Al-Mustaqbal University College
Department of Medical Instrumentation Techniques Engineering
Class: 2nd
Subject: Clinical Chemistry
Lecturer: Prof.Salih H.Kadhim
No. :20

Enzymes and their measurement

Enzymes: are a large bimolecular proteins that act as biological catalysts by accelerating chemical reactions. The molecules upon which enzymes may act are called substrates, and the enzyme converts the substrates into different molecules known as products. Almost all metabolic processes in the cell need enzyme catalysis in order to occur at rates fast enough to sustain life and they serve a wide range important functions in the body, such as aiding in digestion and metabolism.

مثل المساعدة في عملية الهضم والتمثيل الغذائي

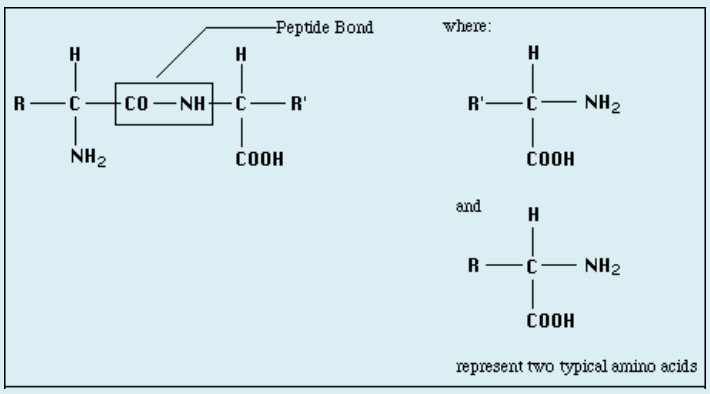
تسمى الجزيئات التي قد تعمل عليها الإنزيمات بالركائز

Enzymes are produced in the body by certain organs like the salivary glands, stomach, pancreas, small intestine or from the food we eat.

يتم إنتاج الإنزيمات في الجسم عن طريق أعضاء معينة مثل الغدد اللعابية أو المعدة أو البنكرياس أو الأمعاء الدقيقة أو من الطعام الذي نتناوله

Enzymes Structure:

Enzymes are proteins, contain chains of amino acids linked together by a peptide bond which is a chemical bond that is formed by joining the carboxyl group of one amino acid to the amino group of another. The characteristic of an enzyme is determined by the sequence of amino acid arrangement as shown in the figure:



Enzymes functions

Enzyme in the body help carry out various chemical functions like digestion of food, assist in the process of providing cellular energy, support the brain functions, repairing and healing

تساعد في عملية توفير الطاقة الخلوية، ودعم وظائف الدماغ وإصلاحه وشفائه

processes within the body, breaking down toxins, detoxification of blood, etc.

Types of Enzymes in the Body:

There are basically three types of enzymes:

1. **Metabolic enzymes**: This type of enzyme speed up the chemical reaction within the cells for detoxification and energy production.

تسريع التفاعل الكيميائي داخل الخلايا لإزالة السموم وإنتاج الطاقة

They enable us to see, hear, feel, move and think. Every organ, every tissue, and all 100 trillion cells in our body depend upon the reaction of metabolic enzymes and their energy factor.

إنها تمكننا من الرؤية والسمع والشعور والتحرك والتفكير. يعتمد كل عضو وكل نسيج وكل 100 تريليون خلية في جسمنا على تفاعل الإنزيمات الأيضية وعامل الطاقة الخاص بها

They are required for the growth of new cells and the repair and maintenance of all the body's organs and tissues. Metabolic enzymes take protein, fat, and carbohydrates and transform them into the proper balance of working cells and tissues. Two particularly important metabolic enzymes are superoxide dismutase **(SOD)** and its partner, **catalase**. Catalase breaks down hydrogen peroxide, a metabolic waste product, and liberates oxygen for the body to use.

2. **Digestive enzymes** : are secreted by the body that helps in digestion of food. They are classified to:

الإنزيمات الهاضمة: يفرزها الجسم وتساعد في هضم الطعام. يتم تصنيفهم إلى :

- **Amylase**: is digestive enzyme produced by the salivary glands, pancreatic amylase is secreted by the pancreas into the small intestine. This enzyme helps in breaking down carbohydrates to simple sugars, like glucose.

الأميليز: هو إنزيم هضمي تنتجه الغدد اللعابية، ويفرز البنكرياس الأميليز في الأمعاء الدقيقة. يساعد هذا الإنزيم في تحطيم الكربوهيدرات إلى سكريات بسيطة، مثل الجلوكوز

- **Proteases**: It helps in digestion of proteins and break down complex proteins into much simpler amino acids. It is present in the stomach, pancreatic and intestinal juices.

البروتيز: يساعد في هضم البروتينات وتكسير البروتينات المعقدة إلى أحماض أمينية أبسط بكثير. وهو موجود في عصير المعدة والبنكرياس والأمعاء

- **Lipases**: Lipases assist in digestion of fats and breaks down fats and other lipids, and converts them to fatty acids and glycerol. It is seen in the stomach, pancreatic juice and food fats.

يساعد الليبيز في هضم الدهون وتكسير الدهون والدهون الأخرى وتحويلها إلى أحماض دهنية وجلسرين. ويشاهد في المعدة وعصارة البنكرياس والدهون الغذائية

Food enzymes : are present in all raw foods like animal or plant products . Food Enzymes are introduced to the body through the raw foods we eat which naturally contain enzymes, providing a source of digestive enzymes when ingested. The cooking and processing of food destroys all of its enzymes. Since most of the foods we eat are cooked or processed in some way and since the raw foods we do eat contain only enough enzymes to process that particular food, our bodies must produce the majority of the digestive enzymes we require.

Enzyme measurement

Blood Enzymes test: Blood enzyme tests can be used to measure the levels and activity of certain enzymes. There are three types of blood enzyme to be assess : ليتم تقييمها

1. **Pancreatic enzyme test: Amylase Enzyme Test:** it measure the level of this enzyme in your blood. Normal Results: is 23 to 85 units per liter (U/L).

The Clinical signification of amylase enzyme: الأهمية السريرية لإنزيم الأميليز

Increased amylase levels may indicate: قد تشير زيادة مستويات الأميليز

- Acute pancreatitis التهاب البنكرياس الحاد
- Cancer of the ovaries, or lungs سرطان المبيضين، أو الرئتين
- Infection of the salivary glands. التهابات الغدد اللعابية
- Intestinal obstruction انسداد المعاء الدقيقة
  - Pancreatic or bile duct obstruction انسداد قناة الصفراء
  - Perforated ulcer ثقوب القرحة
- Tubal pregnancy (may be ruptured)

Decreased amylase levels may indicate:

- Damage to the pancreas تلف البنكرياس
- Kidney disease
  Pancreatic cancer
  Toxemia of pregnancy تسمم الدم اثناء الحمل

2. **Liver enzyme test:** The hepatic function panel evaluates:

- **Alkaline phosphatase (ALP):** This enzyme is found in the liver, bones, intestines, kidneys, and other organs. Kids and teens normally have higher levels of ALP than adults, even when they're healthy, due to bone growth. But ALP levels can also increase when kids have viral infections, liver diseases, or blocked bile ducts. الالتهابات الفيروسية، أو أمراض الكبد، أو انسداد القنوات الصفراوية

  مقارنة بالبالغين عادة ما يكون لدى الأطفال والمراهقون مستويات أعلى من ALP
- **Acid phosphate (ACP):** is found in liver, spleen, red blood cell and bone narrow and secreted with high concentration by the prostate gland. The high level of this enzyme due to prostate disease, female breast cancer and bone cancer.
  يوجد في الكبد والطحال وخلايا الدم الحمراء والعظام الضيقة ويفرز بتركيز عالٍ من غدة البروستاتا
  ويعود ارتفاع مستوى هذا الإنزيم إلى أمراض البروستاتا وسرطان الثدي عند النساء وسرطان العظام
- **Alanine aminotransferase (ALT).** This enzyme, found in the liver, plays a role in metabolism, the process that converts food into energy. If the liver is injured, ALT is released into the bloodstream. Its levels are especially high with acute hepatitis.
  في حالة إصابة الكبد، يتم إطلاق ALT
  في مجرى الدم. مستوياته مرتفعة بشكل خاص مع التهاب الكبد الحاد
- **Aspartate aminotransferase (AST).** This enzyme, which plays a role in processing proteins, is found in the liver, heart, muscles, and kidneys. It is important to diagnose liver disease. heart diseases and muscular disease.

اختبار إنزيم القلب

3. **Cardiac Enzyme test: a. Creatine kinase** is an enzyme which is produced by the majority of muscle cells. is found in the brain, heart and the skeletal muscle cells. The creatine kinase test is usually recommended for people who have had chest pain or weakness in the muscles. There are three forms of creatine kinase; these are: CK-MB: this is mostly found in the heart

muscle cells, CK-BB: this is mostly found in the brain , CK-MM: this is mostly found in the heart and skeletal.

b. Troponin is a protein that helps the muscles to contract. Troponin is found in the cardiac and skeletal muscle cells. There are three types of troponin; these are: Troponin C (TnC), Troponin T (TnT) and Troponin I (TnI) . The troponin test is usually preferred to the CK test for those who are suspected of having a heart attack; this is because the test is more specific in terms of assessing damage to the heart muscle.

Spectrophotometric methods : This is most method widely used to determine the enzyme activity , this assay is a classic enzyme test for the low cost. During a spectrophotometric assay, the operator follows the course of an enzyme reaction by measuring the changes in the intensity of the light absorbed or scattered by the reaction solution. Most tests use the UV/visible (UV/vis) spectroscopy as the detection method, which usually falls into the wavelength range of 100-1100 nm. If the light is in the visible region, meaning the wavelength of 400-700 nm or more broadly 360-900 nm, the color of the assay can be visibly captured by naked eyes. Therefore, this type of tests is also called colorimetric assays.