



BIO202 Solved Final Papers Fall 2020

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Difference between Uracil and thymine? (2 marks)

Uracil has same **structure** as **thymine**, but **Uracil** is demethylated form of **thymine** which means methyl group is deleted at the 5' position. The methylation of **thymine** in DNA makes it more stable than RNA and this protects DNA from attack from enzymes. **Uracil** is energetically less expensive and thus nature used it in RNA.

Phosphodiester bond (2 marks)

A phosphodiester bond occurs when exactly two of the hydroxyl groups in phosphoric acid react with hydroxyl groups on other molecules to form two ester bonds.

What do you know about kinetic enzymes? (3 marks)

Substrate Concentration Affects the Rate of Enzyme-Catalyzed Reactions



A key factor affecting the rate of a reaction catalyzed by an enzyme is the concentration of substrate, [S]. However, studying the effects of substrate concentration is complicated because substrate is converted to product and because of reversibility of reactions, e.g. conversion of product back to substrate. One simplifying approach in kinetics experiments is to measure the initial rate (or initial velocity), designated V_0 , when [S] is much greater than the concentration of enzyme, [E]. The velocity (v) of a reaction is the rate of product formation. Whereas V_0 is the initial velocity and is measured as soon as the reactants and enzymes are mixed. At the start of a reaction, [S] is in large excess of [P]. Thus the initial velocity of the reaction will be dependent on substrate concentration. At that time, the concentration of product is very small and, therefore, the rate of the back reaction from P to S can be ignored.

3 Functions of cGMP (3 marks)

- **cGMP** is a common regulator of ion channel conductance, glycogenolysis, and cellular apoptosis.
- It also relaxes smooth muscle tissues.
- In blood vessels, relaxation of vascular smooth muscles lead to vasodilation and increased blood flow.

Hydrogenation (2 marks)

Hydrogenation refers to the treatment of substances with molecular hydrogen (H_2), adding pairs of hydrogen atoms to compounds (generally unsaturated compounds). These usually require a catalyst for the reaction to occur under normal conditions of temperature and pressure.

Cofactors (2 marks)

Some enzymes require no chemical groups for activity other than their amino acid residues. Whereas some enzymes require molecules other than proteins for enzymic activity. If the non-protein moiety is a metal ion such as Zn^{2+} or Fe^{2+} , it is called a cofactor.

RNA (3 marks)

The genetic master plan is contained in the nucleotide sequence of DNA. It is through the ribonucleic acid (RNA)—the "working copies" of the (DNA) — that the master plan is expressed. RNA is a polymer of ribonucleotides of Adenine, Uracil, Guanine and Cytosine, joined together by 3'-5' phosphodiester bonds. RNA does not contain thymine except in rare cases. The pentose sugar of RNA is D-ribose.

Location: RNA is found in the nucleolus, ribosomes, mitochondria, and cytoplasm. The genetic material for some animal and plant viruses is RNA rather than DNA.

VLDL Properties (5 marks)

VLDLs are assembled in the liver composed predominantly of TAGs synthesized in liver and contain some cholesterol and cholesteryl esters • As VLDL pass through the circulation, TAG is degraded and taken up by peripheral tissues in the form of fatty acids, causing the VLDL to decrease in size and become denser, called VLDL remnant. further removal from these remnants produces low-density lipoprotein (LDL) • LDL particles contain much less triacylglycerol than their VLDL predecessors, and have a high concentration of cholesterol and cholesteryl esters • LDLs contain apoB-100 as their major apolipoprotein • they carry cholesterol to extra hepatic tissues that have specific plasma membrane receptors that recognize apoB-100. • apoB-100 receptors internalize the LDL into the cell. • Remaining LDL is endocytosed by Liver cells. • Oxidized LDL can also accumulate in the macrophage cells lining the arteries resulting in the formation of atherosclerosis.

Primary Structure of DNA (5 marks)

Effect of pH on enzyme activity (3 marks)

The pH optimum varies for different enzymes: • The pH at which maximal enzyme activity is achieved is different for different enzymes, and often reflects the $[H^+]$ at which the enzyme functions in the body. • For example, pepsin, a digestive enzyme in the stomach, is maximally active at pH 2. whereas other enzymes, designed to work at neutral pH, are denatured by such an acidic environment • Another examples is that there are two types of phosphatases in the body. • The one that acts in the alkaline pH is called alkaline phosphatase and the other which acts at acidic pH is known as acid phosphatase.

What is Lanolin? (2 marks)

Lanolin (or wool fat) is secreted by sheep sebaceous glands and It contains both free and esterified cholesterol, e.g., cholesterol-palmitate • Lanolin secretion helps sheep in reducing water evaporation from the skin. • It is used as industrial lubricant and in cosmetics

Effect of pH in ionization of active site (2 marks)

The concentration of H^+ affects reaction velocity in several ways. • First, the catalytic process usually requires that the enzyme and substrate have specific chemical groups in either an ionized or un-ionized state in order to interact. • For example, catalytic activity may require that an amino group of the enzyme be in the protonated form ($-NH_3^+$). • At alkaline pH, this group is deprotonated, and the rate of the reaction, therefore, declines. • Extremes of pH can also lead to denaturation of the enzyme.

Sphingolipids (2 marks)

Sphingosine is an amino alcohol, which is a component of the class of lipids known as sphingolipids • Sphingosine is synthesized in the body in the form of ceramide, to which different moieties are added to form sphingolipids. • Serine and palmitoyl CoA condense to form a product (ketosphinganine) that is reduced. • A very long-chain fatty acid forms an amide with the amino group. a double bond is generated, and ceramide is formed.

Lyases (2 marks)

These enzymes catalyze the addition of • NH_3 , • H_2O or • CO_2 to double bonds or • the removal of these groups leaving behind double bonds. • Lyases are included in a separate class because they catalyze these reactions by means other than hydrolysis or oxidation.

Bile salt (2 marks)

The bile salts, act to break apart the fat globules in the small intestines and allow them to become more "soluble" for absorption. bile salts (conjugated bile acids) are quantitatively the most important organic components of bile • The primary bile acids are synthesized in the liver from cholesterol • These are cholic acid and chenodeoxycholic acid

Unnatural pyrimidines bases (2 marks)

Fluorouracil (5FU) and 6-Aza Cytosine (AZC)

Saponification (2 marks)

Saponification is a process that involves the conversion of fat, oil, or lipid, into soap and alcohol by the action of heat in the presence of aqueous alkali. Soaps are salts of fatty acids and fatty acids are monomers of lipids that have long carbon chains e.g. sodium palmitate.

Function of mRNA (2 marks)

The members of this class function as messengers to convey the information in a gene to the protein synthesizing machinery. The mRNA carries genetic information from the nuclear DNA to the cytosol, where it is used as a template for protein synthesis.

Properties of Glycerol (3 marks)

• Glycerol is widely used in pharmaceutical and cosmetic preparations. • It has the following properties: • Colorless Viscous oily liquid with sweet taste. • On heating with sulfuric acid or KHSO_4 (dehydration) • it gives acrolein that has a bad odor. • used for detection of free glycerol or any compound containing glycerol. • In contrast to glycerol • Sphingosine does not show positive acrolein test. • Therefore glycerolipids and shingolipids can be differentiated on the basis of acrolein test. • Glycerol combines with three molecules of nitric acid to form Glycerol trinitrate that is • used as explosive and vasodilator • On esterification with fatty acids it gives: (1) monoacylglycerol: one fatty acid + glycerol. (2) diacylglycerol: two fatty acids + glycerol. (3) triacyl-glycerol: three fatty acids + glycerol. (4) Gluconeogenic substrate. Glycerol can form dihydroxyacetone phosphate which can convert into glucose or glyceraldehyde phosphate to enter into gluconeogenic pathway

Sterols (3 marks)

Steroids with eight to ten carbon atoms in the side chain at C-17 and a hydroxyl group at C-3 are classified as sterols • Cholesterol is the major sterol in animal tissues • Cholesterol has an eight carbon branched hydrocarbon chain attached to C-17 of the D ring • Ring A has a hydroxyl group at C-3, and ring B has a double bond between C-5 and C-6

Ribozyme (2 marks)

ribozymes — some RNA molecules have intrinsic catalytic activity these RNA enzymes, are called ribozyme

Properties of waxes (3 marks)

Properties of waxes Waxes are insoluble in water, but • soluble in fat solvents and are negative for acrolein test. very resistant to rancidity. • Waxes are not easily hydrolyzed as the fats and are indigestible by lipases (enzymes responsible for fat digestion in body) • Thus they are of no nutritional value

Bees wax (3 marks)

Waxes are widely distributed in nature such as the secretion of certain insects as; • Bees-wax, • Spermaceti of the sperm whale • Waxes also form protective coatings of the skins and furs of animals and • leaves and fruits of plants. • Triacntanol is a fatty alcohol of the general formula $\text{C}_{30}\text{H}_{62}\text{O}$, also known as • melissyl alcohol or myricyl alcohol. • It is found in plant cuticle waxes and in beeswax. • The name cetyl derives from the whale oil (Latin: cetus) from which it was first isolated • Cetyl Alcohol can be found in mooisturizer, facial moisturizer, conditioner, antiaging, hair color, hair bleaching, facial cleanser. hand cream, shampoo, lipstick, eye cream.

Types of RNA (5 marks)

Small nuclear RNA (snRNA) • Small nuclear RNA (snRNA) are large number of small stable RNA species found in eukaryotic cells. • Most of them are complexed with proteins to form ribonucleoproteins. • They are distributed in the nucleus, in the cytoplasm or in both. • They are significantly involved in rRNA

and mRNA processing and gene regulation. • **Large & Small Noncoding Regulatory RNAs** • One of the most exciting discoveries in the last decade of eukaryotic regulatory biology has been the identification and characterization of regulatory nonprotein coding RNAs (ncRNAs). • ncRNAs exist in two general size classes, • **small consisting of microRNA (miRNAs) and silencing (siRNAs)** and • **Large consisting of long noncoding RNAs (lncRNAs)** The small ncRNAs termed microRNA (miRNAs) and silencing (siRNAs) typically inhibit gene expression at the level of specific protein production by • targeting mRNAs through one of several distinct mechanisms. • Both siRNAs and miRNAs typically hybridize, via the formation of RNA–RNA hybridization to their targeted mRNAs • **long noncoding RNAs (lncRNAs)**. • lncRNAs, which as their name implies, do not code for protein (ie, the mRNA encoding genes). • ncRNAs make up a significant portion of eukaryotic transcription • ncRNAs play many roles ranging from contributing to structural aspects of chromatin to regulation of mRNA gene transcription by RNA polymerase II.

Function of tRNA (3 marks)

The t RNA molecules serve as ADAPTERS for the translation of information in the sequence of nucleotides of the mRNA into specific amino acids. • There is at least one (and often several) specific type of tRNA molecule for each of the amino acids commonly found in proteins. • Each t RNA carries its specific amino acid to the site of protein synthesis. • There it recognizes the genetic code word on mRNA (codon) and this specifies the addition of its amino acids to the growing peptide chain.

Properties of TAGS (5 marks)

Neutral fats are • colourless, odorless and tasteless substances • Solubility: • They are insoluble in water but soluble in organic fat solvents(e.g., ether, benzene, acetone, chloroform) • 5. Specific gravity: • The specific gravity of all fats is less than 1.0, consequently all fats float in water • 6. Emulsification: • Emulsions of fat may be made by shaking vigorously in water and by emulsifying agents such as gums and soaps • • The emulsification of dietary fats in intestinal canal, brought about by bile salts, is a prerequisite for digestion and absorption of fats. • The bile salts, act to break apart the fat globules in the small intestines and allow them to become more "soluble" for absorption. • The hydrophobic fat molecules will clump together into globules in the watery mixture in the digestive system. • The emulsifiers break them down to smaller "globules" and allow them to become more soluble.

Hybridization (3 marks)

Hybridization is combined with gel electrophoresis techniques that separate nucleic acids by size, • coupled with radioactive or fluorescent probe labeling to provide a detection of a nucleotide sequence.

Difference between fats and oils (5 marks)

Difference between Fats and Oils	
Fats	Oils

Solid at room temperature	Liquid at room temperature
Saturated and trans are its types	Unsaturated fats like monounsaturated and polyunsaturated are its types
Mostly derived from animal	Mostly derived from plants
Increases cholesterol levels	Improves cholesterol levels
Mainly comes from animal food but also through vegetable oil by process called hydrogenation	Mainly comes from plants or fish
Example: Butter, beef fat	Example:Vegetable oil, fish oil
Contains 9 cal/gm	Contains 9 cal/gm

Characteristics of Palmitic Acid (3 marks)

Palmitic Acid(16:0) Palmitic acid, or hexadecanoic acid, is the most common saturated Fatty Acid found in animals, plants and microorganisms • Palmitic acid mainly occurs as its ester in triglycerides (fats), especially palm oil. • It is also found in high amounts in Butter, Cheese, milk and meat • Excess carbohydrates in the body are converted to palmitic acid. • Palmitic acid is the first fatty acid produced during fatty acid synthesis and the precursor to longer fatty acids • As a consequence, palmitic acid is a major body component of fats found in the animals.

Ligand (10 marks)

In biochemistry and pharmacology, a ligand (from the Latin ligandum, binding) is a substance (usually a small molecule), • that forms a complex with a biomolecule to serve a biological purpose. • In a narrower sense, it is a signal triggering molecule, binding to a site on a target protein • A molecule bound reversibly by a protein is called a ligand. • Ligands include substrates, inhibitors, activators, and neurotransmitters • A ligand may be any kind of molecule, including another protein. • A ligand binds at a site on the protein called the binding site, binding site is complementary to the ligand insize,shape ,charge, and hydrophobic or hydrophilic character. • Furthermore, the interaction is specific: the protein can discriminate among the thousands of different molecules in its environment and selectively bind only one or a few. • The binding of a protein and ligand is often coupled to a conformational change in the protein that makes the binding site more complementary to the ligand, permitting tighter binding

called induced fit. • A given protein may have separate binding sites for several different ligands. • In a multi-subunit protein, a conformational change in one subunit often affects the conformation of other subunits. • Interactions between ligands and proteins may be regulated, through interactions with additional ligands. • These other ligands may cause conformational changes in the protein that affect the binding of the first ligand.

Rancidity and Factors affecting it (5 marks)

Rancidity • The chemical deterioration of fats. • When lipid-rich foods are exposed too long to the oxygen in air, they may spoil and become foul smelling. • **Rancidity Definition:** It is a physico-chemical change in the natural properties of the fat leading to the development of unpleasant odor or taste or abnormal color • It occurs particularly on aging after exposure to atmospheric oxygen, • light, moisture, bacterial or fungal contamination and/or heat. • Saturated fats resist rancidity more than unsaturated fats that have unsaturated double bonds. • Rancidity is due to Oxidation, Hydrolysis • **Oxidative Rancidity:** Oxidation of the fat molecules give rise to some short chain aldehydes, ketones and dicarboxylic acids which have objectionable taste and odor. • The unpleasant taste and smell associated with rancidity result from the oxidative cleavage of double bonds in unsaturated fatty acids the oxygen of the air is necessary for this type of rancidity. This can be prevented by addition of antioxidants such as vitamin E to foods. • **II. Hydrolytic Rancidity** : It is due to the slow hydrolysis of fats, • which in case of fats like butter results in the liberation of short chain fatty acids which are volatile and have rancid taste and odor.

Enzyme Classification (10 marks)

IUB Classification of Enzymes: International Union of Biochemists (IUB) developed an unambiguous system of enzyme nomenclature in which each enzyme has a unique name and code number • As an example, the formal systematic name of the enzyme (hexokinase) catalyzing the reaction

• $\text{ATP} + \text{D-glucose} \rightarrow \text{ADP} + \text{D-glucose-6 phosphate}$ is $\text{ATP:glucose phosphotransferase}$, • Its Enzyme Commission (E.C.) number is 2.7.1.1. • (2) denotes the class name (transferase) • (7) the subclass phosphotransferase • (1) denotes a hydroxyl group as acceptor • (1) D-glucose as the phosphoryl group acceptor. • In the systematic naming system, enzymes are divided into six major classes each with numerous subgroups

- 1) **Oxidoreductases:** catalyze oxidation reduction reactions further divided into four subgroups; • Oxidase, • Dehydrogenases, • Hydroperoxidases • Oxygenases.
- 2) **Transferases:** These bring about a transfer of functional groups such as phosphate and amino group from one molecule to another molecule called donor and acceptor molecules respectively. The common examples of this group are • Transaminases • Phosphotransferases (Kinases) • Hexokinase is a phosphotransferase which catalyze the transfer of phosphate groups.
 - $\text{Glucose} + \text{ATP} \rightarrow \text{Glucose 6-phosphate} + \text{ADP}$.
- 3) **Hydrolases:** These enzymes catalyze hydrolysis, i.e. add water molecule to the substrate which is simultaneously decomposed; the functional group of substrate is transferred to water.

Common example of hydrolyses are: • Protein hydrolyzing Enzymes (peptidases).

• Carbohydrases • Lipid hydrolyzing enzymes e.g. Lipases and Phospholipases.

- 4) **Lyases** : These enzymes catalyze the addition of NH_3 , H_2O or CO_2 to double bonds or the removal of these groups leaving behind double bonds. Lyases are included in a separate class because they catalyze these reactions by means other than hydrolysis or oxidation.
- 5) **Isomerases**: These enzymes catalyze the structural change within a single molecule by the transfer of groups within it, resulting in the formation of an isomeric form of substrate.
- 6) **Ligases**: These enzymes catalyze condensation reactions joining two molecules by forming C-O, C-S, C-N and C-C bonds. The energy for condensation is provided by cleavage of high energy phosphates, e.g. ATP, GTP etc.

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