وزارة التعليم العالي والبحث العلمي
الجامعة التقنية الشمالية
اسم التشكيل :- المعهد التقني الدور

الحقيبة التعليمية

قسم تقنيات المختبرات الطبية

اسم المقرر:	الكيمياء السريرية
المرحلة / المستوى:	الثاني
الفصل الدراسي:	الثاني
السنة الدراسية:	٢٠٢٥ / ٢٠٢٦

معلومات عامة

اسم المقرر:	الكيمياء السريرية						
القسم:	تقنيات المختبرات الطبية						
الكلية: المعهد	المعهد التقني الدور						
المرحلة / المستوى	الثاني						
الفصل الدراسي:	الثاني						
عدد الساعات الاسبوعية:	نظري	١	عملي		٢		
عدد الوحدات الدراسية:	٣						
الرمز:	MLT٢١١						
نوع المادة	نظري		عملي		كلهما	*	
هل يتوفر نظير للمقرر في الاقسام الاخرى	كـلا						
اسم المقرر النظير	-						
القسم	-						
رمز المقرر النظير	-						

معلومات تدريسي المادة

اسم مدرس (مدرسي) المقرر:	د. مها الطيف جاسم
اللقب العلمي:	أستاذ
سنة الحصول على اللقب	٢٠٢٠
الشهادة :	دكتوراه
سنة الحصول على الشهادة	٢٠١٢
عدد سنوات الخبرة (تدريس)	١٦

الوصف العام للمقرر

يكتب في هذا الجزء وصفاً عاماً و ملخصاً للمقرر الدراسي :-

تفسير نتائج تحاليل الكيمياء الحياتية ودمجها مع الممارسة السريرية و تدريب الطلبة على المشاركة والاندماج ضمن فريق العمل لإنجاز المهام الموكلة اليه بالاعتماد على منهج حل المشكلات. بناء معارف الطلبة وفهمهم في دراسة الوحدات التعليمية المتخصصة والمتقدمة وبشكل واسع بالاعتماد على الاستقلالية وتوجيه الذات في التعليم

الاهداف العامة

- تعريف مادة الكيمياء السريرية النظري
- التعرف على الامراض المرتبطة بعلم الكيمياء السريرية النظري وكيفية تشخيصها
- فهم الية تطور الامراض ومسبباتها وطرق تشخيصها سريريا
- فهم المؤثرات الخارجية التي تؤدي لظهور الامراض
- التطبيق النظري والعملي لطرق التشخيص الامراض على الاجهزة الحديثة المتوفرة مثل جهاز السبكتروفوتوميتر وجهاز الطرد المركزي والحمام المائي وجهاز الاليزا .
- تحليل النتائج التي يتوصل اليها الطلبة ومقارنتها مع النتائج القياسية

الأهداف الخاصة

- التعرف على اهم الامراض وكيفية تشخيصها
- التعرف على اهم الاصابات والامراض واهم المعالجات المستخدمة .
- فهم اهم الامراض والاعراض وانواعها ومسبباتها وطرق تشخيصها وعالجها
- تطبيق معايير التشخيص ومقارنة أنواعها والتعلم على أحدث أجهزة التشخيص
- تحليل النتائج من خلال مقارنة نتيجة الشخص السليم مع المريض

أمثلة الأهداف التعليمية .

تزويد الطلاب بأساس واسع ومتوازن من المعرفة والمهارات العملية في الكيمياء السريرية والعلوم الأساسية ذات الصلة .تنمية القدرة لدى الطلاب على تطبيق معارفهم ومهاراتهم الكيميائية في حل المشكلات النظرية والعملية في الكيمياء السريرية

الأهداف السلوكية او نواتج التعلم

- تعلم الطالب مهارة كيفية سحب عينات الدم وحفظ العينة ونقلها الى المختبر
- يتعلم الطالب مهارة اجراء الفحوصات المرضية لغرض تشخيصها من خلال القياسات الدقيقة باستخدام جهاز سبكتروفوتوميتر .
- يكتسب الطالب مهارة تشغيل جهاز سبكتروفوتوميتر ومعايرته قبل الفحص وبعد الفحص

((أمثلة أهداف تدريسية)) :- بعد الانتهاء من الدرس (المحاضرة) سيكون الطالب قادرا على ان

- ماهية العمليات السريرية والامراض المرتبطة بها
- يميز ويعرف الكيمياء السريرية وعلاقتها بالطب والعلوم الاساسية الاخرى.

المتطلبات السابقة

- لايوجد

الأهداف السلوكية او مخرجات التعليم الأساسية		
ت	تفصيل الهدف السلوكي او مخرج التعليم	آلية التقييم
١	تعلم الطالب مهارة كيفية سحب عينات الدم وحفظ العينة ونقلها الى المختبر	• المحاضرات . • الواجبات الفردية والمشاركة . • حلقات النقاش والاختبارات .
٢	يتعلم الطالب مهارة اجراء الفحوصات المرضية لغرض تشخيصها من خلال القياسات الدقيقة باستخدام جهاز سبكتروفوتوميتر .	• البحث وتطوير المهارة من خلال الابحاث في المختبرات
٣	يكتسب الطالب مهارة تشغيل جهاز سبكتروفوتوميتر ومعايرته قبل الفحص وبعد الفحص	• مشاريع فردية او جماعية . • اختبارات .

أساليب التدريس (حدد مجموعة متنوعة من أساليب التدريس لتناسب احتياجات الطلاب ومحتوى المقرر)

الاسلوب او الطريقة	مبررات الاختيار
المحاضرات النظرية والعملية	محدد وواضح ويطبق بسهوله وهو التقليدي
تدريب الطلبة في المستشفيات والمختبرات التعليمية	التفاعل بين الكادر المتخصص و الطلبة
اعتماد المحاضرات الفيديوية لزيادة المعرفة	تقديم الخلاصة والفهم للموضوع

المقرر الدراسي :– الكيمياء الحياتية المستوى الدراسي الثاني – الفصل الأول

الاسبوع	الساعات	مخرجات التعلم المطلوبة	اسم الموضوع	طريقة التعلم	طريقة التقييم
١	٣	المعرفة والتطبيق العملي	Protein determination methods	عملي + نظري	الاختبارات والتقارير
٢	٣	المعرفة والتطبيق العملي	Lipid , types of lipids , function classification .	عملي + نظري	الاختبارات والتقارير
٣	٣	المعرفة والتطبيق العملي	Digestion , absorption of lipid .	عملي + نظري	الاختبارات والتقارير
٤	٣	المعرفة والتطبيق العملي	Metabolism of lipid , disease appeared with abnormal condition .	عملي + نظري	الاختبارات والتقارير
٥	٣	المعرفة والتطبيق العملي	Cholesterol , triglyceride , free fatty acid .	عملي + نظري	الاختبارات والتقارير
٦	٣	المعرفة والتطبيق العملي	Lipo proteins ,types ,disease accompanied with abnormal condition .	عملي + نظري	الاختبارات والتقارير
٧	٣	المعرفة والتطبيق العملي	Hyper lipedemia , acidosis ketones body .	عملي + نظري	الاختبارات والتقارير
٨	٣	المعرفة والتطبيق العملي	Enzyme , important in body .	عملي + نظري	الاختبارات والتقارير
٩	٣	المعرفة والتطبيق العملي	Classification , properties .	عملي + نظري	الاختبارات والتقارير
١٠	٣	المعرفة والتطبيق العملي	Factors effect on enzyme activity .	عملي + نظري	الاختبارات والتقارير
١١	٣	المعرفة والتطبيق العملي	Changes in Enzyme activity and the disease accompanied with that change .	عملي + نظري	الاختبارات والتقارير
١٢	٣	المعرفة والتطبيق العملي	liver function test .	عملي + نظري	الاختبارات والتقارير
١٣	٣	المعرفة والتطبيق العملي	Hormones , types , properties , function .	عملي + نظري	الاختبارات والتقارير
١٤	٣	المعرفة والتطبيق العملي	Hormones mechanism , disease accompanied with abnormal secretion .	عملي + نظري	الاختبارات والتقارير
١٥	٣	المعرفة والتطبيق العملي	Tests and comprehensive .	عملي + نظري	الاختبارات والتقارير

A: Over view

١- Target population:

This educational package is designed to the second-class students in the Department of Medical Laboratory Technology at Al-Dour Technical Institute.

٢- Rationale:

This (Unit) will aid those who want to learn the basic clinical biochemistry concepts that apply to the health field. It is also intended for students who have little or no science background.

There is a need for a "simplified "clinical biochemistry unit that presents the major concepts clearly for people entering the health occupations.

The student will discover, the concise nature of this unit has made each sentence significant. Thus, the reader will be intellectually challenged to learn each new concept as it is presented.

٣-Central ideas:

٣-١: General view of protein.
٣-٢: Types of protein.
٣-٣: Peptide bond.
٣-٤: Properties of protein.
٣-٥: Estimation total protein and albumin.

٤- Instructions:

٤-١: Study the over view carefully.
٤-٢: Learn briefly the modular unit of this package.
٤-٣: Perform the pre-test of this unit:

- If you get (٨) degree, or more. You will not need to learn this modular unit. In this case you must contact with your teacher to inform him about your results.
- But when you get less than (٨) degree in this test, you will need to continue learning this modular unit.

٤-٤: After you studying this modular unit.
The post-test you must do it.

- If you get (٨) degree or more, you must go to learn the second modular unit.
- In case you get less than (٨) degree, you Must return to the same unit in order to learn and understand the steps which you need.
- After you complete the studying, perform
  The post-test examination for checking.

B: Performance Objectives:

After studying this modular unit, you should be able to:

١. Define protein.
٢. Classified protein.
٣. Explain peptide bond.
٤. Define denturation.
٥. Estimation albumin, globulin & total protein.

Pre-test:

- Put a circle in front of right sentence: -

١. Protein are polymers of
a-carboxylic acid b-α-amino acid
c-β-amino acid d-di carboxylic acid
٢. Conjugated protein such as
a-albumine b-globulin
c-glycoprotein d-metaprotein
٣. Protein sensitive to
a-PH b-ionic concentration
c-heat d-solvent
٤. Denturation is a change in
a-composition of protein b-concentration of protein
c-charge of protein d-solubility of protein
٥- Building unit of protein is
a-carboxylic acid b-aldehyde
c-amino acid d-ketone

C: The Modular unit of this Package:

Estimation of protein

Several methods of protein estimation are available depend upon:

١- Nitrogen content.
٢- Aromatic A.A content.
٣- Phenol content.
٤- The peptide bond content.

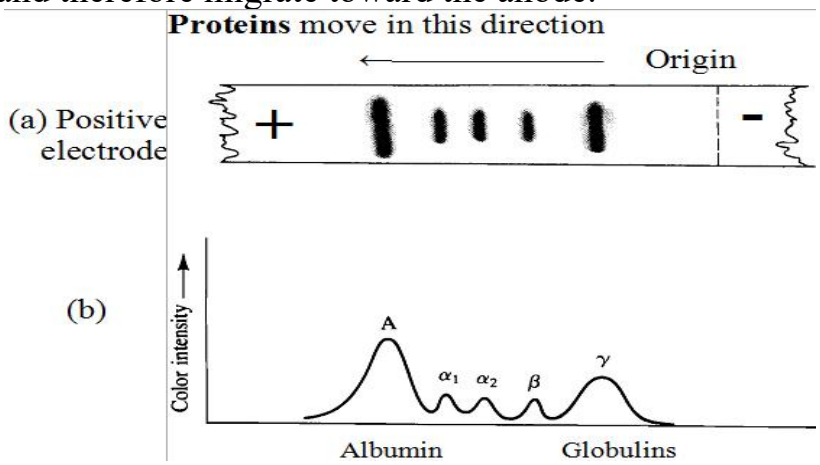
A. Kjeldal method.
B. Biuret method.
C. Separation of protein by electrophoresis.

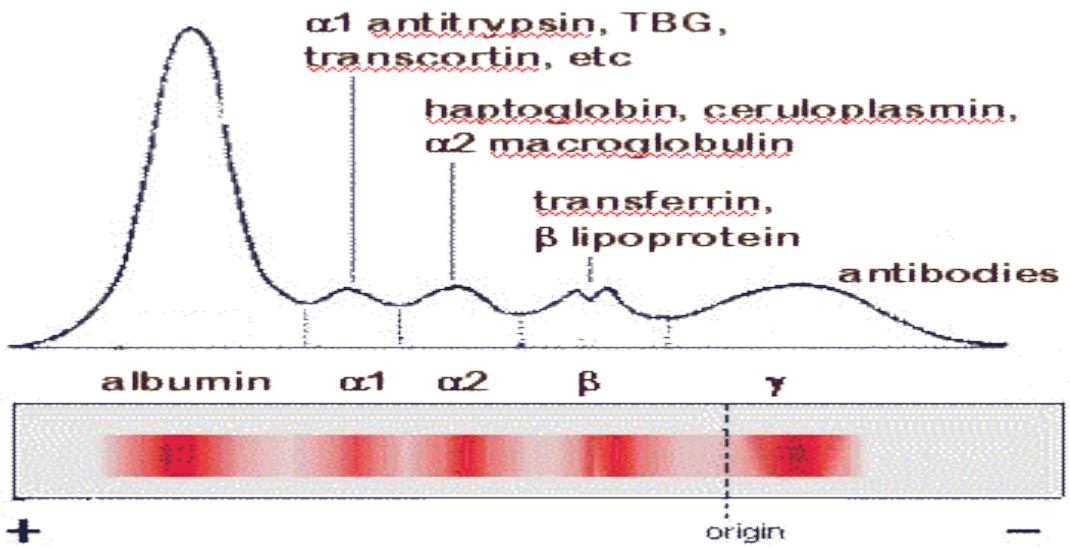
Electrophoresis: Is the migration of charged particles in an electric field. At a pH alkaline, a protein will carry a net negative charge and therefore migrates to the anode when a current is passed. Different proteins vary markedly in their negative charge & therefore in electric mobility. Electrophoresis is especially used for the separation of macro molecular substance such as proteins and lipids.

The direction and speed of electrophoresis depends upon several factors such as:

١- Neat charge of the molecule.
٢- Size & shape of the molecule.
٣- Electric field strength.
٤- Nature of the supporting medium.
٥- The temperature of operation

One of the important factors is the pH of the buffer solution. The most commonly used pH for protein electrophoresis is pH ٨,٦. Under the these conditions most proteins are negative and therefore migrate toward the anode.





Electrophoresis can be carried out in a system whereby the solution containing the ions to be separated is supported in a medium such as paper, starch, agar or cellulose acetate.
The widely used support medium in clinical laboratories is cellulose acetate which require fewer samples, less time for separation and better resolution. It is stable, non-toxic & cane be made transparent in most accurate quantitation.

Serum electrophoresis

Certain conditions or diseases may be associated with decreases or increases in various serum proteins, as reflected below.

Protein	May be decreased in:	May be increased in:
Albumin	• Malnutrition and malabsorption • Pregnancy	• Dehydration
Alpha ١ globulin	• Congenital emphysema (alpha-١ antitrypsin deficiency, a rare genetic disease)	• Acute or chronic inflammatory diseases
Alpha ٢ globulin	• Severe liver disease • Hemolysis	• Kidney disease (nephrotic syndrome)
Beta globulin	• Cirrhosis	• High blood cholesterol (hypercholesterolemia)
Gamma globulin	• Variety of genetic immune disorders	• Polyclonal, antibody produced by or derived from different plasma cells: Chronic inflammatory disease

Urinary protein

Normal urine contains little amount of protein, which is not detectable by the ordinary method of protein determination in urine and the test is said to be positive when the protein concentration in urine is more than ٢٠ mg/dl.

The qualitative test is best applied on morning urine sample because it is more concentrated which will make the detection more easier. If the test is delayed for determination the sample should be kept in refrigerator after addition of few drops of toluene as preservative.

There are two methods to determination the protein urea:

١- Heat coagulation test.

٢- Sulpho salicylic acid test.

Bence Jones Protein (BJP)

Is usually, but not invariably or exclusively, found in the urine of patients with malignancy of β cell, but can rarely be found without malignant disease. It consists of free monoclonal light chains, or fragment of them, which have been synthesized much in excess of H chains, implying a degree of differentiation. Because of its relatively low molecular weight (٢٠٠٠٠ to ٤٠٠٠٠) the protein is filtered at the glomerulus and only accumulates in the plasma if there is glomerular impairment or if it is polymerizes. BJP may damage renal tubular cells and may form large casts, producing the "myeloma kidney".

BJP is the only protein of a M.wt. lower than albumin likely to be found in significant amount in un concentrated urine in the absence of haemoglobinuria or myoglobinuria.

Post-test

➢ **Put a circle in front of right sentence:-**

١. Building unite of protein

a-carboxylic acid b-amino acid

c-glucose d-ester

٢. In protein molecule building unit conjugated by

a-ionic bond b-peptide bond

c-glycosidic bond d-H-bond

٣. derived protein such as

a-albumine b-globulin

c-glycoprotein d-metaprotein

٤. Dipeptid bond have a formula

a-CON b-CONH

c-CNH_2 d-CN_2H

٥. Change in composition of protein called

a-rancidity b-condensation

c-denturation d-glycolysis

Lipid and Lipoprotein

They are ester of fatty acids. The lipids are a Heterogeneous groups of compounds related to fatty acids, they have the common property of being relatively insoluble in water but are soluble in non-polar solvents such as ether, chloroform, ethanol, benzene, carbon tetra chloride, ----etc.

Lipids have a variety of biological functions:

١. They serve as fuel as fuel molecules, as highly concentrated energy stores (٩ Kcal/gm).
٢. As Component of cell membrane.
٣. Cholesterol is important for the formation of steroid hormone and bile salts.

General Classification of lipid :-

١- **Simple Lipid**: Esters of fatty acids with various alcohols
   a. Natural fats: Tri esters of F.A with glycerol.
   b. Waxes : Esters of fatty acid with mono hydroxy aliphatic alcohols higher than glycerol

٢- **Compound lipid**: Esters of F.A with alcohol plus other groups.
   a. Glycolipids (cerebroside): Lipids containing a carbohydrate and also nitrogen but no phosphate and no glycerol.
   b. Phospholipids: Lipid containing phosphoric acid and in most cases a nitrogenous base.
   c. Lipoproteins: The combination of lipid with plasma protein.
   d. Sulpho lipids: Lipids characterized by possessing sulphate group.

٣- **Derived Lipids**: Derivative obtained by hydrolysis of those given in group ١&٢, which still possess the general physical characteristic of lipids.
   a. Saturated and unsaturated F.A.
   b. Mono glyceride and di glyceride.
   c. Alcohol include
      - Straight chain alcohol of higher molecular weight obtained from hydrolysis of waxes.
      - Sterols and other steroid including vitamin D.
      - Alcohols include vitamin A

Digestion of lipid

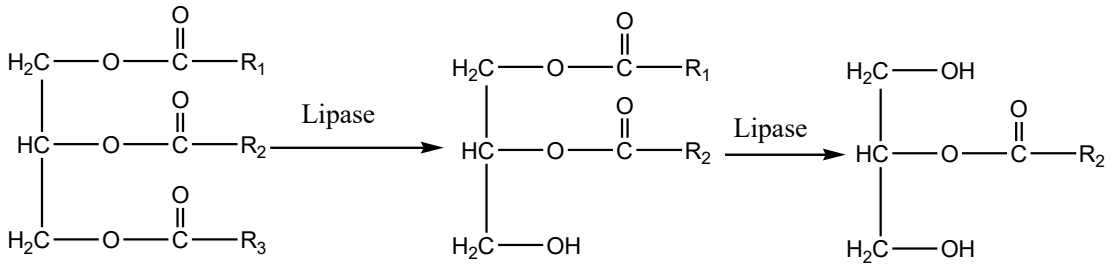
The stomach content (Chyme) is introduced in to the duodenum, the pancreatic and bile ducts open in to the duodenum also. The alkaline content of pancreatic and biliary secretion neutralize the acid of the chyme and changes the pH to the alkaline side, this shift of pH is necessary for the activity of the enzyme contained in pancreatic & intestinal juice.

The enzyme contained in pancreatic juice, which is responsible, for fat digestion includes lipase and cholesterol esterase.

Lipase:

Fats are hydrolyzed by a pancreatic lipase to F.A, glycerol, mono acyl glycerol, and di acyl glycerol. Pancreatic lipase is specific for the hydrolysis of ester linkage at position ١ and ٣of triglyceride, because of the difficulty of hydrolysis of the secondary ester linkage in TG.

The hydrolysis is aided by the bile, which emulsifies the fats so that they can be acted upon readily by pancreatic lipase.



TG 1,2- di acyl glycerol 2- mono acyl glycerol

The mono acyl glycerol are the major end product of lipid digestion.

Cholesterol esterase:

This enzyme catalyzes the hydrolysis of cholesterol ester, which thus mainly absorbed from the intestine in a non-esterified form.

Absorption of lipid

Absorption occurs from the small intestine with in the intestinal wall, mono acyl glycerol may be reconverted to TG, the free glycerol passes directly to the portal vein.

All FFAs present in intestinal wall are reincorporated to TG which then passes to the lymphatic vessels for distribution to the rest of the body, TG is transported in the form of chylomicrons.

Lipid Metabolism :

After the absorption of lipid is enter the liver and the excess is store in adipose tissue, the metabolic process happened as follows :

١- **Glycerin metabolism**

Glycerin → Phosphoglyceraldehyde → Glucose
Glycerin → Glyceraldehyde → Oxide → $CO_2 + H_2O$ + energy
Glycerin → Glycogen

٢- **Fatty acids metabolism**

a- Elongation

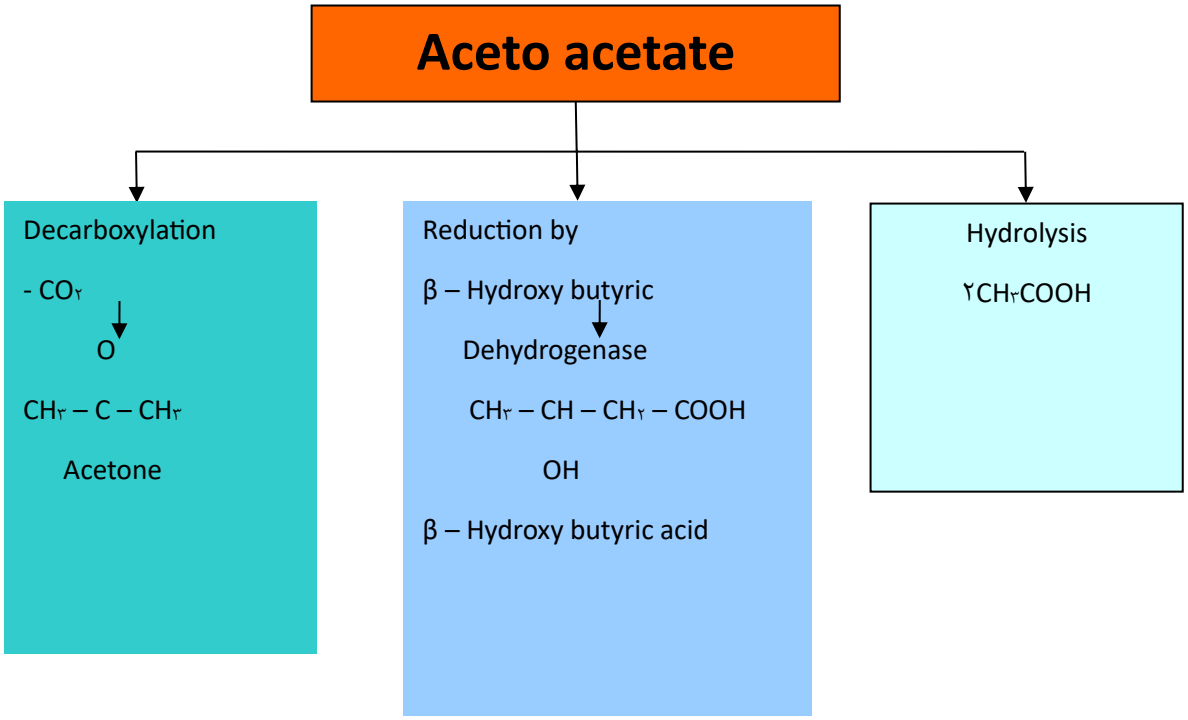
b- Saturation

Oelic Acid ⇌ Steric Acid
(Unsaturated) (Saturated)

٣- **Fatty acid Oxidation**

$CH_3COOH + CH_3 - C - SCOA \rightarrow CH_3 - C - CH_2COOH$

Simple FA Acetyle CoA Aceto acetate



The acetic acid produced from fatty acid oxidation many reaction such as:

١. CH_3COOH oxidizes to → $CO_2 + H_2O$ + Energy .

٢. CH_3COOH converted to → Keton bodies .

٣. $CH_3COOH + CH_3 - \underset{\underset{O}{\|}}{C} - CoA \rightarrow CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2COOH$

٤. Participate in formation of hem compound that is essential in formation of hemoglobin .

٥. Participate in formation of cholesterol in the body .

٦. May react with oxalic acetic acid produced from carbohydrate metabolism and enter (TCA) cycle therefore its decrease of ketone bodies formation .

Blood Lipoprotein

It is insoluble lipid in water , but are carried in the body fluid as protein complex called lipoprotein .

LIPOPROTEIN

Core water Insoluble
Non polar consist of two group
١. Cholesterol ester .
٢. Tri glycerol .

Peripheral water soluble
consist of (٣) group
١. Free cholesterol
٢. Phospholipid
٣. Apo proteins

Peripheral water soluble Polar

Apo proteins

↓

a. A
b. B .
c. C .
d. D .
e. E .

Each Apo protein has

Lipoprotein

Chylomicron | VLDL | LDL | IDL | HDL

Classification of Lipoprotein :

Its occurred according to their density by using ultracentrifugation so generally lipoproteins classified in the (٤) classes :

A. (Two Classes) : Most important For transport cholesterol these are :

١) HDL (high density lipoprotein) : It is transported cholesterol from cell .

٢) LDL (Low density lipoprotein) : its transported cholesterol to cell .

B. Two classes are most important For (TG) transport :

٣) VLDL (Very low density lipoprotein) : Transport endogenous (TG) from the liver to the cells .

٤) Chylomicron : Transported exogenous (TG) from the intestine to the cells .

٥) Fifth Class Called IDL : Intermediate density between LDL & VLDL , it contains both cholesterol & TG .

Properties of lipoprotein

Properties	Chylomicron	VLDL	LDL	HDL
Density gm/ml	> ٠,٩٠	< ٠,٩ – ٠,٦	٠,٠٦- ١,٠٦	١,٠٦٣-١,٢١
Lipid	٨٥ – ٩٧٪	٥٠ – ٩٠	٧٥	٥٠
Protein	٣ – ١٠٪	٥ – ١٠	٢٥	٥٠

Reference values:

٤- S. Cholesterol < ٢٠٠ mg/dl.

٥- S. TG male (٦٠ – ١٦٥)mg/dl Female (٤٠ – ١٤٠)mg/dl.

٦- LDL < ١٣٠ mg/dl.

٧- HDL > ٣٥ mg/dl.

Plasma lipids

Four forms of lipid present in the plasma, they are:

١. F.A (in the plasma FFA are carried mainly bound to albumin).

٢. Tri glyceride.

٣. Phospholipids.

٤. Cholesterol (about ٢/٣rd of the plasma cholesterol is esterified to form cholesterol ester).

Bile:

Bile is produced in the liver and stored in the gallbladder. When meat or fats enter the small intestine, they cause it to secrete a hormone cholecystokinin – pancreozymin (CCK _ PZ) this hormone enters the blood stream and is carried to the gallbladder where it causes that organ to empty in to the duodenum through the bile duct.

Bile is a yellowish – brown to green viscous liquid with a pH of ٧,٨ – ٨,٦ because it is alkaline, it serves to neutralize the acid entering from the stomach. Bile contains bile pigments, bile salts and cholesterol.

Bile salts: They are derived from cholic acid, a steroid similar to cholesterol in structure.

Bile pigments: Bilirubin is the main bile pigment excreted in to the bile by the liver.

Cholesterol and coronary heart disease:

There is a great correlation between raised serum lipid levels and the incidence of coronary heart disease and atherosclerosis. Of the serum lipid, cholesterol has been the one most chiefly concerned in this relationship.

However , other parameters such as cholesterol/PL ratio, lipoprotein concentration, TG concentration …. Etc. show similar correlation.

Patient with arterial disease may have any one of the following abnormalities:

١- Elevated concentration of TG with normal concentration of cholesterol.
٢- Elevated level of cholesterol with normal TG.
٣- Elevation of both cholesterol and TG.

Atherosclerosis:

It is characterized by the deposition of cholesterol ester and other lipids in the connective tissue of the arterial wall.

Diseases in which prolonged elevated levels of LDL& VLDL occurs in the blood, ex. Diabetes mellitus, hypothyroidism and other condition of hyperlipidemia are often accompanied by premature or more severe atherosclerosis.

Ketone bodies:

Under certain metabolic conditions, when there is a deficiency in carbohydrate metabolism, which is a sole source of energy production, lipid metabolism will increase to substitute the lack of energy. This increase in lipid metabolism is associated with a high rate of F.A oxidation, which lead to an accumulation of acetyl CoA.

The liver produce considerable quantities of acetoacetate, β-hydroxy butyric acid and acetone from this compound, which then pass in to the blood. These three substances are known as ketone bodies.

The concentration of total ketone bodies in the blood is ١mg/dl. Higher than the normal level present in blood constitute katonemia. The overall condition called ketosis.

Aceto acetic and β-hydroxy butyric acid are strong acids and are buffered with cations when present in blood, their continued excretion decrease the alkali reserve leading to ketoacidosis.

Obesity

The disease is due to irregularity of fat metabolism leading to fat accumulation in body at adipose tissue. Therefore its treatment is directed for reducing the caloric intake from fat and carbohydrate but maintaining the food which is rich in the protein, vitamins, minerals at normal level.

Important notes:

- Fats serve as a fuel in the body producing more energy per gram than either carbohydrate or protein. Metabolism of fat preduces ٩Kcal/gm, whereas the metabolism of either carbohydrate or protein produced only ٤Kcal/gm.

- Linoleic, linolenic and arachidonic acid a long chain unsaturated F.A required for prostaglandin synthesis are essential F.A. that is they are not synthesized in the body but must be included in the diet.

Enzymes

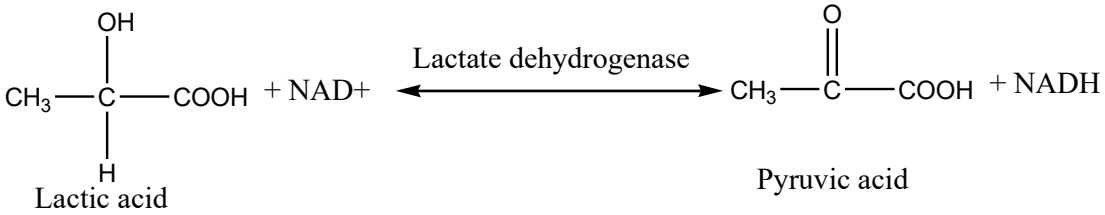
Enzymes : Are organic compounds, protein nature Produced by living cells. Its Catalyzed all biochemical reactions without being changed and Very specific .Its present in intracellular or extracellular .Have large M.wt ranged (١٣٠٠٠ – ٥٠٠,٠٠٠) Daltons or more .They are diagnostic tools used for elucidation many disease .The distribution of enzyme in cells depends its functions (Cytoplasm, Cell Wall, Etc.) .

Substrate : Is the substances upon which the enzyme act .

Classification of Enzyme :

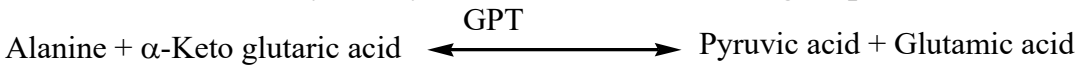
Its classified according to the types of reactions :

١- Oxidoreductase: They catalyze oxidation and reduction reaction.

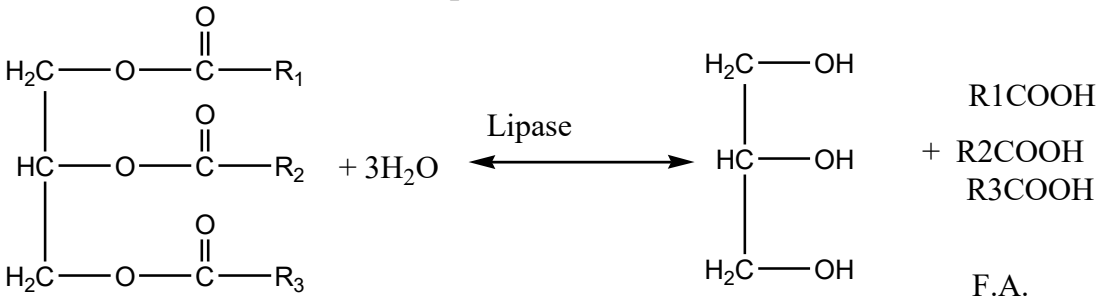


Lactic acid — Pyruvic acid

٢- Transferase: They catalyze the transfer of some group from one molecule to another.

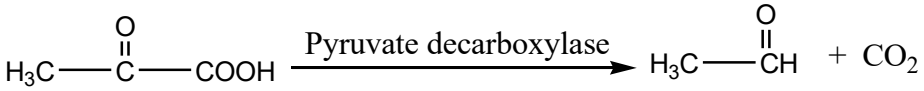


٣- Hydrolases: They catalyze the hydrolysis of the substrate by addition of water molecule across the bond which is split.

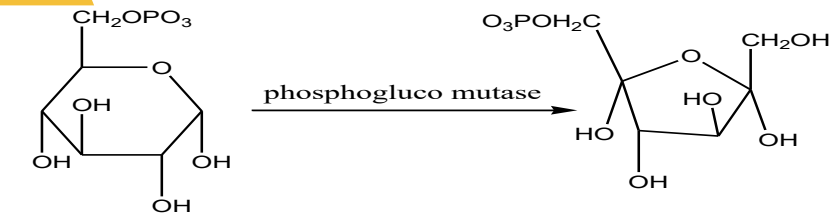


TG — Glycerol

٤- Lyases: They catalyze the addition or removal of groups from substrate without hydrolysis, oxidation or reduction.



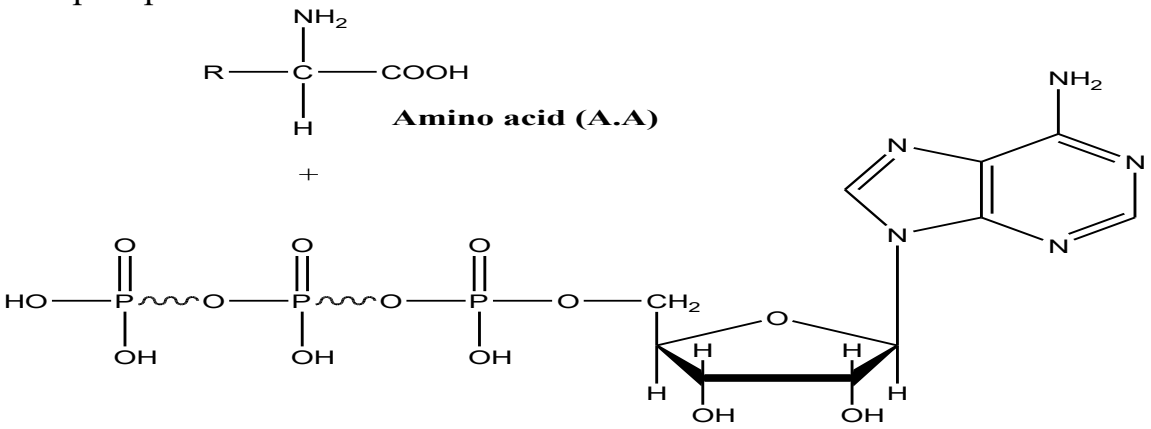
٥- Isomerase: They catalyze the conversion of a compound in to an isomer.



Glucose-6-phosphate

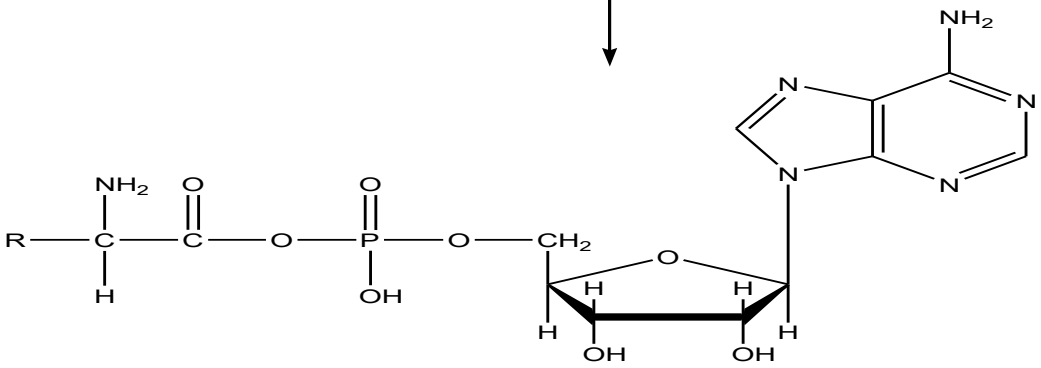
Fructose-6-phosphate

٦- Ligases: They catalyze the linking of molecules coupled with the breaking of pyro phosphate bond in ATP.



Adenosine tri phosphate (ATP)

A.A activating enzymes



Pyroxy phosphate (ppi)

Iso enzyme : Is the enzyme that catalyzed the same reaction but differ in their amino acids sequences like lactase dehydrogenase which contain four subunit each subunit may be either of the heart (H) or the muscle (M) type , in lactate dehydrogenase have five isoenzyme [HHHH,HHHM,HHMM,HMMM,MMMM] .

Enzyme active site : Is the region in which substrate acts. And converted to product . the enzyme released without changed .

Proenzyme : (Zymogen): It is the inactive state of enzyme like pepsinogen .

Pepsinogen inactive form $\xrightarrow[\text{Protolytic enzyme}]{\text{Acidic media}}$ Pepsin active form

Denaturation : I is the loss of activity of the enzyme (E) by changing of specific three dimension configuration of the enzyme molecule by effecting these factors (PH , temp , Acids , bases , Urea , heavy metal) the change in these factors leads to change in the position of functional group that are need to make the enzyme substrate complex .

Halo enzyme : It is the enzyme has proteins part (apoenzyme) + non protein part (Co – factor) .

Name culture of enzyme :

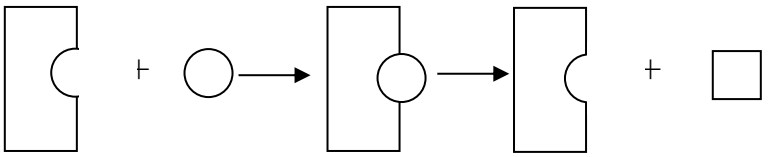
١. **Trivial name** → trypsin , pepsin .
٢. **The name depends substrate + ase , eig** : Urease , Phosphatase .
٣. **The name depends type of reaction:** likes carbonic acid an hydrolase .
٤. **Named depends function**

EC : enzyme code number .
IUb : **International Union biochemistry .**

Factors effecting enzyme activity :

١- **Combination between enzyme and substrate**: It is main step in catalytic process the enzyme acts on the substrate (S) through the active site the groups attached to the active site is called Active group ex [SH , NH_2 , COOH]

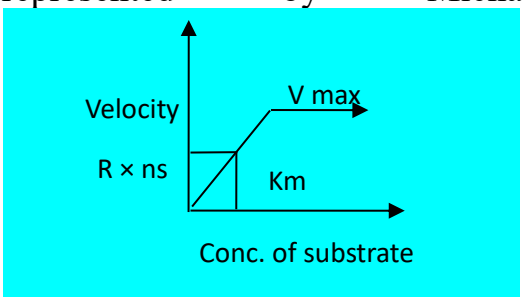
E (Enzyme) + S(Substrate) ⇄ ES (transition state) → E + P (product)



E S Transition state E Product

So any change in the shape of substrate molecule makes it not suitable for enzyme action .

٢- **Concentration of enzyme and substrate**: The Conc. of the enzyme and substrate could be represented by Michaelis – menten curve

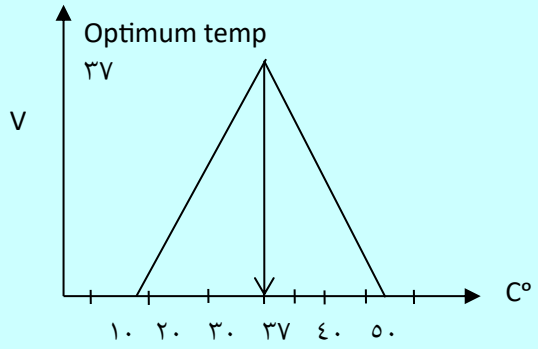


From the curve we can see the velocity of the r×ns is proportional to the Conc. of the substrate but to certain limit , At high Conc. of substrate , the velocity of (r × ns) will maximum (Vmax) velocity (stable) and independent one Conc. of Substrate , Also Michaelis menten constant .

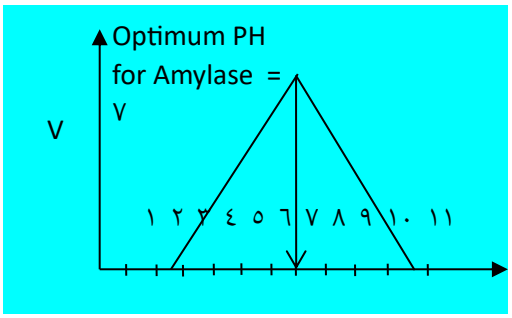
Which is very important for diagnosis of enzyme , each enzyme has special (KM) value .
Km :- A value equal the concentration of substrate at which the velocity of the reaction is half the maximum velocity .

٣- **Temperature** : The temperature effect the enzyme activity , it's found that (٣٧C°) is the optimum temp. for all enzyme in the body , At ٠C° all enzyme are inactive the increased the velocity of enzyme r×n about (٥٠ – ١٠٠٪) a slight change (١ – ٢) C° in temp caused change in velocity about (١٠ – ٢٠)% .
At ١٠٠C° the enzyme will caused enzyme stop activity .

Effect of temp. on enzyme Activity



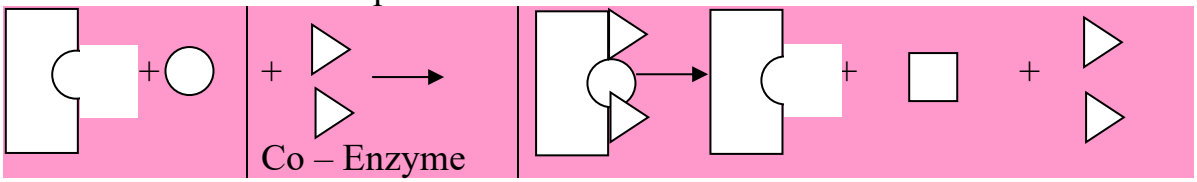
٤- **Hydrogen ion Conc. (PH)**: Enzyme are very sensitive to PH , each enzyme has special (PH) called optimum PH and the changes in PH effected the enzyme activity ex: Pepsin action in acidic media and be came in active in alkaline media , while trypsin acts in alkaline (PH) and becomes in active in Acidic media amylase acts in PH = ٦,٩ – ٧. ALP acts in PH = ٩,٦ – ١٠ .ACP acts in PH = ٤,٩ – ٥



٥- **Co enzyme and activators** : Are the organic or inorganic compounds helps the enzyme in their reaction .

A - Co enzyme : It is the second substrate or Co-substrate have these properties :

١. Organic Substances .
٢. Less specific than enzyme , the same coenzyme can enter many different reaction .
٣. The protein part of each enzyme attached specifically to the protein part of enzyme at different adjacent site to accept atoms or group from the substrate transported them to another acceptor molecule .



E S		ES E P

There are many chemical r×n shown , how the coenzyme enter more than one reactions , but the enzyme enter only one reaction .

$$CH_3 - \underset{H}{\overset{OH}{C}} - COOH + NAD \underset{}{\overset{LDH}{\rightleftharpoons}} CH_3 - \overset{O}{C} - OOH + NADH$$

Lactic Acid — Pyruvic Acid

$$CH_3CH_2OH + NAD \underset{}{\overset{ADH}{\rightleftharpoons}} CH_3 - \overset{O}{C} - H + NADH_2$$

Ethyl Alc. — Acetaldehyde

LDH = Lactate dehydrogenase (Enzyme)
ADH = Alcohol dehydrogenase (Enzyme)
NAD = Nicotine amid adenine Di nucleotide (Oxidized form)
$NADH_2$ = Reduced form .

B – Activators :

١. Usually inorganic .
٢. The increase enzyme activity and in the absence of activator , the enzyme is inactive or slow activity .
٣. The role of action of activators is unknown they may help in the formation of (ES) complex or may acts as anti-inhibitor of enzyme or may be effect on protein configuration .
٤. Examples of activators are (Ca , Cl , Mn) For salivary amylase (Mg) for plasma phosphatase (Ca) For thrombin .

٦- **Inhibitors** : Substances that slow down or stop the enzyme activity , Ex : heavy metal Pb , anticoagulant , Protein ppt.

Types of Inhibitors :

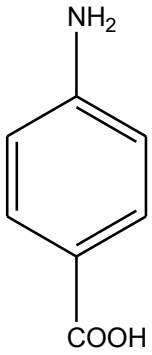
a. Completive inhibitor .
b. Non completive inhibitor .
c. Uncompetitive inhibitors .
d. Substrate inhibitors .

A- **Completive Inhibitors** : Substrate have the same structure of substrate , So they compete the substrate in the active site of the enzyme and reduced the interaction of the substrate and the enzyme .

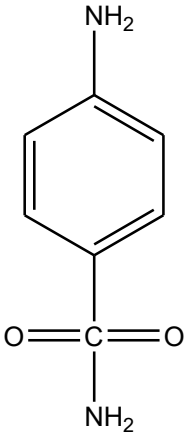
Ex : The completive inhibitors is malonate (Li) While the substrate is succinate (S) they are compete on the enzyme succinic dehydrogenase .

$$\begin{matrix} COOH \\ CH_2 \\ CH_2 \\ COOH \\ \text{Succinic} \end{matrix} \xrightarrow[\text{Dehydrogenases}]{\text{Succinic}} \begin{matrix} COOH \\ CH \\ CH \\ COOH \\ \text{Fumaric Acid} \end{matrix} + 2H$$

Acid	
COOH CH٢ COOH	Malonic acid(Completive inhibitors)



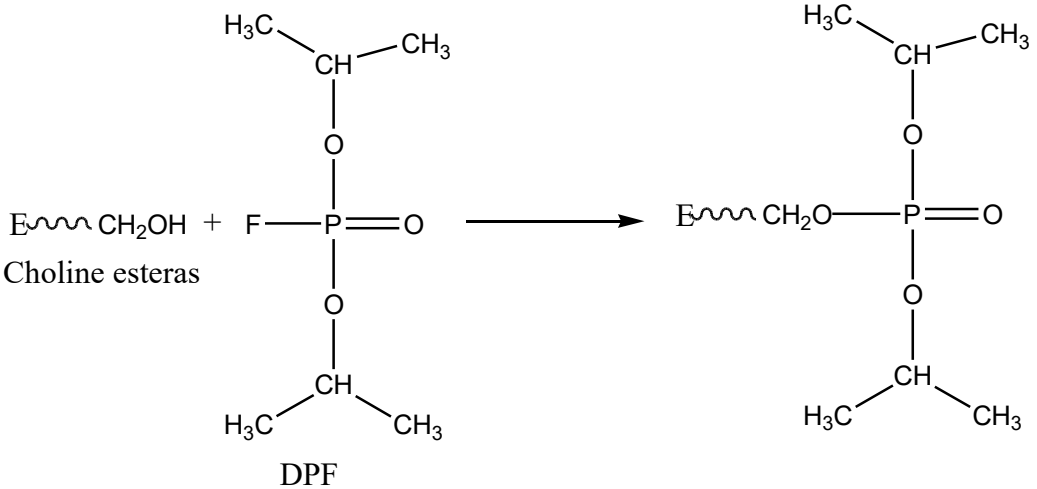
P- Amino Benzoic Acid (PABA)



Sulphonamide

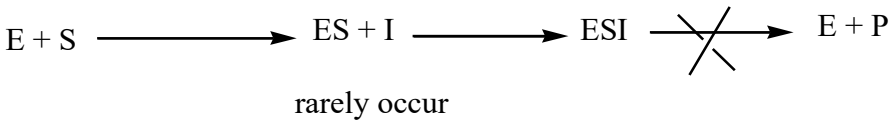
The compound P – amino benzoic acid is substrate for some enzyme need by some kind of bacteria for growth & reproduction of bacteria , drugs companies found that compounds metheprin is a completive inhibitors for r × n so it can be given to bacteria instead of P – amino benzoic acid

B- **Non completive inhibitors** : Are the substances combined with enzyme in a position differ from active site and then will effected the r×ns ability of enzyme with substrate ex: The inhibitors bind to enzyme or enzyme substrate complex and decrease the activity of the enzyme .



C- Uncompetitive inhibitors:

These inhibitors combine only with the ES complex, forming an irreversible complex as in the following equation:



D- **Substrate inhibitors** : This happened When there is a high concentration of substrate , That is after the reaction velocity reach (Vmax) and still adding substrate lead to decrease the (r×n) velocity .

Allosteric enzyme : Enzyme bind with effectors or modifiers at site other than the active site effectors can acts as activators or inhibitors of the reaction , allosteric enzyme usually found in metabolic path way .

How can we measured enzyme Activity :

١- By measuring decreasing in substrate quantity from the original quantity before reaction .

٢- By measuring the amount of products formed by enzyme reaction .

Enzyme Unit : Is the amount of enzyme which catalyzed and transformed of ١µ mole of substrate (S) per ١ Min .

How can be the enzyme react with substrate :

Enzyme have catalytic site and have three dimension conformation , the reaction explained by these theory .

١. **The Lock and key of temple model:** which explain the interaction between (S) and (E) at catalytic site because it's quite complement in shape , rigid template .

٢. **The induced fit model**: an essential feature is the flexibility of catalytic site and the (S) induced Fit conformation change in Enzyme .

Turn over : Is the No. of moles of substrate transferred to product per minute under optimum condition catalyzed by enzyme activity .

Enzyme Unites :

١. **International Unit (IU)** : Is the enzyme activity that catalyzed the formation of ١µ mole of product per minute under Optimum condition .

٢. **Ketal Unit** : The amount of enzyme that catalyzed the conversion of one mole of substrate per second .

٣. **Bondanesky Unit** : The amount of enzyme that will split one (mg) of phosphate – phosphorus From B – glycerol phosphate at PH = ٨,٦ , ٦٠Min , ٣٧C^{o}

Clinical significance of Enzyme :

١. **Creatine Kinase (CK)or Creatine PhosphoKinase (CPK) Enzyme** : Is an enzyme catalyzed the reversible transfer of phosphate from adenosine triphosphate (ATP) to creatine , this reaction makes possible storage high energy phosphate . in more stable form that (ATP) .

Creatine + ATP CK Creatine phosphate + ADP

Occurrence :

١. Skeletal muscle
٢. Cardiac muscle
٣. Thyroid gland
} High Concentration .
٤. Prostate gland
٥. Brain .
٦. Liver (Small amount) .
٧. Kidney .

The CK enzyme highly increased in these :

١. Myocardial infraction (MI) .
٢. Muscular dystrophy .
٣. Shock .

Moderately increased in :

١. Muscle injury .
٢. Exercise .
٣. intramuscular injection .
٤. Hypothyroidism .
٥. Alcoholism .

(CPK) is protein in nature present as isoenzyme , it consist of two sub unit (M and B) .
(MM) for muscle isoenzyme (cardiac and skeletal) .
(MB) from comes of (MI) disease .
(BB) in brain , Smooth muscle in gastric tract , also increased in tumors of bronchus prostatic tumor , breast tumor .
(CK) activity is usually higher in men than woman because of the greater muscle mass in men

It is increased also in :

١. damage of heart tissue .
٢. Damage of skeletal tissue .
٣. Brain damage .

٢. **Lactate dehydrogenase** : Is reversibly catalyzed the oxidation of lactate to pyruvate by transferring hydrogen from lactate to the Co – factor (NAD) according to this reactions .

Lactate + NAD $\underset{\text{((LD))}}{\rightleftharpoons}$ Pyruvate + NADH + H

((LD)) is distributed widely in tissue and present in high concentration in liver , cardiac muscle , kidney , skeletal muscle , erythrocyte . The N.V for serum (L D) activity is (١٢٣-٢٩٠) IU/L

Clinical significance : It is increased in :

١. Myocardial infraction .
٢. Liver disease .
٣. Muscle trauma .

٤. hemolytic anemia .
٥. pernicious anemia .
٦. Shock .
٧. Renal infection .

It is moderate increased in :

١. Viral hepatitis
٢. Renal disease .

Isoenzyme for (LD) : there are (٥) isoenzyme can be detected by electrophoresis normally the two different poly peptide chain (m) type typical for skeletal muscle and (H) type from cardiac muscle .
Five different Isoenzyme combination (HHHH) (LD١) from heart , muscle , blood , kidney . (MHHH)(LD٢) also heart , (MMHH)LD٣ in lung and other tissue , (MMMH) LD٤ in many tissue and (MMMM) LD٥ primary in skeletal muscle and liver .

٣. **Gamma glutamyle transferase (GGT)** : This enzyme catalyzed the transfer of glutamyl group from one peptide to anther it is present in numerous tissue including kidney , pancreas , and prostate . Elevation of (GGT) can be seen individual taking drugs , such as Phenobarbital , it is also sensitive to alcohol .

It is increased by

١. Liver disease (obstruction Jaundice) .
٢. Alcoholic liver cirrhosis .
٣. Cardiac disease .
٤. Biliary tract disease .

٤. **Alkaline Phosphatase** : (ALP) It is have optimum activity at PH (٩,٦-١٠) & ٣٧C° , it have high isoenzyme forms , there are (٣ to ٤) in one serum sample , it is activated by presence divalent ions such as Mg, Co and (Mn) but (PO_4) Borate , oxalate , and cyanide ion inhibited the enzyme , it is denaturation at ٥٦C° .

Clinical Significance : It is increased in

١. Liver disease .
٢. Bone disease .
٣. Pregnancy .
٤. Growth of children .

KAU : The activity of enzyme that liberated ١gm of phenol at ١٥min incubation at ٣٧C° and PH = ٩,٦ – ١٠ .
N.V. of ALP = ٣ – ١٣ KAU/١٠٠ml serum .

٥. **Acid Phosphate (ACP):** The ACP belong to the hydrolase enzyme
Synthesis of (ACP) occurrence : ACP is present in many tissue such as :

١. Liver
٢. Spleen .
٣. Milk .
٤. Erythrocyte .

٥. Platelets .
٦. Bone marrow .
٧. Prostate gland .

The Prostate gland is enriched source (١/٣ – ١/٢) of enzyme in healthy male .
The ALP & ACP used to diagnosis many disease like carcinoma .

Properties of ACP :

١. It have Optimum activity at PH (٤,٨ – ٥,١) , ٣٧C° .
٢. Have many isoenzyme , but there are (٣ – ٤) present in serum sample .
٣. ACP is activated by divalent ion such as Mg , Co , Mn .
٤. Inhibited by anion such as PO٤ , Borate , oxalate , cyanide .
٥. denaturation at ٥٦C° .

KAU : the activity of enzyme that liberated ١gm of phenol at ١ Hr incubation time ٣٧C° , PH = ٤,٨ – ٥,١ .
N.V of ACP for adult = ١ – ٣,٥ KAU / ١٠٠ml serum .
L – tartarate : inhibited enzyme ACP comes from prostate gland .

Clinical significance : it is increased in :

١. Breast Cancer .
٢. Leukemia .
٣. Prostate Cancer .
٤. Hyper parathyrodism .
٥. bone cancer .
٦. Baget disease
٧. Growth of children .

٦. **Transamination GOT and GPT** : GOT glutamate oxaloacetate transaminase also called Aspartate transferase AST .

Classification : GOT & GPT belong to of enzyme called transaminase .
Trans aminase : It is a group of enzyme which catalyzed the conversion of amino acid to keto acid to form new amino acid and keto acid that need by body the reaction is reversible .
Sources and occurrence : GOT is widely present in human tissue such as :

١. Human plasma .
٢. Bile .
٣. CSF .
٤. Cardiac muscle
٥. Liver .
٦. Skeletal Muscle .
٧. Kidney .

GOT properties :

١. Optimum activity of GOT&GPT at ٧,٤PH and ٣٧C° .
٢. It is inhibited by presence of anticoagulant .
٣. It is stable for (٣) day at room Temp. and ١ week at ٠ – ٤C° and stable for ١ month at deep freeze .

Clinical Significance :

١. Heart disease such as cardiac damage myocardial infraction .

٢. Liver disease , such as viral hepatitis , liver cancer , liver cirrhosis , obstruction Jaundice .
٣. Muscular disease , Muscular dystrophy .

N.V for S. GOT = ٢ – ٢٠ IU/L or
٢ – ٢٣ μ mole / min /L .
N.V for S.GPT = ٢ – ١٥ IU / L
٢ – ٣٨ μ mole / min / L .

Liver function tests

The Liver is the largest and most versatile organ in the body. It consists of two main lobes, its weight is from (١٤٠٠-١٥٠٠) gm in normal adults. Metabolic disturbances in hepatic disease are therefore adult characteristic and may serve as diagnostic aids.

Functions of the liver:

٣- The hepatocyte are responsible for the conjugation of bilirubin and for its excretion in the biliary tract.

٤- The liver is the Centre of metabolic activity for carbohydrate, lipid and protein.

- **Carbohydrate**: sugar is converted to glycogen. Glycogen is stored as carbohydrate reserve being reconvertible to glucose.
- **Protein**: Amino acids are deaminated and the NH_3 converted to urea, Ig are synthesized in the cells of RES. Production of fibrinogen, prothrombin and heparin in the liver cells….etc.
- **Lipid**: It is the major site for the conversion of acetyl CoA to F.A, TG and cholesterol. Then cholesterol further metabolized into bile acid, VLDL, HDL, PL are synthesized in the liver.

Formation of the ketone bodies, Vit.D, many enzymes are synthesized in the liver cells like SGPT, SGOT, γALP, ……etc.

٣- The liver detoxification many metabolic products and drugs prior to their excretion in urine. The detoxification process involve chemical changes and or conjugation with glucoronic acid, glycine or sulphate by hydrolysis, carboxylation and demethylation, these various mechanism serve to convert many toxic substances or insoluble substances into other form that either more soluble or less toxic.

٤- The liver stores a variety of compounds including iron, copper, Vit.B_{12}, Vit.A and glycogen.

٥- The liver excrete many natural and foreign substances in the biliary tract.

When the liver is diseased one or more but not necessary all of its function is impaired.

The importance of liver function tests:

١- To assess the severity of liver damage.
٢- To differentiate different type of jaundice.
٣- To find out the presence of latent liver disease.

Liver function tests are divided into three classes:

١- Tests indicating cell damage e.g. SGOT&SGPT there activity increased in Viral Hepatitis, Liver Cirrhosis. SGPT is more specific indicator of liver cell damage than that of SGOT.

٢- Tests indicating liver dysfunction:

a- Conjugating capacity e.g. Bilirubin.

b- Excretion capacity e.g. BSP.

c- Synthetic capacity e.g. Albumin & A/G ratio

Jaundice:

When the bile pigment in blood is excessive, it escapes into the tissues, which than become yellow . this condition is known as jaundice.

Jaundice may be due to the production of more bile pigment than the normal liver can excrete, or it may result from the failure of a damaged liver to excrete the bilirubin in normal amounts. In the absence of hepatic damage, obstruction of excretory ducts of the liver by preventing the excretion of bilirubin will also cause jaundice.

Jaundice is sometimes subdivided into three major groups:

١- Hemolytic or pre hepatic jaundice:

In hemolytic jaundice , there is an increased breakdown of Hb, the liver cells are unable to conjugate all the increased bilirubin leads to increased production of urobilinogen which appear in urine in large amounts.

٢- Hepatic jaundice:

It results from liver damage, which cannot conjugate bilirubin. The indirect serum bilirubin level will be high, urine will show the presence of bilirubin and increased amount of urobilinogen.

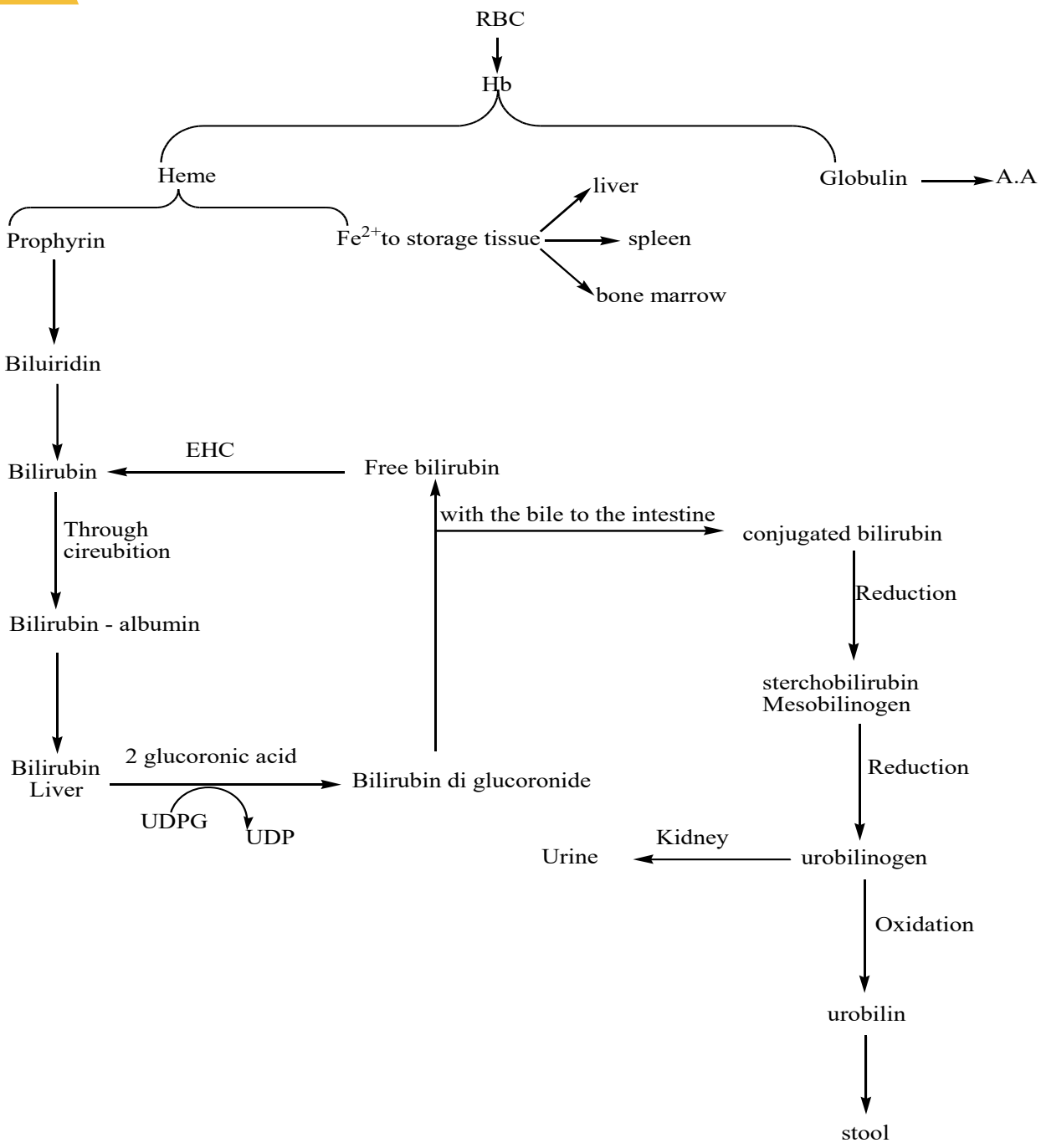
٣- Obstructive or post hepatic jaundice:

This type of jaundice result from the obstruction of common bile duct. As a result of obstruction, bilirubin does not pass into the intestine, so no urobilinogen is found in urine, direct serum bilirubin level will be high, urine will show the presence of bilirubin.

Bilirubin is of two types:

١- Direct bilirubin: It is bilirubin di glucoronide, it is water soluble.

٢- Indirect bilirubin: It is albumin bound bilirubin.it is water insoluble


RBC
Hb
Heme
Globulin
A.A
Prophyrin
Fe2+ to storage tissue
liver
spleen
bone marrow
Biluiridin
Bilirubin
EHC
Free bilirubin
with the bile to the intestine
conjugated bilirubin
Through cireubition
Reduction
Bilirubin - albumin
sterchobilirubin
Mesobilinogen
Bilirubin Liver
2 glucoronic acid
Bilirubin di glucoronide
UDPG
UDP
Reduction
Kidney
Urine
urobilinogen
Oxidation
urobilin
stool

Albumin/Globulin A/G:
The normal A/G ratio is ١,٢/١. In advanced liver disease, the albumin is decreased and globulin is increased, so that A/G ratio is reversed. Low serum albumin is found in severe liver damage due to the impaired ability of the liver to form albumin.

Bromosulphthalein (BSP):
A measured amount of dye is injected intravenously. The liver rapidly removes the dye and excretes in the bile. If the liver function is impaired, the excretion is delayed and larger proportion of the dye remains in the serum.
It is very sensitive test and is most useful in liver cell damage without jaundice, cirrhosis and chronic hepatitis.
In healthy adults not more than ٥٪ of the dye slould remain in blood, but the bulk of dye is removed in ٢٥ min. in hepatic diseases, cirrhosis, ٤٠ to ٥٠٪ of the dye retention takes place.

٣- Tests for cholestasis: It is of two types
   a- Intra hepatic causes e.g. Viral hepatitis, Drugs, Pregnancy.
   b- Extra hepatic causes e.g. Gallstones, Carcinoma, Fibrosis.

Teats indicating cholestasis are :

١- Alkaline phosphatase ALP.
٢- ٥ – Nucleotidase.
٣- γ-glutamyl transferase γGT.
٤- Bromosulphthalein test BSP.

Alkaline phosphatase ALP:
It is produced from bone & liver, which secrete it to plasma. Therefore any increase of activity of this enzyme denotes to bone damage or liver damage, as it is increased in rickets and jaundice. In children the normal value of enzyme is greater than that of adult as child used this enzyme for building up process in precipitating phosphorous in the bone tissue, also its increased in month of pregnancy. Abnormal values seen in bone disease like hyperparathyroidism, bone cancer, liver diseases like cholestasis, hepatitis & liver cirrhosis. Lower values than normal are seen in arrested bone growth, Vit. D deficiency.
Its normal value is (٣-١٣) KAU/dl of plasma in adult, while it is up to ٢٠ KAU/dl in childhood.

Hormone

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

General functions of hormones

١. Regulation of metabolism hormones effect the metabolism of carbohydrate , protein , lipid and minerals , directly their synthesis , storage mobilized and utilization according to needs .
٢. Growth the growth of bone and various type of tissue is under the control of hormone .
٣. Homeostasis: Hormone an important role in internal environment .
٤. Behavior : Hormones have an important role in behavior , fear, behavior are due to several neural hormones .
٥. Reproduction: reproductive organ are highly sensitive to hormone .

Classification of hormone

Its classified according to its chemical composition :

a. Amino acid derivatives such as thyroid it ($T^{٣}$,$T^{٤}$) epinephrine and serotonin .
b. Poly peptide such as pituitary hormone e.g. oxytocin, ADH, ACTH .
c. Proteins and glycoprotein such as insulin growth H . TSH . LH . FSH .
d. Steroids like progesterone , estrogen .

Target organs : the organ that hormone act on.

The similarity of hormone with enzyme :

١. They are needed in very small amount for their action .
٢. They are not change before and after their reaction .

The hormone differ from enzyme :

It is differed in several as pact :

١. They are produced in an organ other than used for their action such as thyroid hormone ($T^{٣}$, $T^{٤}$) .
٢. They are secreted in blood such as thyroid H . and steroid H . but the enzyme show their action in the cell .
٣. The chemical nature for hormone is protein , poly peptide and steroids , but all enzyme are protein in nature .

Control of hormone secretion :

There are several mechanism for maintaining the balance between the product of hormone and the need of the organism for hormone .

The interior pituitary occupies a central position in the control of hormone secretion , it secretes several hormone which stimulate and maintain certain other endocrine gland , in the absence of these tropic hormone , the target organ are unable to maintain a normal rate of secretion .

The main target organ of the tropic hormone are the (thyroid gland) , adrenal cortex , testes and ovary , these hormones are controlled by the fed back mechanism .

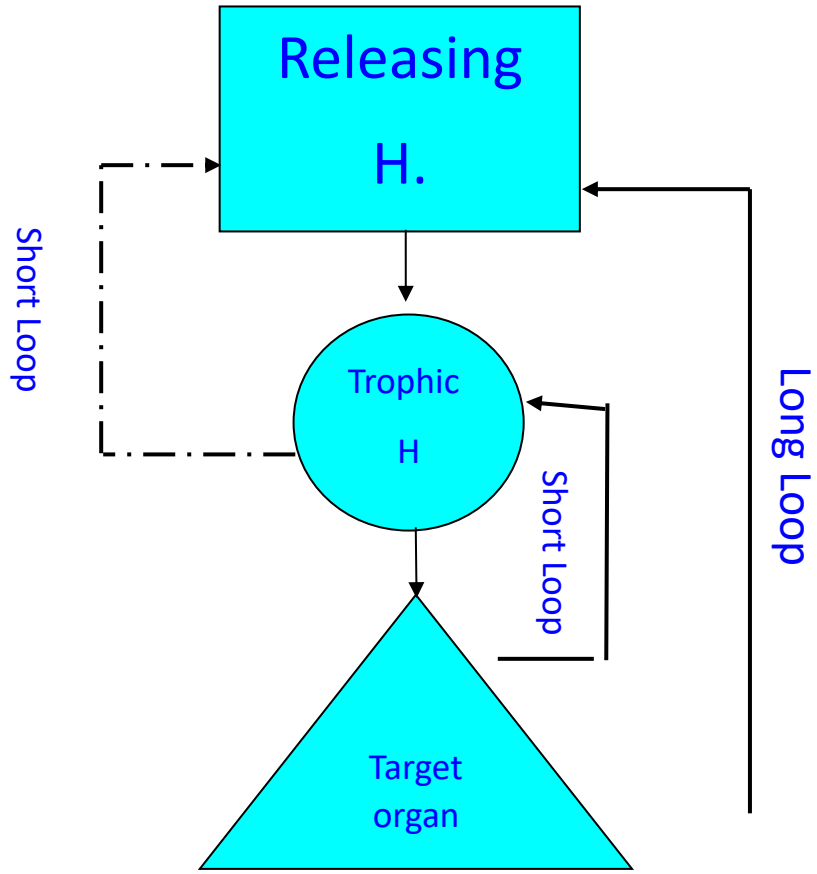
Feedback mechanism : It may be described as one in which the functions of two variable A&B are inter dependent .

They are two types of feedback mechanism :

١. Negative feedback control .
٢. positive feedback control .

Negative Feed Back control:

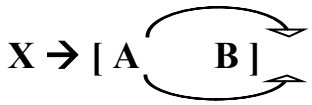
It is commonly employed especially by the hypothalamic – Pituitary gland system as example illustrated in figs .



The figure Explain the negative feedback control system used to regulated the function of thyroid hormone , adrenal , ovary and testis .

Example : Of negative Feedback control is the decreased of ($Ca^{+٢}$) level in the blood act to stimulated increased the secretion of PTH . Which increased the blood ($Ca^{+٢}$) level , The raised of ($Ca^{+٢}$) level caused the PTH gland to secrete less of hormone resulting decline of the ($Ca^{+٢}$) level in the blood .

Positive Feedback Control :
In this case (A) is directly increase to (B) when B , A is also increased this could be represented as follows



Lipophilic hormone : it is include steroid hormone its cross cell membrane and bind to specific captor inside their target cell the hormone receptor complex then exerts its effect on the transcription of particular gene in the nucleus , that nucleus , that increased synthesis of particular m RNA corresponding protein .
Hydrophilic hormone : Involved amino acid hormone peptide hormone , hydrophilic hormone bind to specific receptors on the outside of the cell membrane .
Regulation of hormone secretion :
The action of hormone at target organ is regulated by four factors .

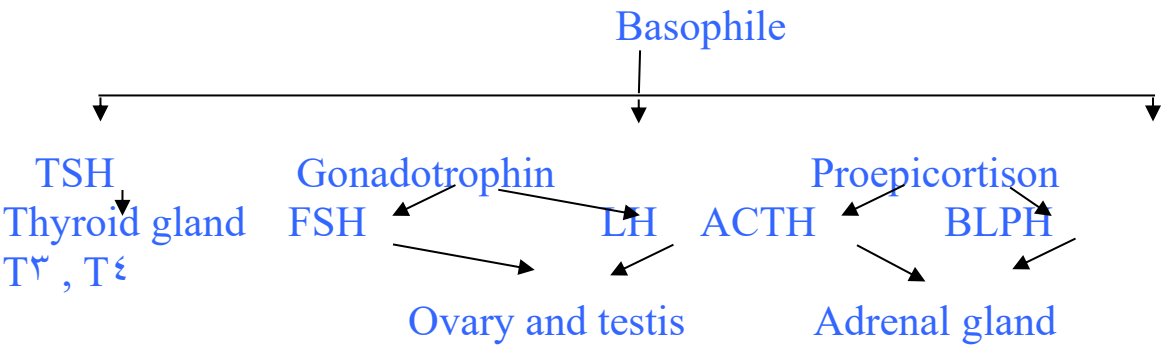
١. Rate of synthesis and secretion of steroid H. From endocrine gland .
٢. It depend in some cases by specific transported system in the plasma .
٣. The specific receptors in target cell membrane is differ from tissue to tissue .
٤. The degradation of hormone take place by the liver or kidney.

Hormone Receptor :
It is found on the cell membrane is consider as first messenger on cell the receptors recognize the hormone by its domain . [H] + [R] → [HR] affinity to associate high affinity has very high (Ka) value .
Measurement of hormone :
Hormone is measured its activity by radio immunoassay .
Factors effecting on hormone secretion :

١. Neurotransmitter may influence hormone synthesis and release .
٢. Stress can increased hormone synthesis .
٣. Change metabolic product .
٤. Drugs may modulate normal endocrine response .

Primary endocrine disease :
Its adipose appeared when there is disorder in target glad .
Secondary endocrine disease :
Its disorder due to pituitary or hypothalamic lesion while the target gland are normal .
Hypothalamus and Anterior pituitary :

١. Hypothalamus secreted (R.F) releasing factors stimulated and regulated hormone .
٢. Interior pituitary cell can be classified in to two types of staining reactions :
    a) Acidophilic has two kinds , growth hormone and prolactin hormone , both are simple polypeptide with some amino acid sequence the actions are effected peripheral tissue directly stimulation or inhibition usually through neural stimuli .
    b) Basophil are contain three kinds such as TSH , Gonadotrophic , Proapicotison .



Chemical structure :

TSH , FSH , LH → Glycoprotein

ACTH → large poly peptide .

The actions of these hormones is stimulated and inhibited depending mainly on feedback mechanism .

CLINICAL SIGNIFICANCE

Hormone	Excess	Deficiency
Growth H.	١. Acromegaly ٢. Gigantism	Dwarfism
Prolactin	Galactorrhoea Infertility	Lactation Failure
ACTH	Cushing syndrome	Secondary adrenal hypo function
TSH	Hyperthyroidism	Secondary hypothyroidism
LH & FSH	Precocious puberty	Secondary hypogondism infertility

---

References

---

١ -AL-Mothafr Sami
(Biochemistry) ١stEdition
Baghdad University, ١٩٨٤
٢-David T Plummer
(An introduction to biochemistry)٢nd Edition
McGR-Hill Book company (UK) Limited, ١٩٧٨.
٣. Carl A.Burtis
(Tietz Textbook of Clinical Chemistry) ٢nd Edition
W.B.SAUNDDERS COMPANY ١٩٧٧