IQRA NATIONAL UNIVERSITY PESHAWAR

SUBJECT:- BIOCHEMISTRY II

CLASS /SECTION:- BSDT/B.

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RAD II and DT II

Final term

BIOCHEMISTRY

Marks 50

1) Write down the 4 steps involve in beta oxidation?

Beta Oxidation

Beta oxidation takes place in four steps: dehydrogenation, hydration, oxidation and thyolisis. Each step is catalyzed by a distinct enzyme.

Briefly, each cycle of this process begins with an acyl-CoA chain and ends with one acetyl-CoA, one FADH2, one NADH and water, and the acyl-CoA chain becomes two carbons shorter. The total energy yield per cycle is 17 ATP molecules (see below for details on the breakdown). This cycle is repeated until two acetyl-CoA molecules are formed as opposed to one acyl-CoA and one acetyl-CoA.

Beta Oxidation Step 1

Dehydrogenation

In the first step, acyl-CoA is oxidized by the enzyme acyl CoA dehydrogenase. A double bond is formed between the second and third carbons (C2 and C3) of the acyl-CoA chain entering the beta oxidation cycle; the end product of this reaction is trans-Δ2-enoyl-CoA (trans-delta 2-enoyl CoA). This step uses FAD and produces FADH2, which will enter the citric acid cycle and form ATP to be used as energy. (Notice in the following figure that the carbon count starts on the right side: the rightmost carbon below the oxygen atom is C1, then C2 on the left forming a double bond with C3, and so on.)

Beta Oxidation Step 2

Hydration

the second step, the double bond between C2 and C3 of trans-Δ2-enoyl-CoA is hydrated, forming the end product L-β-hydroxyacyl CoA, which has a hydroxyl group (OH) in C2, in place of the double bond. This reaction is catalyzed by another enzyme: enoyl CoA hydratase. This step requires water.

Beta Oxidation Step 3

Oxidation

In the third step, the hydroxyl group in C2 of L-β-hydroxyacyl CoA is oxidized by NAD+ in a reaction that is catalyzed by 3-hydroxyacyl-CoA dehydrogenase. The end products are β-ketoacyl CoA and NADH + H. NADH will enter the citric acid cycle and produce ATP that will be used as energy.

Beta Oxidation Step 4

Thiolysis

Finally, in the fourth step, β-ketoacyl CoA is cleaved by a thiol group (SH) of another CoA molecule (CoA-SH). The enzyme that catalyzes this reaction is β-ketothiolase. The cleavage takes place between C2 and C3; therefore, the end products are an acetyl-CoA molecule with the original two first carbons (C1 and C2), and an acyl-CoA chain two carbons shorter than the original acyl-CoA chain that entered the beta oxidation cycle.

2) Write down clinical significance of the following enzymes

a) Alkaline phosphatase

Alkaline phosphatase (ALP, ALKP, ALPase, Alk Phos) , or basic phosphatase, is a

homodimeric protein enzyme of 86 kilodaltons. Each monomer contains five cysteine residues, two zinc atoms and one magnesium atom crucial to its

catalytic function, and it is optimally active at alkaline pH environments.The level of alkaline phosphatase in the blood is checked through the ALP test, which is often part of routine blood tests. The levels of this enzyme in the blood depend on factors such as age, sex, or blood type.Blood levels of alkaline phosphatase also increase by two to four times during pregnancy. This is a result of additional alkaline phosphatase produced by the placenta.Additionally, abnormal levels of alkaline phosphatase in the blood could indicate issues relating to the liver, gall bladder or bones. Kidney tumors and infections as well as malnutrition have also shown abnormal level of alkaline phosphatase in blood.Alkaline phosphatase levels in a cell can be measured through a process called "The scoring method". A blood smear is usually taken and stained to categorize each leukocyte into specific "leukocyte alkaline phosphatase indices". This marker is designed to distinguish leukocytes and determine different enzyme activity from each sample's extent of staining

b) Creatine kinase

Creatine kinase (CK), also known as creatine phosphokinase (CPK) or phosphocreatine kinase, is an enzyme expressed by various tissues and cell types. CK catalyses the conversion of creatine and uses adenosine triphosphate (ATP) to create phosphocreatine (PCr) and adenosine diphosphate (ADP). This CK enzyme reaction is reversible and thus ATP can be generated from PCr and ADP.tissues and cells that consume ATP rapidly, especially skeletal muscle, but also brain, photoreceptor cells of the retina, hair cells of the inner ear, spermatozoa and smooth muscle, PCr serves as an energy reservoir for the rapid buffering and regeneration of ATP in situ, as well as for intracellular energy transport by the PCr shuttle or circuit.Thus creatine kinase is an important enzyme in such tissues.

Clinically, creatine kinase is assayed in blood tests as a marker of damage of CK-rich tissue such as in myocardial infarction (heart attack), rhabdomyolysis *(severe muscle breakdown), muscular dystrophy, autoimmune myositides, and acute kidney injur*

c) gamma-glutamyl transferase

Gamma-glutamyl transferase (GGT) is an enzyme that is found in many organs throughout the body, with the highest concentrations found in the liver. GGT is elevated in the blood in most diseases that cause damage to the liver or bile ducts. This test measures the level of GGT in a blood sample.

Normally, GGT is present in low levels, but when the liver is injured, the GGT level can rise. GGT is usually the first liver enzyme to rise in the blood when any of the bile ducts that carry bile from the liver to the intestines become obstructed, for example, by tumors or stones. This makes it the most sensitive liver enzyme test for detecting bile duct problems.

3) How many proteins are involve in electron transport chain and how do electrons move in the electron transport chain?

The electron transport chain is a series of four protein complexes that couple redox reactions, creating an electrochemical gradient that leads to the creation of ATP in a complete system named oxidative phosphorylation. It occurs in mitochondria in both cellular respiration and photosynthesis. In the former, the electrons come from breaking down organic molecules, and energy is released. In the latter, the electrons enter the chain after being excited by light, and the energy released is used to build carbohydrates.

The electron transport chain (ETC) is a series of complexes that transfer electrons from electron donors to electron acceptors via redox (both reduction

and oxidation occurring simultaneously) reactions, and couples this electron transfer with the transfer of protons (H+ ions) across a membrane.

4) Write the steps involved in uric acid formation ?

<u>Steps For Uric Acid formation:</u>

Uric acid is a heterocyclic compound of carbon, nitrogen, oxygen, and hydrogen with the formula $C_5H_4N_4O_3$. It forms ions and salts known as urates and acid urates, such as ammonium acid urate. Uric acid is a product of the metabolic breakdown of purine nucleotides, and it is a normal component of urine. High blood concentrations of uric acid can lead to gout and are associated with other medical conditions, including diabetes and the formation of ammonium acid urate kidney stones.

5) How uric acid formation takes place in body?

Hyperuricemia is an excess of uric acid in the blood. Uric acid passes through the liver, and enters your bloodstream. Most of it is excreted (removed from your body) in your urine, or passes through your intestines to regulate "normal" levels.

Normal Uric acid levels are 2.4-6.0 mg/dL (female) and 3.4-7.0 mg/dL (male). Normal values will vary from laboratory to laboratory.

Also important to blood uric acid levels are purines. Purines are nitrogen-containing compounds, which are made inside the cells of your body (endogenous), or come from outside of your body, from foods containing purine (exogenous). Purine breaks down into uric acid. Increased levels of uric acid from excess purines may accumulate in your tissues, and form crystals. This may cause high uric acid levels in the blood.