Course Title: Biochemistry II Rad 2nd semester

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Qno1 .Write steps involve in uric acid formation?

Ans:

Uric acid

Description

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.

Formula: $C_5H_4N_4O_3$

IUPAC ID: 7,9-Dihydro-1H-purine-2,6,8(3H)-trione

Molar mass: 168.1103 g/mol

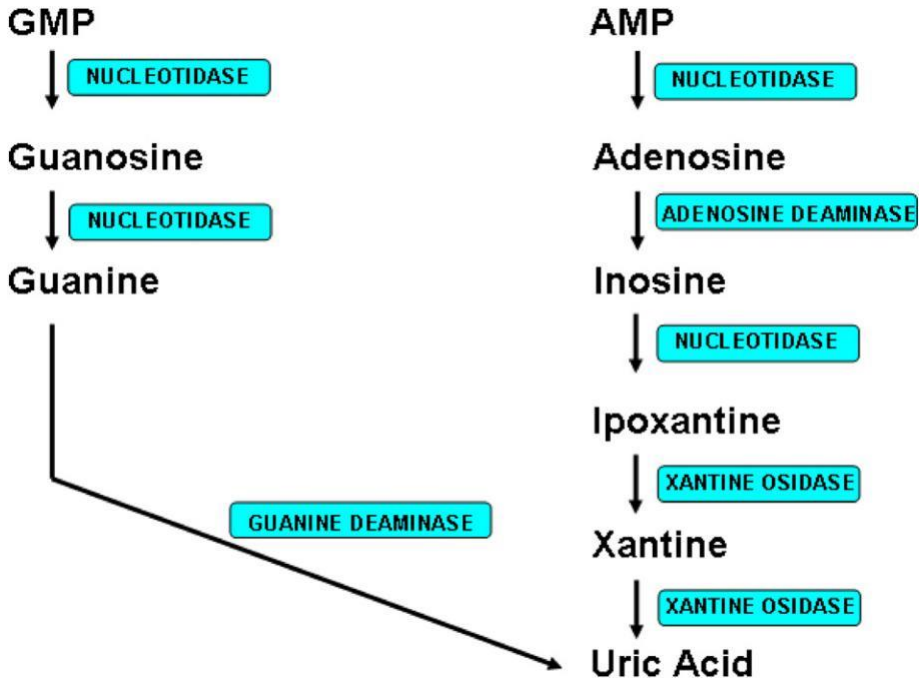
Soluble in: Water

Basicity (pK_b): 8.4

Beilstein Reference: 156158

Heat capacity (C): 166.15 J K^{-1} mol^{-1} (at 24.0 °C)

- *Purines perform many important functions in the cell, being the formation of the monomeric precursors of nucleic acids DNA and RNA the most relevant one.*
- *Purines which also contribute to modulate energy metabolism and signal transduction, are structural components of some coenzymes and have been shown to play important roles in the physiology of platelets, muscles and neurotransmission.*
- *All cells require a balanced quantity of purines for growth, proliferation and survival.*
- *Under physiological conditions the enzymes involved in the purine metabolism maintain in the cell a balanced ratio between their synthesis and degradation.*
- *In humans the final compound of purines catabolism is uric acid.*
- *All other mammals possess the enzyme uricase that converts uric acid to allantoin that is easily eliminated through urine.*
- *Overproduction of uric acid, generated from the metabolism of purines, has been proven to play emerging roles in human disease.*
- *In fact the increase of serum uric acid is inversely associated with disease severity and especially with cardiovascular disease states.*
- *This review describes the enzymatic pathways involved in the degradation of purines, getting into their structure and biochemistry until the uric acid formation.*



Qno2:write down clinical significance of the following enzymes

A) ALP
B) CK
C) GGT

Ans:

a) ALP

ALP is an enzyme found in your bloodstream. It helps break down proteins in the body and exists in different forms, depending on where it originates.

Your liver is one of the main sources of ALP, but some is also made in your bones, intestines, pancreas, and kidneys. In pregnant women, ALP is made in the placenta.

Why take an alkaline phosphatase level test?

An ALP test may be performed to determine how well your liver and gallbladder are functioning or to identify problems with your bones.

Liver and gallbladder

Checking ALP levels in the blood is a routine part of liver function and gallbladder tests. Symptoms such as jaundice, abdominal pain, nausea, and vomiting may lead your doctor to suspect something is wrong with your liver or gallbladder.

The ALP test can be helpful in identifying conditions such as:

- *hepatitis (inflammation of the liver)*
- *cirrhosis (scarring of the liver)*
- *cholecystitis (inflammation of the gallbladder)*
- *blockage of bile ducts (from a gallstone, inflammation, or cancer)*

You may also need an ALP test if you're taking a medication that has the potential to damage your liver, such as acetaminophen (Tylenol). Measuring

ALP is one way to check for that damage and is typically done together with other liver function tests.

Reference Values

Males

0-11 months: <178 U/L

12 months-6 years: <21 U/L

7-12 years: <24 U/L

13-17 years: <43 U/L

> or =18 years: 8-61 U/L

Females

0-11 months: <178 U/L

12 months- 6 years: <21 U/L

7-12 years: <24 U/L

13-17 years: <26 U/L

> or =18 years: 5-36 U/L

b) CK

Clinical Information

Creatine kinase (CK) is an enzyme that catalyzes the reversible phosphorylation of creatine (Cr) by adenosine triphosphate (ATP). Physiologically, when muscle contracts, ATP is converted to adenosine diphosphate (ADP), and CK catalyzes the rephosphorylation of ADP to ATP using creatine phosphate as the phosphorylation reservoir. The CK enzyme is a dimer composed of subunits derived from either muscle (M) or brain (B). Three isoenzymes have been identified: striated muscle (MM), heart tissue (MB), and brain (BB). Normal serum CK is predominantly the CK-MM isoenzyme.

CK activity is greatest in striated muscle (MM isoenzyme), heart tissue (MB isoenzyme), and brain (BB isoenzyme). Serum CK concentrations are reflective of muscle mass causing males to have higher concentrations than

females. CK may be measured to evaluate myopathy and to monitor patients with rhabdomyolysis for acute kidney injury.

c) GGT

Clinical Information

Gamma-glutamyltransferase (GGT) is primarily present in kidney, liver, and pancreatic cells. Small amounts are present in other tissues. Even though renal tissue has the highest level of GGT, the enzyme present in the serum appears to originate primarily from the hepatobiliary system, and GGT activity is elevated in any and all forms of liver disease. It is highest in cases of intra- or posthepatic biliary obstruction, reaching levels some 5 to 30 times normal. GGT is more sensitive than alkaline phosphatase (ALP), leucine aminopeptidase, aspartate transaminase, and alanine aminotransferase in detecting obstructive jaundice, cholangitis, and cholecystitis; its rise occurs earlier than with these other enzymes and persists longer. Only modest elevations (2-5 times normal) occur in infectious hepatitis, and in this condition, GGT determinations are less useful diagnostically than are measurements of the transaminases. High elevations of GGT are also observed in patients with either primary or secondary (metastatic) neoplasms. Elevated levels of GGT are noted not only in the sera of patients with alcoholic cirrhosis but also in the majority of sera from persons who are heavy drinkers. Studies have emphasized the value of serum GGT levels in detecting alcohol-induced liver disease. Elevated serum values are also seen in patients receiving drugs such as phenytoin and phenobarbital, and this is thought to reflect induction of new enzyme activity.

Normal values are observed in various muscle diseases and in renal failure. Normal values are also seen in cases of skeletal disease, children older than 1 year, and in healthy pregnant women-conditions in which ALP is elevated.

Normal range of GGT

- *According to the Mayo Clinic, the normal range for GGT levels is 9–48 units per liter (U/L).*
- *Normal values can vary due to age and sex.*

- *The GGT test can diagnose liver damage, but it can't determine the cause.*
- *If your GGT level is elevated, you'll probably have to undergo more tests*

Qno3: How many proteins are involve in electron transport chain and how do electrons move in the electron transport chain?
Ans:

How many proteins are involve in electron transport chain?

- *The electron transport chain is the portion of aerobic respiration that uses free oxygen as the final electron acceptor of the electrons removed from the intermediate compounds in glucose catabolism.*
- *The electron transport chain is composed of four large, multiprotein complexes embedded in the inner mitochondrial membrane and two small diffusible electron carriers shuttling electrons between them.*
- *The electrons are passed through a series of redox reactions, with a small amount of free energy used at three points to transport hydrogen ions across a membrane.*
- *This process contributes to the gradient used in chemiosmosis.*
- *The electrons passing through the electron transport chain gradually lose energy, High-energy electrons donated to the chain by either NADH or $FADH_2$ complete the chain, as low-energy electrons reduce oxygen molecules and form water.*
- *The level of free energy of the electrons drops from about 60 kcal/mol in NADH or 45 kcal/mol in $FADH_2$ to about 0 kcal/mol in water. The end products of the electron transport chain are water and ATP.*
- *A number of intermediate compounds of the citric acid cycle can be diverted into the anabolism of other biochemical molecules, such as nonessential amino acids, sugars, and lipids.*
- *These same molecules can serve as energy sources for the glucose pathways.*

How do electrons move in the electron transport chain?

The electron transport chain (ETC) is the major consumer of O2 in mammalian cells.
The ETC passes electrons from NADH and FADH2 to protein complexes and mobile electron carriers.
Coenzyme Q (CoQ) and cytochrome c (Cyt c) are mobile electron carriers in the ETC, and O2 is the final electron recipient.

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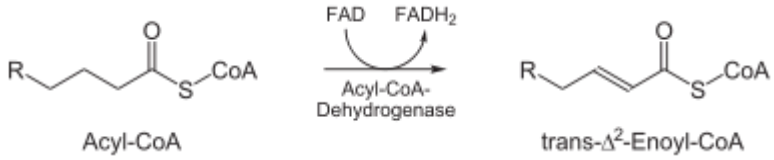
Q no 4: write down the four steps involved in beta oxidation?
Ans:

Steps of Beta-oxidation

- *Once the triglycerides are broken down into glycerol and fatty acids they must be activated before they can enter into the mitochondria and proceed on with beta-oxidation. This is done by Acyl-CoA synthetase to yield fatty acyl-CoA.*
- *After the fatty acid has been acylated it is now ready to enter into the mitochondria.*
- *There are two carrier proteins (Carnitine acyltransferase I and II), one located on the outer membrane and one on the inner membrane of the mitochondria. Both are required for entry of the Acyl-CoA into the mitochondria.*
- *Once inside the mitochondria the fatty acyl-CoA can enter into beta-oxidation.*

1.Oxidation

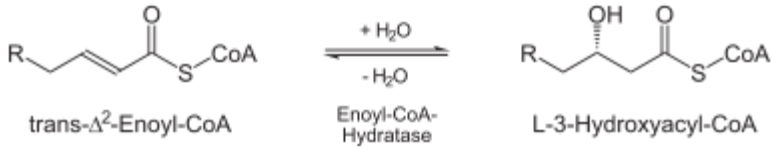
A fatty acyl-CoA is oxidized by Acyl-CoA dehydrogenase to yield a trans alkene. This is done with the aid of an [FAD] prosthetic group.



Acyl-CoA trans-Δ^2-Enoyl-CoA

2.Hydration

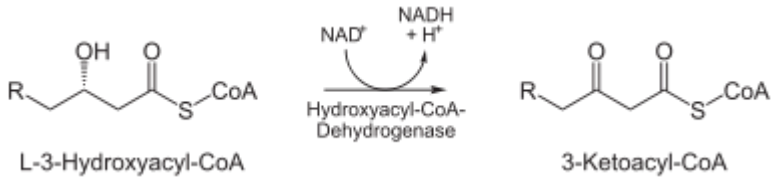
The trans alkene is then hydrated with the help of Enoyl-CoA hydratase



trans-Δ^2-Enoyl-CoA L-3-Hydroxyacyl-CoA

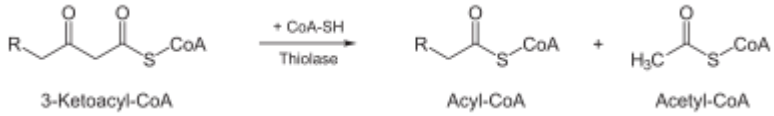
3.Oxidation

The alcohol of the hydroxyacly-CoA is then oxidized by NAD^+ to a carbonyl with the help of Hydroxyacyl-CoA dehydrogenase. NAD^+ is used to oxidize the alcohol rather then [FAD] because NAD^+ is capable of the alcohol while [FAD] is not.



4.Cleavage

Finally acetyl-CoA is cleaved off with the help of Thiolase to yield an Acyl-CoA that is two carbons shorter than before. The cleaved acetyl-CoA can then enter into the TCA and ETC because it is already within the mitochondria.



Q no 5: where uric acid start and normal range in the body?
Ans:

Uric Acid

- *Uric acid production and metabolism are complex processes involv-ing various factors that regulate hepatic production, as well as renal and gut excretion of this compound.*
- *Uric acid is the end product of an exog-enous pool of purines and endogenous purine metabolism.*
- *The exoge-nous pool varies significantly with diet, and animal proteins contribute significantly to this purine pool.*
- *The endogenous production of uric acid is mainly from the liver, intestines and other tissues like muscles, kidneys and the vascular endothelium.*
- *Uric acid is a $C_5H_4N_4O_3$ (7,9-dihydro-1H-purine-2,6,8(3H)-trione) heterocyclic organic compound with a molecular weight of 168 Da.*
- *Many enzymes are involved in the conversion of the two purine nucleic acids, adenine and guanine, to uric acid.*
- *Initially, adenosine monophosphate (AMP) is converted to inosine via two different mechanisms; either first removing an amino group by deaminase to form inosine monophosphate (IMP) followed by dephosphoryla-tion with nucleotidase to form inosine, or by first*

removing a phosphate group by nucleotidase to form adenosine followed by deamination to form inosine.

- *Guanine monophosphate (GMP) is converted to guanosine by nucleotidase.*
- *The nucleosides, inosine and guanosine, are further converted to purine base hypoxanthine and gua-nine, respectively, by purine nucleoside phosphorylase (PNP).*

NORMAL RANGE

- *At physiologic pH, uric acid is a weak acid with a pKα of 5.8. Uric acid exists majorly as urate, the salt of uric acid.*
- *As urate concen-tration increases in blood, uric acid crystal formation increases.*
- *The nor-mal reference interval of uric acid in human blood is 1.5 to 6.0 mg/dL in women and 2.5 to 7.0 mg/dL in men.*
- *The solubility of uric acid in water is low, and in humans, the average concentration of uric acid in blood is close to the solubility limit (6.8 mg/dL).*
- *When the level of uric acid is higher than 6.8 mg/dL, crystals of uric acid form as monosodium urate (MSU).*
- *Humans cannot oxidize uric acid to the more soluble compound allantoin due to the lack of uricase enzyme.*
- *Normally, most daily uric acid disposal occurs via the kidneys*

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The End

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