscles .

Digestion and absorption of CHO

1- In the mouth

The main digestible carbohydrate in the diet are the poly , starch , sucrose . Lactose , cellulose . They digested by the action of "Salivary amylase" to form intermediate dextrin , maltose and some glucose .

2- In the stomach

Salivary amylase activity is inhibited at the acid pH of the stomach (HCL) stops action of amylase .

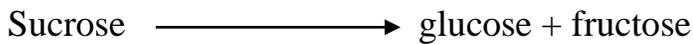
No digestion occur in the stomach only simple hydrolysis occur by the action of HCl which hydrolysis the disaccharide to mono saccharide .

3- In the Small intestine

The pH change to an alkaline pH because of the alkaline pancreatic amylase . The pancreatic amylase digest all the remaining starch , glycogen → maltose .

Further digestion

invertase



Maltase



Lactase



The end products of CHO digestion is mono saccharide .

Occurrence	Type	End products	Enzyme
Mouth	Starch	Dextrin	S. amylase
S. intestine	Starch	Maltose	P. amylase
Intestine	Lactose	g + galactose.	Lactase
Intestine	Maltose	2 glucose	Maltase
Intestine	Sucrose	g + F	Invertase

The rate of absorption decrease in :

- 1- Diarrhea .
- 2- Infection with bacteria .
- 3- Poisoning .
- 4- Malnutrition .
- 5- Hyperparathyroidism .
- 6- Infection of the intestine .

Malabsorption of CHO occurs in :

- 1- Generalized intestinal disease .
- 2- Pancreatic disease .
- 3- Intestinal disaccharide deficiency .

Metabolism of CHO

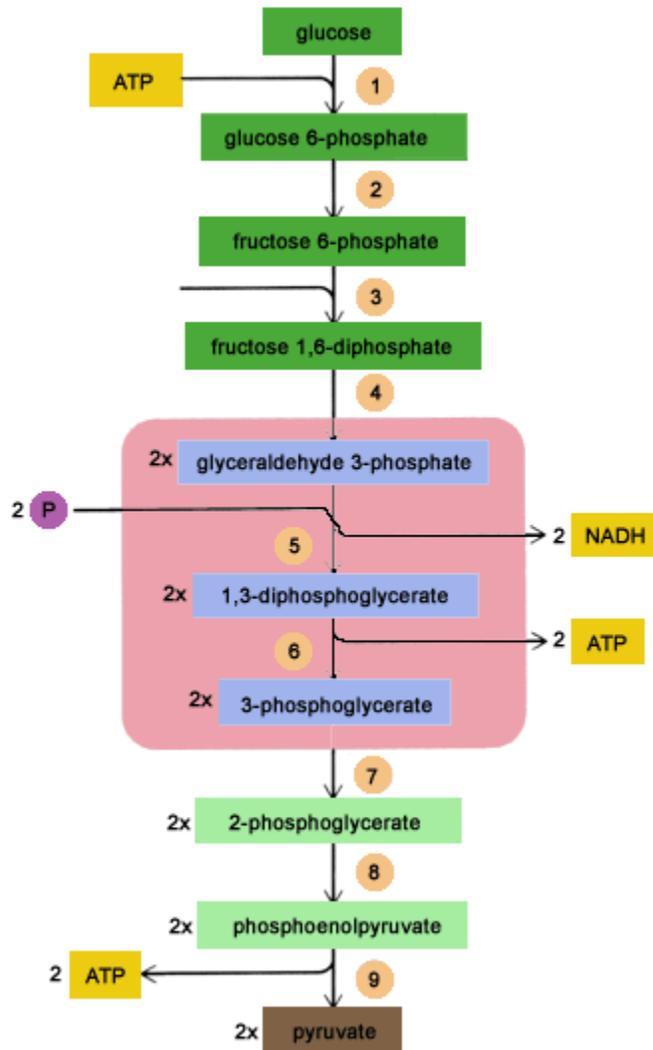
The process take place inside the body regarding biological material divided in to :

- 1- **Anabolism** : The building up of material inside the body .
 - 2- **Catabolism** : The breakdown of material inside the body .
- **The major process of catabolic reaction where glucose in degradation to**
 - **$\text{CO}_2 + \text{H}_2\text{O} + \text{energy} \longrightarrow \text{main product}$**

ايض الكاربوهيدرات يتضمن العمليات التالية :

1- Glycogen form From (g-6-p) by the action of glucose -6-phosphatase which is found in liver and kidney .

2- Glycolysis Is the break down of glucose for the production of energy or conversion of glucose to lactate or pyruvate .



- 3- **Gluconeogenesis** It is the formation of glucose or glycogen from non - CHO substance (fats , protein) .
- 4- **Krebs cycle** It is the source of energy required for normal activities .
- 5- **Glycogenesis** It is formation of glycogen from CHO substance .

The role of liver in CHO metabolism

- 1- It can store excess glucose in the form of glycogen if the glucose is more the requirement of the body .
- 2- In case of glucose shortage the stored glycogen is converted to glucose .
- 3- Liver convert galactose , fructose into → glucose .

The role of muscle

- 1- It can transfer glucose into glycogen .
- 2- It can breakdown lactose into lactic acid .

(Lactic acid produced is release to the blood goes to the liver and changes into glucose) .

The hormones controlling the level of the body glucose

- 1- **Insulin** Formed by the β – cells of pancreas .
 - 1- ↓ the level of glucose in blood .
 - 2- ↑ glycogenesis .
 - 3- ↑ the permeability of liver and muscle cell to glucose .

2- **Glucagon** Formed by the α – cell of pancreas increase the level of glucose .

3- **ACTH** (Adino cartico trophic hormone) formed by pituitary gland .

1- \uparrow the level of glucose in blood .

2- \downarrow glycogenesis .

3- \downarrow the permeability of the glucose .

4- **Glucocorticoid** (Cortisone , hydroxyl cortisone) .

5- **Adrenal** .

1- \uparrow glucose in blood .

2- \uparrow glycogenesis

6- **Sex hormones**

Female sex hormone estrogen male sex hormone testosterone .

If any hormones are absence or increase then can destroy CHO – met and leading to appearance of disease .

Diabetes

- Diabetes complicated disease whose causes and metabolic reactions are not totally understood .
- It is a disorder that causes the blood sugar level to rise above normal .
- In diabetes the β – cells of the pancreas respond slowly or not all to the level of glucose in the blood .

Two type of Diabetes

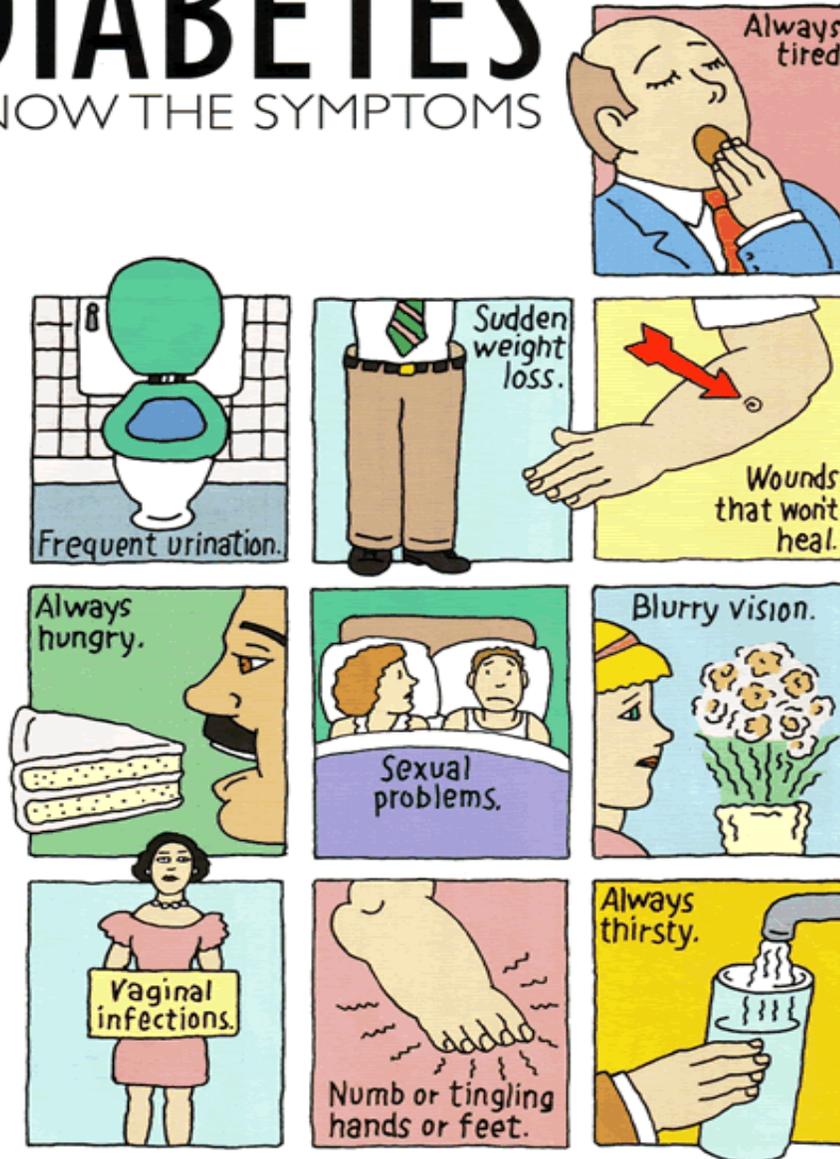
- 1- **Juvenile onset diabetes** (10-12) years .
- 2- **Maturity onset diabetes adult diabetes** (30- 40) years .

J.D	M.D
1- Occur in young people (10-12) years	(30-40) years old people
2- Sever (acute)	Chronic
3- Individual who take the ability to produce insulin	Is much more common
4- One diet injectional of insulin	Is heredity disease



DIABETES

KNOW THE SYMPTOMS



If you have any of these symptoms, see your doctor. For more information about diabetes call Eli Lilly and Company at 1-800-545-5979 or Boehringer Mannheim Corporation at 1-800-858-8072.

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داء السكري

مرضى مزمن يحدث نتيجة عجز بنية البنكرياس لإفراز كمية كافية من الانسولين
تففي باحتياجات الجسم

دور الانسولين

- تحويل الطعام، في المعدة، إلى جلوكوز
- إفراز الانسولين من البنكرياس
- دخول الانسولين إلى الدورة الدموية

دخول الجلوكوز إلى الدورة الدموية

النوع الاول

أكثر الفئات تعرضاً هم الأطفال ثم الكبار، يهاجم جهاز المناعة البنكرياس، فيصبح عاجزاً عن إفراز الانسولين أو يفرز القليل منه، ترتفع نسبة الجلوكوز، وتزداد حاجة الجسم للانسولين لتنظيم مستوى الجلوكوز وعملية التمثيل الغذائي

النوع الثاني

يسبب الأطفال السمنة وذوي الأوزان المفرطة، من لديه تاريخ اسري للمرض، بعض الاجناس هناك إنسولين، ولكنه غير كافٍ، يقاوم الجسم استعمال الانسولين، ربما لتكامل الجسم، فترتفع نسبة الجلوكوز في الدم

الأعراض

- ▶ زيادة العطش
- ▶ زيادة التبول
- ▶ زيادة الجوع
- ▶ سرعة التعب
- ▶ فقدان الوزن
- ▶ تأثر البصر

المضاعفات

- ▶ تلف العين
- ▶ تغيرات قلبية
- ▶ تلف الكلى
- ▶ عجز جنسي
- ▶ صعوبة التبول
- ▶ تنميل بالأطراف
- ▶ نقص الدورة الدموية

العلاج

- ▶ حقن الانسولين
- ▶ غذاء، مسحي متوازن
- ▶ التحكم في وزن الجسم
- ▶ التحكم في مستوى سكر الدم
- ▶ التحكم في مستوى ضغط الدم

● يتخلص الانسولين من الجلوكوز الزائد، ويساعده على دخول الخلايا

شبكة أبو نواف
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المصدر: منظمة الصحة العالمية، مراكز مكافحة الأمراض

Kenton bodies

- 1- Aceto acetic acid .
- 2- β – hydroxyl butyric acid .
- 3- acetone.

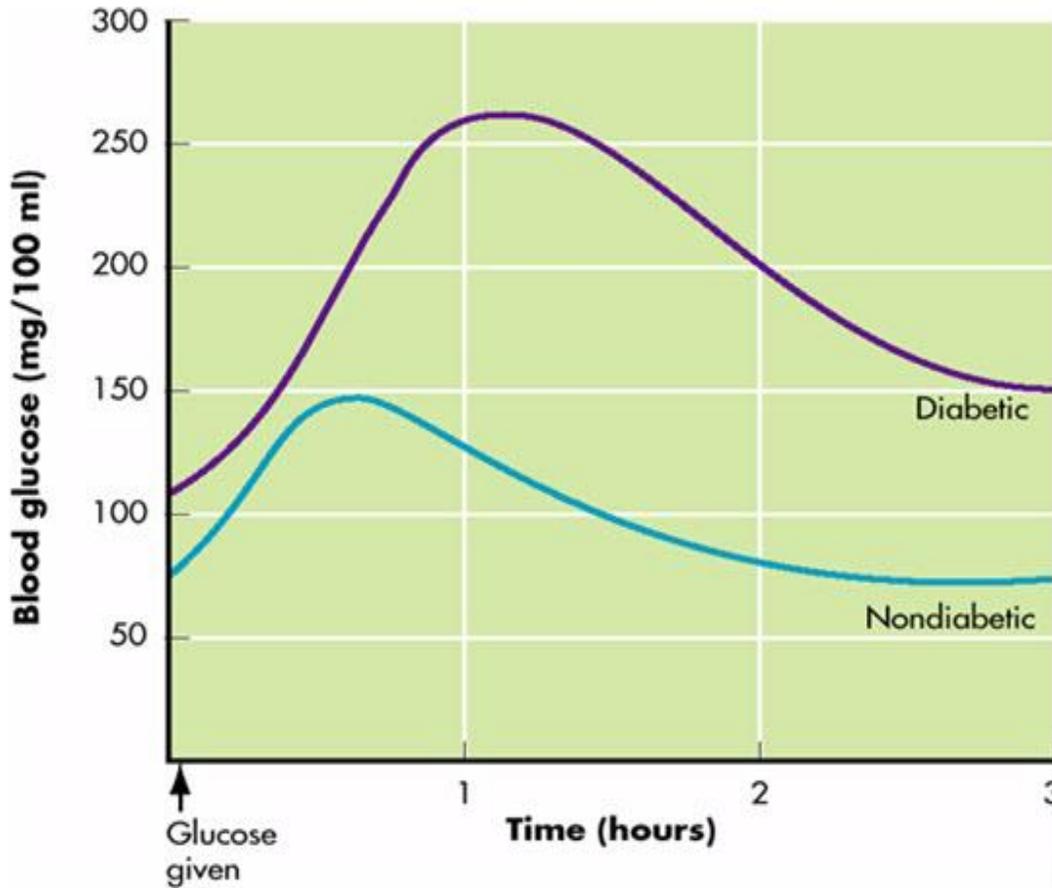
Glucose tolerance test

The steps for building the curve can be summarized as following :

- 1- the subject should be fasting overnight (8pm - 8am) .
- 2- the subject is not allowed to have any food . fluid or smoking or doing excises before the test .
- 3- the fasting blood sample is collected from the vein .
- 4- after drawing of the fasting blood sample the subject is given 50gm glucose /100ml water or 1gm glucose/kg of body weight .
- 5- several blood sample are drown every 1/2hr . for (2-3) hr and then we plot a curve showing the relation between blood glucose level and time ..
 - a) the fasting level in normal should be less than 120mg glucose/100ml blood .

The level of blood glucose rises and reaches it max. at (60-90)min after the glucose dose and never reaches values more than 190mg/100ml .

After 90min it starts to decline till it reaches the pre - dose level or even less by (120 – 150) .



Mellituria

وهي حالة ظهور السكر في الإدرار

قد يكون glucose ويعرف بـ glucose uria

أو fructose ويعرف بـ fructose uria

أو maltose ويعرف بـ Maltose uria

Is the appearance of sugar in urine each mellituria could be

Alimentary

Mean the sugar appearing in urine as a result of eaten high carbohydrate that causing a large amount of glucose , sucrose , starch it is temperally and disappear (2 - 4) hr after meal .

Essential

Mean the sugar in urine as a result of Biochemical a regiment :

- 1- deficiency of insulin .
- 2- deficiency in hormones .
- 3- the adrenalin and non adrenalin increased in blood sugar under stress and emotional condition .
- 4- renal glucose uria .

Physiological

The type of glucoseuria appear in pregnancy called physiological glucoseuria .

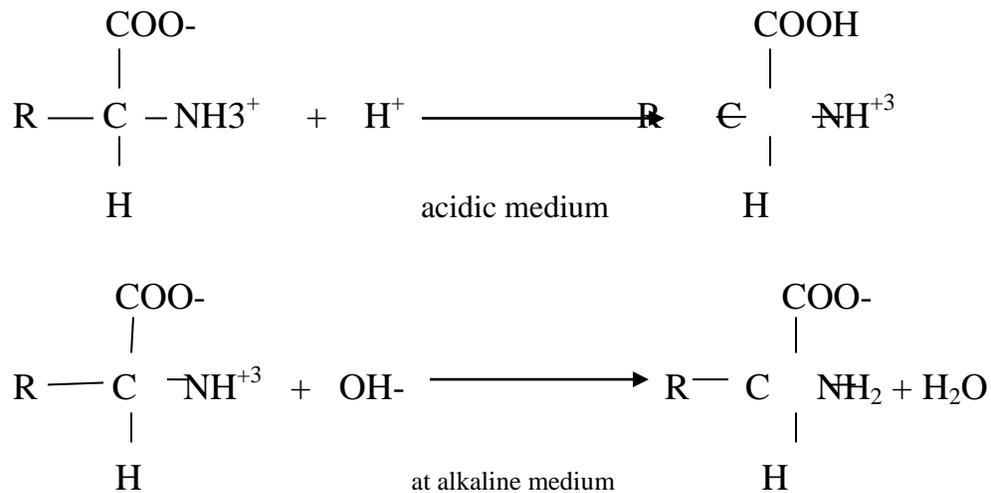
Proteins

All proteins contain C, H, O, N. and S may be contain Po_4 , I , Fe , Cu and Zn .

The average nitrogen contain is a proximately (16%) when protein are breakdown by acid , alkaline , or enzymatic hydrolyze . It is found that basic unit consist of α – amino acid . This a. a are linked together by peptide bonds .

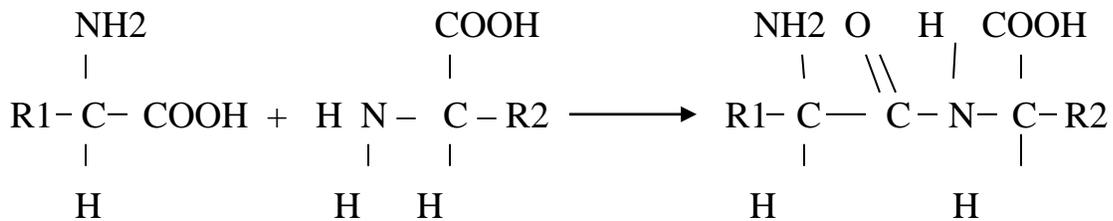
Amino acid contain both the acid part group and the basic amino group with the molecule .

This type of ionized molecular with negative and positive charge is referred to as a dipolar ion or zwitter ion .

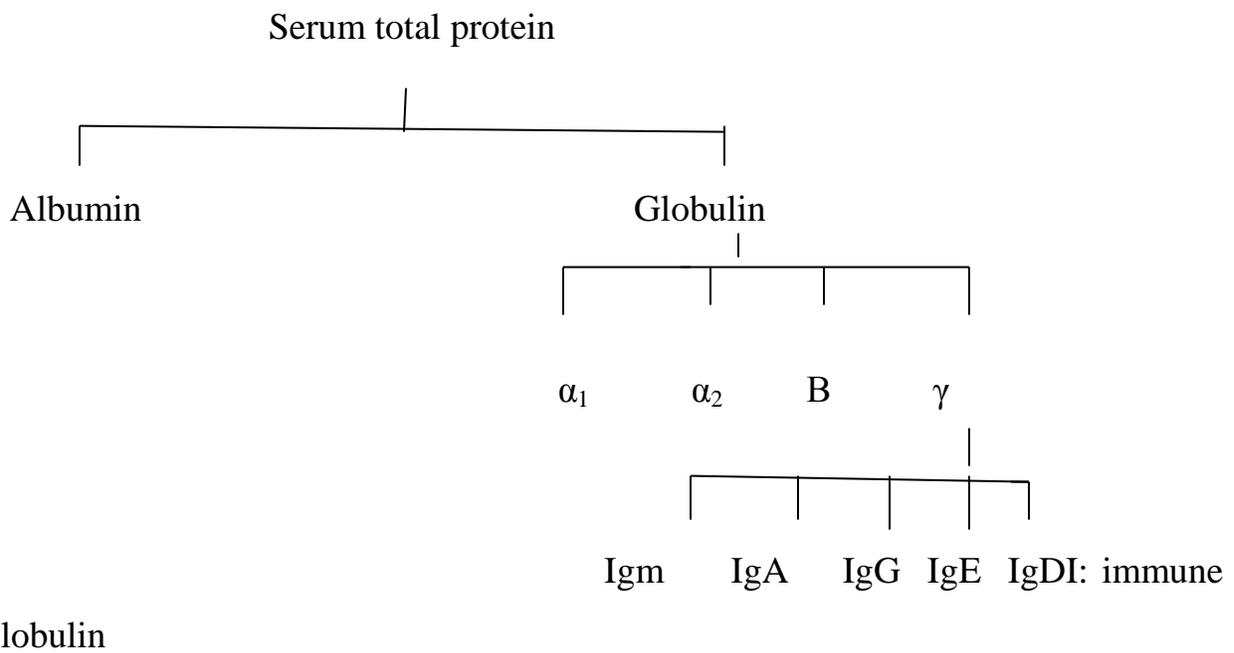


The Peptide bond

Amino acid can react with one another to form peptide bond by the linkage of amino group of one acid with carboxyl group of another acid .



Classification of protein



Source of plasma protein

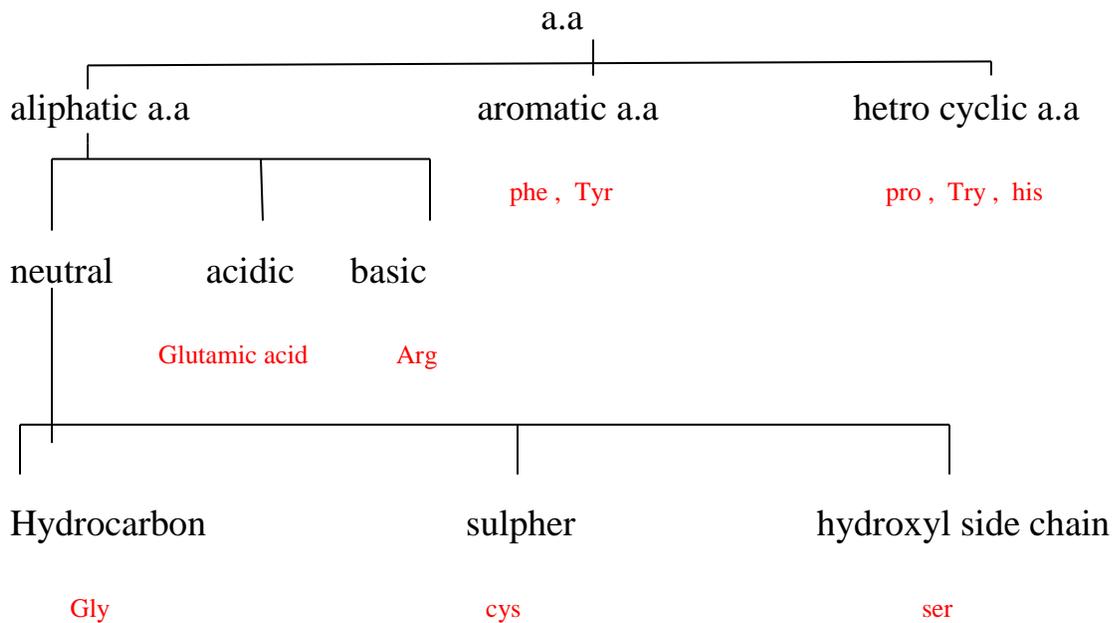
Some protein are synthesized in liver like albumin , carrier protein the antibodies synthesized in reticuloendothelial system

Functions of protein

- 1- maintaining proper volume of fluid between blood and tissue
- 2- antibodies are protein .
- 3- Enzymes are protein .
- 4- Carry compounds from tissue to another like lipid , CHO hormone . Vit., Ca, Fe and there is specific function of protein .
- 5- It has role in clottentation .
- 6- It is apart of body protein .

Classification of protein

A- According to amino acid.



B- *Amino acid can divided in to :*

1- Essential amino acid

Which is the body need it but can't synthesized it inside the body it found in food .

It 10 amino acid , loose one of a. a. led to lower the synthesized of protein .

2- Non essential a. a.

It were 10 main acid which the body can synthesized it inside the body loose one of these a. a. catalyze the cell to synthesized it .

Structure of protein

- 1- **Primary structure** :: it is the number and type of amino acid in the protein molecule .
- 2- **Secondary structure** :: The coiling of the peptide chain into an helical structure .
- 3- **Tertiary structure** :: Refers to the coiling of several helical or protein of single helix into a three dimensional structure .
- 4- **Quaternary structure** ::this structure resulting from interaction between poly peptide unit of protein containing more than one subunit in the present of disulfide bond .

The Lipids

Lipid : Organic compounds , non soluble in water but soluble in a certain special solvent (Fat solvent) Like benzene , ether , chloroform and CCl_4 .

General Properties

- 1- Non soluble in the water but soluble in (Fat solvent) .
- 2- It has a direct relation with the human or animal because the body produces lipid or can be get a profit from this lipids .
- 3- Exist at the form of esters generally came from conge cate between the fatty acid and alcohol .

Some of these lipids

- 1- Volatile oils .
- 2- Fixed or non volatile oils .

Useful for manufacturing : it is consist from aldehydes or ketone .

- 3- Metallic oils

It is a hydro carbonate compounds came from petrol as the kerosene and this type does not contain the esters or fatty acid .

Important of lipids

- 1- Source of energy .
- 2- Making the detergent as the soap .
- 3- A good solvent for some vitamins which are not soluble in the water as A,K,E,D .
- 4- As isolator in subcutaneous tissue .
- 5- As pudding around some organs like liver , kidney and heart
- 6- Can serve as structure and functional elements of bio membrane .
- 7- Combination of fat with proteins (lipoprotein) are important cellular constituents in cell membrane and membrane of nucleus Micro some , Mitochondria .
- 8- Contains cholesterol which is useful for preparing some hormones or bill salts and at the same time cholesterol considered one of the source of vit β_{12} .

Classification of lipids

Lipid are esters of fatty acids and alcohol .



F.A alcohol ester water

There are classified into three kinds :

- 1- Simple lipids .
- 2- Compound lipids .
- 3- Derived lipids .

a- Simple lipids

Ester of FA + Alcohol .

- 1- Fat F.A + glycerol .
- 2- Waxes F.A + long chain alcohol (C₁₆-C₃₆)

a- Compound lipids

Ester of F.A + alcohol + other group :

- 1- Phospholipids .
- 2- Amino lipid .
- 3- Glucolipid .
- 4- Sulpholipid .
- 5- Lipoprotein .

b- Derived lipid

Derived from hydrolysis of 1 + 2 :

- 1- F. A .
- 2- Steroids .
- 3- Alcohols .
- 4-

Plasma lipid ; Its include :

- 1- Fatty acid .
- 2- Triglyceride .
- 3- phosphor lipid .
- 4- cholesterol .

1- **Fatty acid (F.A)**

F.A comprise one of the simple molecules forms of the lipids and these are :

- 1- straight chain compound .
- 2- mono carboxylic acid .
- 3- They contain even number of "C" atoms .
- 4- saturated containing no double bonds or unsaturated with one or more double bond most important F.A. in the plasma .

A- palmitic acid (C_{16}) $CH_3(CH_2)_{14}COOH$ saturated .

B- oleic acid (C_{18}) $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$ unsaturated with one double bound .

Fatty acid may be free (FFA) or esterified with glycerol (EFA) .

The FFA are rapidly taken up by most tissue for satisfying energy requirement .

N.V = (8 – 31) mg/100ml .

2- *Triglyceride (TG)*

N.V = (0 – 15) mg/100ml .

They are also called neutral glyceride 95% of TG . is present in tissue.

TG. Can be hydrolyzed by strong alkaline or acid or by enzymes known as lipase .

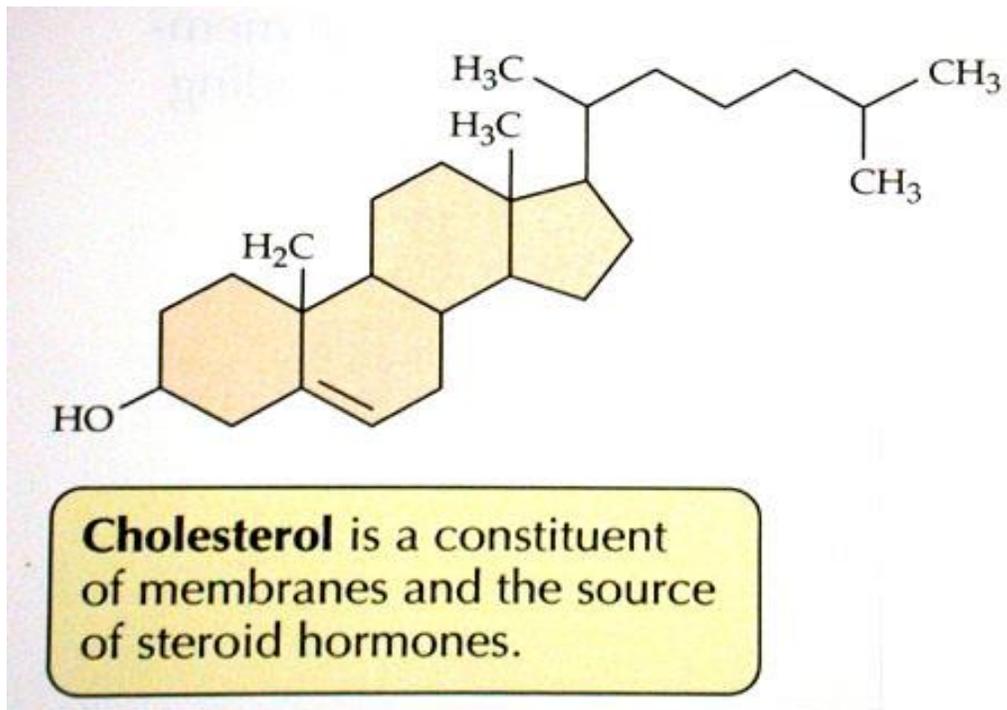
Up on hydrolysis TG. Is converted into mono and di glyceride .

3- *Phospholipids*

N.V = (175 – 250) mg/100ml .

It is also called glycerophosphate , they are complex lipids (contain atoms of P,N. in addition of C,H,O) e.g.: of phospholipids are lecithin and sphingomyelin .

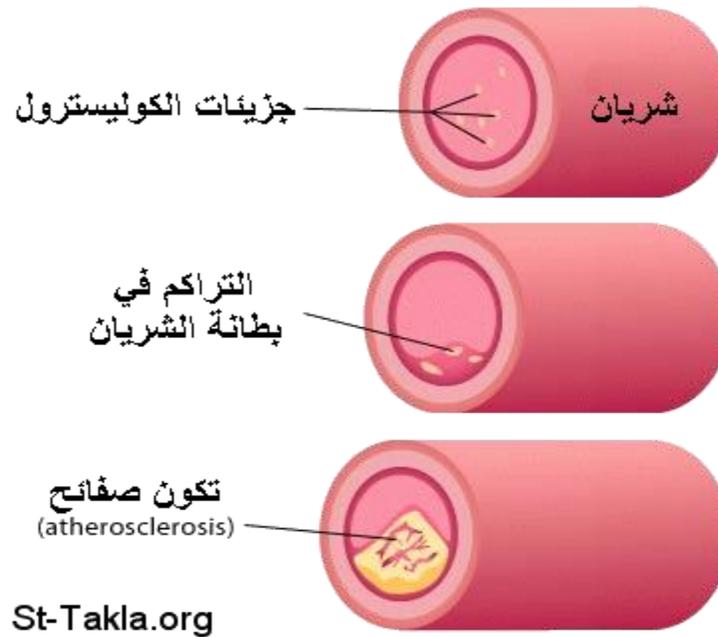
4 – *cholesterol*



Classification :

Cholesterol is a steroid compound containing a steroid nucleus (the ring system A, B, C, D).

Chole : means bile, sterol means solid alcohol, therefore cholesterol means bile solid alcohol.



Occurrence : cholesterol is present in most human tissues such as (brine , nerve tissue , bile , liver and blood .

in the blood cholesterol is present in tow forme:

- 1- free cholesterol : which represents 1/3 of total cholesterol .
- 2- esterified cholesterol which represent 2/3 of total cholesterol .

NOTE : cholesterol is present in many dietary such as ,egg yolk , milk , meet and dairy products .

Synthesis : cholesterol can be synthesized internally **from** simple compounds such as (amino acid , FA, and carbohydrate)

This synthesis takes place in the liver , skin , gonada , intestine and adrenal .

Factors effecting cholesterol level :

- 1- inherited defect in lipoprotein metabolism endocrine system disease or liver disease , renal disease .
- 2- several hormones markedly affect the cholesterol levels such as:
 - a- thyroxin of the thyroid gland which inversely affect cholesterol level .
 - b- female sex hormone (estrogen) which lower cholesterol level .

N .V. : (140 – 280) mg / 100 ml

Clinical significance :

- 1- bile – duct obstruction : due to reduction of excretion .
- 2- nephritic syndrome : due to elevated protein and lipid in the plasma .
- 3- diabetes mellitus : due to malabsorption of proteins and lipids .
- 4- arteriosclerosis : due to cholesterol deposits in the blood vessels.

Decreased level of cholesterol are found in :

- 1- severe hepatitis : liver cirrhosis due to large damage of parenchymal cells responsible the cholesterol synthesis .
- 2- hyper thyroidism : due to the inverse nature of the thyroxin hormone .

Lipoprotein

Are combination of lipid and protein other than albumin . Lipids are insoluble in water but plasma lipid are soluble because they are combined with protein .

Lipoprotein can be separated by

1- (*electrophoresis*) into :

- 1- α – Lipoprotein : these are contain mostly cholesterol and phospholipids .
- 2- pre – β lipoprotein : these are contain mostly cholesterol .
- 3- β lipoprotein : these are contain mostly cholesterol .
- 4- chylomicrons : these are contain mostly Triglycerol .

2- (*ultra centrifuge*) of Lipoprotein : This is method for separation of L.P. which depended on molecular density when suspended in salt solution of specific gravity 1.063 some of the L.P. separated together with other plasma protein these are :

- 1- High density L.P. [HDLP] : Which correspond to the α Lipoprotein in the electrophoresis patter . This contain more protein than lipid .
- 2- Low density L.P. [LDLP] : Consist mostly of cholesterol and phospholipids they correspond to the β – L.P. .
- 3- Very low density L.P. [VLDL] : They have a most higher of Lipids and correspond to the Pre – β – L.P. .
- 4- Chylomicrons : Which are usually separated before ultra centrifuge.

الحالات المرضية التي يكون سببها الدهن

- 1- ***Ketosis*** : In acute starvation or impaired CHO metabolism .
reprinted by uncontrolled diabetes this will be an excessive degradation of fatty acid in the liver cell also excessive mobilization of fatty acid from adipose cell , as a result these accumulation a- acetone . b- aceto acetic acid . c- β – hydroxyl butyric acid .

These compound are called ketone bodies and the condition is known as ketosis or acidosis .

- 2- ***Fatty liver*** : It is abnormality of lipids metabolism which involves the accumulation of excessive fat in liver .

Fatty liver is often associated with :

- 1- Alcoholism .
- 2- malnutrition .
- 3- obesity .
- 4- Diabetes mellitus .
- 5- high level of fatty in the diet

Enzymes

Are biological catalyst which bring about chemical reaction in living cell .

All enzymes are proteins .

Enzymes are highly specific for their substrate .

Coenzymes : Are low molecular weight organic compound non protein .

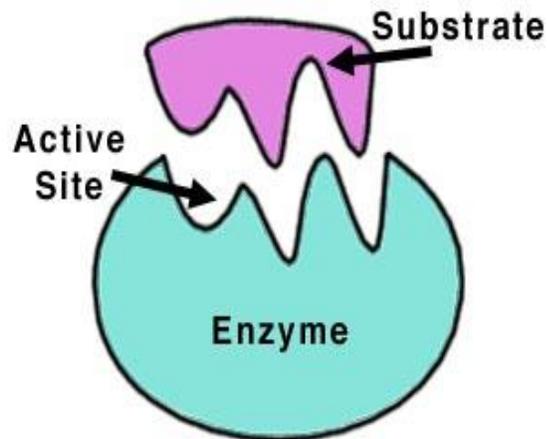
Apo enzymes : Refers to the protein part of the enzymes .

Holo enzyme : apo enzymes + coenzymes .

(protein part) (non protein part)

Isoenzyme : are different shapes of some enzyme catalyst the some reaction but different in plays and biochemical and immunological properation and can be identify by electrophoresis and immune electrophoresis method .

- **Luke and key theory .**
- **Active site**



Type of enzymes

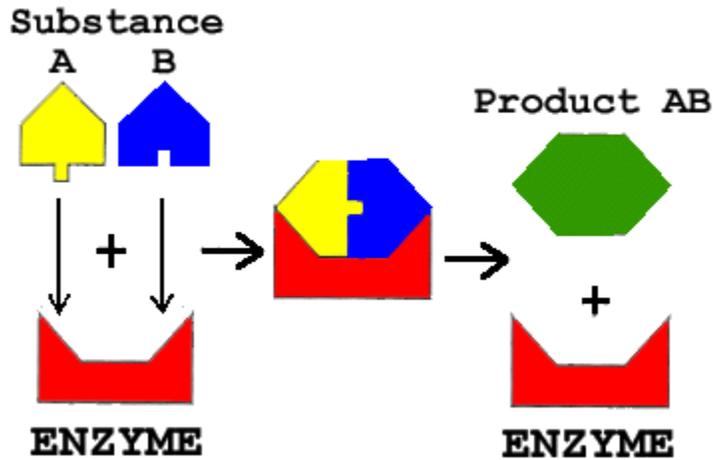
- 1- Intra cellular enzyme .
- 2- Extra cellular enzyme .

Classification of enzymes

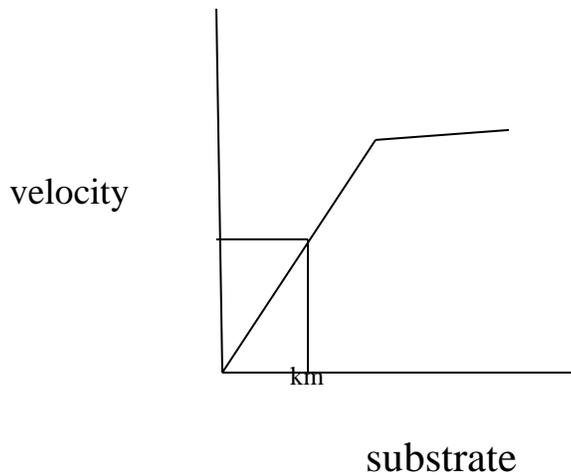
The enzymes are classified into six major classes .

- 1- *Oxido reductases* : They catalyze oxidation and reduction reaction .
- 2- *Transferases* : They catalyze the transfer some group from one molecule to another molecule .
- 3- *Hydrolases* : They catalyze the hydrolysis of the substrate by addition of water molecule across the bond .
- 4- *Lyases* : They catalyze the addition or removed of group from the substrate without hydrolysis oxidation or reduction .
- 5- *Isomerases* : They catalyze the conversion of a compounds into an isomer .
- 6- *Ligases* : They catalyze the linking together of molecules coupled with the breaking of pyrophosphate bond in ATP .

Factor effects on the activity of the enzyme



1- *Effect of substrate concentration :*



K_m: Michalies – menten constant is equal to the substrate concentration at which the initial velocity is half of maximum velocity.

$$V_{max} \cdot S$$

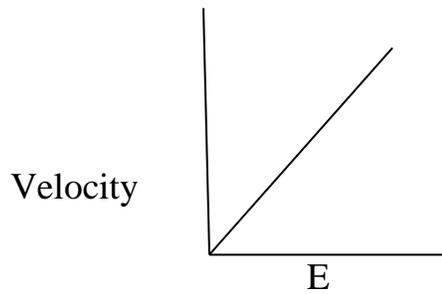
$$V = \frac{V_{max} \cdot S}{K_M + S}$$

$$K_M + S$$

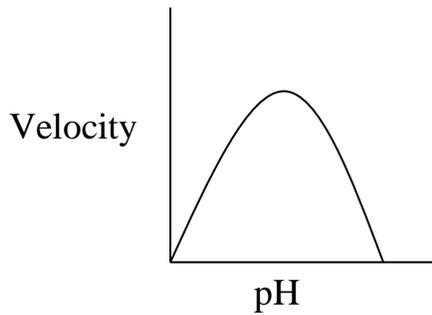
V = velocity S: substrate V_{max} : maximum velocity

K_M : Michaelis-Menten constant .

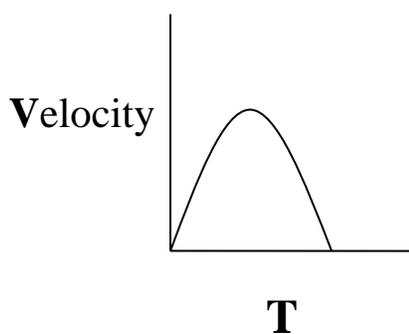
2- Effect of enzyme concentration :



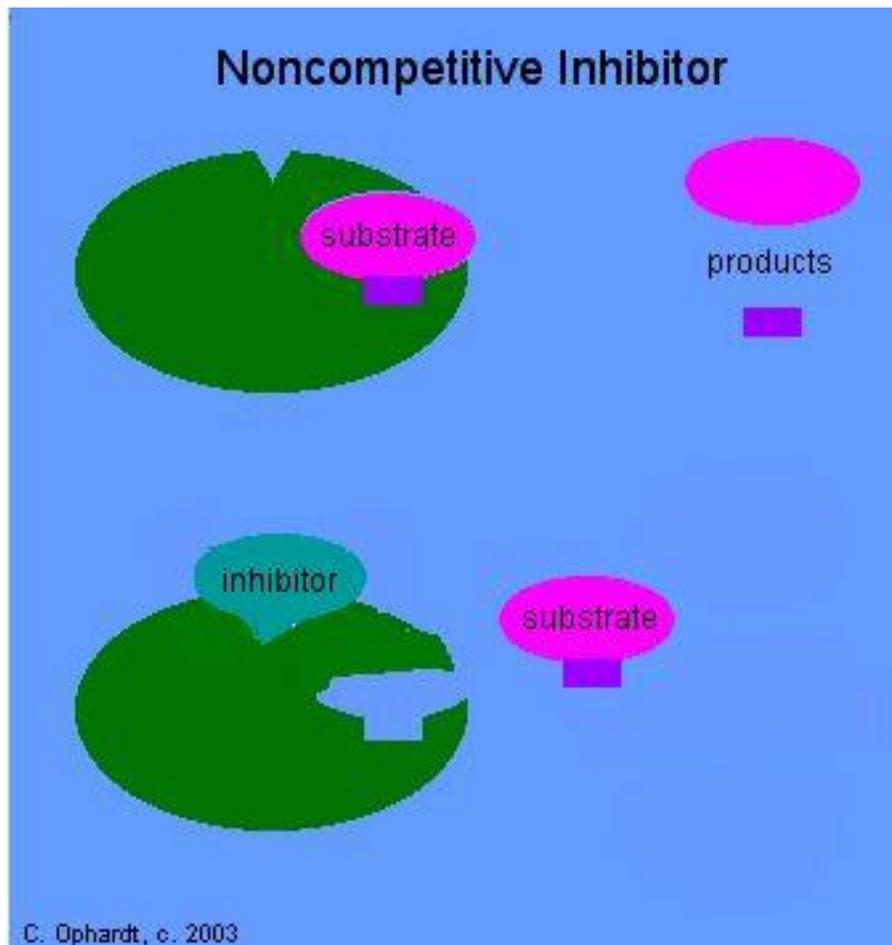
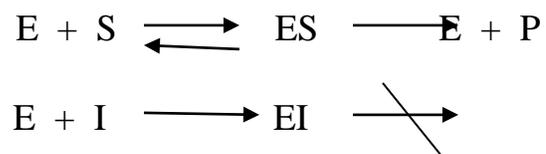
3- Effect of pH :



4- Effect of Temp :

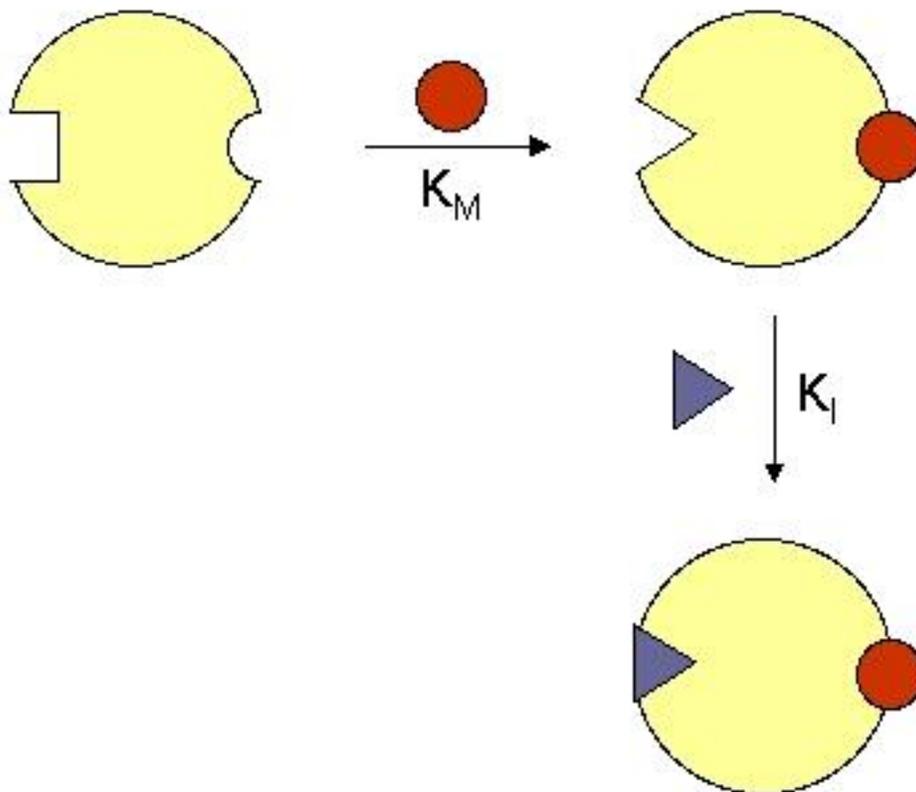


2- **Non – competitive inhibition** : They bind to different sites of the enzyme .



3- *Uncompetitive inhibition* :

The inhibitors combine only with the [E – S] forming irreversible complex .



Hormone

Define as organic compounds produced by endocrine system and secreted directly into the blood to act to their site of release or at distant organ in the body .

What Are Hormones?

Hormones : are actually tiny chemical messengers located inside of your body. They are unable to be seen with the human eye and travel throughout the internal superhighway - otherwise known as the bloodstream - to all of your body's organs and tissues. Different hormones perform specific roles inside of your body. Some of these hormones work quickly to start or stop a process, and some will continually work over the course of a long period of time to perform their necessary jobs. Some of these jobs include the body's growth and development, metabolism (or production of energy), sexual function and reproduction.

- Factor effecting on hormones activity

a- age (hormones concentration \propto age)

b- gland diseases.

General functions of hormones

- 1- Regulation of metabolism hormones effect the metabolism of carbohydrate , protein , lipid and minerals , directly their synthesis, storage mobilized and utilization according to needs.
- 2- Growth of bone and various type of tissue is under the control of hormone .
- 3- Homoestasis : hormone an important role in internal environment.
- 4- Behavior : hormones have an important role in behavior , fear ,depression and sex , behavior are due to several neural hormones.
- 5- Reproduction : reproductive organ are highly sensitive to hormone.

Kinds of Hormones

There are two major classes of hormones:

1. Steroids hormones (are derived from cholesterol) In vertebrates synthesized from cholesterol by adrenal cortex. Example: cortisol

2. Non-steroid hormones

I. Amine-derived hormones are derived from the amino acids
ex:[epinephrine and nor epinephrine]

II. Peptides are made up of amino acids ex:[oxytocin]

III. Proteins [growth hormone, insulin]

IV. Glycoprotein [FSH,TSH]

Types of hormones

A. Pituitary hormones -

The most important glands in the endocrine system included:-

1. Growth hormone (GH)

- Is a protein
- Helps adults maintain muscle and bone mass
- Affecting on lipolysis, blood glucose, and skeletal growth.
- Normal value in plasma 0-3 mg/ml.

2. Thyroid-stimulation hormone (TSH)

- It is a glycoprotein.
- Is required for synthesis of thyroid hormones in thyroid gland.
- Accelerate the uptake of iodine in the thyroid gland.
- If absence leads to atrophy of thyroids gland.

3. Adrenocorticotrophic hormone (ACTH)

- It is an oligo peptide.
- Clinical significance Cushing's syndrome.
- Responsible of formation & secretions of adrenal hormone.

B. Thyroid hormones

Are required for normal growth & development included thyroxin (T4) & triiodothyronine (T3).

Thyroxin (T4)

- An iodo-derivatives.
- Thyroid gland containing about 20 mg.
- Affected on oxidative processes.
- Clinical significance

Hypo; in myxedema

Hyper; in Graves' disease.

C. Parathyroid hormones

Parathyroid (PTH)

- Is a polypeptide.
- Synthesized by parathyroid gland.
- Important in calcium metabolism.
- Clinical significance Hyper; re-solution of the calcium of bone Hypo; tetany.

D. Pancreatic hormones

-The hormones are produced in islets of langerhans. There are: - [insulin, glucagon, somatostatin, pancreatic polypeptide]

i. Insulin

- Produced by the β -cell of langerhans isles of the pancreas.
- Control the carbohydrate metabolism.
- Clinical significance: diabetes mellitus.

ii. Glucagon

- Secreted by the α -cell.
- Has an opposite action of insulin.
- Stimulates the hydrolysis of neutral fats.

E. Adrenal hormones

- The adrenal gland consists of a medulla & cortex.

1. Adrenaline

- Produced within the adrenal gland (small glands located at the top of each kidney).
- Adrenaline works with noradrenalin to produce the “fight or flight” • Response by increasing the supply of oxygen to the brain and muscles

2. Noradrenalin

- It is works with adrenaline.
- Produce the “fight or flight” response it boosts the oxygen supply to the brain and the supply of glucose to the muscles.

Endocrine gland	structure	Tissue	affect
Growth H.	Poly peptide	Liver	Catalys growth
Prolactin	Poly peptide	Milk gland	Catalys product milk
Adrino cortico tropen	Poly peptide	Pituitary	Adrino corticoid steroid
MSH	Poly peptide		Contain melanin
Parathyroidism	Poly peptide	Kidney , intestine	Increase absorbed Ca^{+2}
Insulin	Poly peptide	General	carbohydrate
Glucagon	Poly peptide	Liver	Hydrolysis glycogen
Thirotropen	glycoprotein	Thyroid	Produce and excretion thyroid H.
FSH	glycoprptein	Pituitary	Growth sp
Thyroxin	Derived amino acid	General	Increase O_2
Adrenaline	Derived a.a	Heart muscle	Increase hypertension
Cortisol	Steroid	General	Metabolism (carbohydrate , protein)
Aldosteron	Steroid	General	Reabsorption Na^{+1}

