Bio202 MCQS (Mid-Term)

Glucose residues in amylose are linked by _____.
α (1,4) linkage
β (1,4) linkage
α (1,6) linkage
None of these

Q
The number of carbon atoms in lysine is _____.
4
6
8
10

Q
If the carbonyl group is present at the end of the monosaccharide then it is called _____.
Acid anhydride
Aldose
Ketose
None of these

Q
The number of stereoisomers for a molecule containing only one chiral carbon is _____.
16
2
4
8

Q
Seminal fluid is rich in _____.
Fructose
Lactose
Xylose
Arabinose

Q
Which of the following glycosidic linkage exists between two glucose units of maltose?

alpha 1,4
beta 1,4
alpha 1,6
alpha1,4 and alpha 1,6

Q
Amino sugar is formed by the replacement of the hydroxyl group at ------ of the parent monosaccharide with amino group.
C-1
C-2
C-3
C-6

Q
Which one of the following is a structural homopolysaccharide?
Cellulose
Starch
Glycogen

All of these
Q
Which one of the following amino acids is not specified by three letter codon?
Serine
Proline
Selenocysteine
Methionine

Q:
Acid dissociation constants are designated as _____.

PKa
K
Pa
None of these

Q
The pI of glutamate is _____.

1.2
5.6
3.22
6.7

Q
Which of the following amino acid is negatively charged at physiological pH?
Aspartate
Lysine
Alanine
Proline

Q
Which of the following refers to particularly stable arrangements of amino acid residues giving rise to recurring structural patterns?
Primary structure
Secondary structure
Tertiary structure
Quaternary structure

Q
Keratin is present in _____.
Hair
Nail
Hoof
All of these

Q
Which of the following amino acid is involved in the hydrophobic interactions in the tertiary structure of protein?
Phenylalanine
Cysteine
Glycine
None of these

Q
The free energy of a protein molecule is influenced by _____.
Hydrophobicity
hydrogen bonds
electrostatic interactions
All of these

BIO-202 Biochemistry MCQS and Notes (MID Term)

Q
Which of the following diseases is caused by protein misfolding?
Alzheimer's disease
Huntington's disease
Parkinson's disease
All of these

Q
Iron is a _____.

non-metal
metalloid
transition metal
halogen

Q
Myoglobin can bind _____ molecules of oxygen.

One
Two
Three
Four

Q
The partial pressure of oxygen (pO2) in lungs is about _____.
30 mmHg
50 mmHg
100 mmHg
200 mmHg

Q
In sickle cell anemia, Glutamate is replaced with _____.

Arginine
Alanine
Methionine
Valine

Q
Oxy hemoglobin dissociation curve describe the relationship of ----------
Available Oxygen
Amount of carbon dioxide carried by hemoglobin
Fibrinogen
Oxy-hemoglobin curve stability

Q
Which one of the following is made up of two molecules of glucose?
Maltose
Starch
Cellulose
Amylose

Q
Which bond exists between the carbonyl group and oxygen of a hydroxyl group in ring structure of glucose?
Ionic
Covalent
hydrophobic interaction
both ionic and covalent

Q
In Benedict test, the formation of cuprous oxide is indicated by the formation of _____.
blue ppt

silver mirror
red ppt
none of these

Q
Glucose 6 Phosphate is formed by the addition of phosphate group to C6 of glucose by _____ linkage.
Ether
Ester
Ionic
none of these

Q
E. coli convert lactose of milk to lactic acid by action of _____.
Beta galactosidase
Amyloglucosidase
Alpha amylase
Maltase

Q
At any pH above pI, gycine has a net _____ charge and will move towards the _____.
negative, anode
negative, cathode
positive, anode
positive, cathode

Q
Which of the following amino acids contain two COOH groups?
Alanine
Glutamate
Glycine
Valine

Q
Which of the following amino acid is positively charged at physiological pH?
Lysine
Aspartate
Tyrosine
Alanine

Q
Peptide bond is _____ linkage between two amino acids.
Ester
Amide
Ether
None of these

Q
Which of the following shows the greatest tendency to form α helices in most experimental model systems?
Glycine
Alanine
Proline
Serine

Q
Immunoglobulin G (IgG) consists of _____.
Two heavy chains and two light chains
Four heavy chains
Four light chains
None of these

BIO-202 Biochemistry MCQS and Notes (MID Term)

Q
The free energy of a protein molecule is influenced by _____.
Hydrophobicity
hydrogen bonds
electrostatic interactions
All of these

Q
Proteins are denatured by _____.
Temperature
Ph
organic solvents
temperature, pH, organic solvents

Q
About _____ of amino acid residues in the myoglobin are found in alpha helices.
98%
78%
27%
10%

Q
Hemoglobin is found exclusively in _____.
white blood cells
red blood cells
platelets
platelets and white blood cells

Q
The partial pressure of oxygen (pO2) in lungs is about _____.
30 mmHg
50 mmHg
100 mmHg
200 mmHg

Q
In sickle cell anemia, Glutamate is replaced with _____.
Alanine
Methionine
Valine
Arginine

VU_M

1. Table sugar is ... Sucrose
2. R group in Alanine side chain is CH3
3. Which amino acid is ketogenic and glucogenic.... Tyrosine
4. Example of homo polysaccharides ...
5. Ammout of CO2 transported by bicarbonate is ....
6. Medium size fatty acids contain no of carbons....
7. The substitution of a hydrogen for the hydroxyl group at C-6 of

L-galactose & • L-mannose produces; • L-fucose and • L-rhamnose. All of these .

8. If the second group is a hydroxyl, the Oglycosidic bond is an acetal link because it results
9. PI of glycine is ... 5.97
10. PL of alanine is 5.7
11. Glutamate Pl is 3.22
12. PL of histidine 7.59
13. Histadine has 3 Diassociate Hydrogen
14. Negative charged amino acids ... Aspartate – Glutamate
15. Keto genic Amino Acids ..... Lucine – Lysine
16. Amino Acids have .... .linkage ... Amide linkage
17. Sickle cell anemia .... Glutamate – Valine
18. Postitive charged Aminoacids .....Lysine-arginine-Histidine
19. enzyme that catalyzes the interchange, or shuffling, of disulflde bonds until the bonds of the native conformation are formed. ..... Protein disulfide isomerase (PDI
20. organic solvents disturb interaction in protein..... Hydrophobic interaction
21. Iron belongs to ..... Transition metals
22. Polar amino acid is .... Histidine
23. 1 torr = 1mmHg
24. In hemoglobin the 2 molecules have ..... sigmoidal
25. carbamates account for about 15% of the CO2 in venous blood
26. the CO2 is transported as dissolved..... • HCO3- (80 to 85%)
27. At high altitude of hills and mountains, where the pO2 is considerably _____The delivery of oxygen to the tissues is_____.....Lower-reduced.
28. Fatty Acids are classified on the basis of ..... Hydrocarbon Chain Length and Degree of saturation and dietary requirement..

Carbohydrates

Q. Difference between Aldose and Ketose sugar.

• If the carbonyl group is at an end of the carbon chain (that is, in an aldehyde group) the monosaccharide is an aldose

• If the carbonyl group is at any other position (in a ketone group) the monosaccharide is a ketose

Q. Define Carbohydrates and Explain its 4 major groups.

Carbohydrates are polyhydroxy aldehyde or polyhydroxy ketones. It is further classified into 4 major groups.

Q. what are simplest monosaccharides? Give 2 examples

The simplest monosaccharides are the two three-carbon trioses

Examples : – Glyceraldehyde,an aldotriose – Dihydroxyacetone, a ketotriose

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. Define Diasacchrides and give example.

Disaccharides are those sugars which yield two molecules of the same or different monosaccharides on hydrolysis – Maltose - 2 molecules of glucose on hydrolysis

Examples. Maltose , sucrose , galactose

Q. Define oligosaccharides with example.

Oligosaccharides are short chains of monosaccharide units or residues (310) joined by characteristic linkages called glycosidic linkage

Q. Define polysaccharides with example

Polysaccharides (Glycans) are those which yield more than 10 molecules of monosaccharides on hydrolysis • Some have hundreds or thousands of units • Some polysaccharides, such as cellulose, are linear chains; others, such as glycogen, are branched

Q. Define starch and give its structure.

Starch is a homopolysaccharide formed by units of glucose and the storage form of carbohydrates in plants.

Structure contains two types of homopolysaccharides, amylose and amylopectin.

Contains thousands monomers linked by (1,4 glycoside linkage)

Q. Difference between Homo polysaccharides and hetropolysaccharides

Polysaccharides are further divided into two groups:

1. Homopolysaccharides (homoglycans): Polymers of same monosaccharide units e.g. starch, glycogen, inulin, cellulose, dextrins, dextrans

2. Heteropolysaccharides (heteroglycans): Polymer of different monosaccharide units or their derivatives e.g. Mucopolysaccharides (glycosaminoglycans)

Q. Write the Biomedical Importance of Carbohydrates.

Biomedical Importance • Chief source of energy • Constituents of compound lipids and conjugated proteins • Lactose , the principal sugar of milk • Degradation products utilized for synthesis of other substances such as fatty acids, amino acids, cholesterol, etc

Constituents of mucopolysaccharide s which form the ground substance of mesenchymal tissues • Certain carbohydrate derivatives are used as drugs like cardiac glycosides. Inherited deficiency of certain enzymes in metabolic pathways of different carbohydrates can cause diseases e.g. galactosemia, glycogen storage diseases, lactose intolerance, etc • Derangement of glucose metabolism is seen in Diabetes mellitus

Q. What is lactose intolerance?

Lactose tolerance means the body cannot easily digest lactose, a type of natural sugar found in milk and dairy products.

Q. Define isomerism.

Isomerism • The existence of two or more compounds having the same molecular formula but a different arrangement of atoms within the molecule..

Q. Define Allotropy

Allotropy, the existence of a chemical element in two or more forms, which may differ in the arrangement of atoms in crystalline solids

Q. Define types of Isomers

Stereoisomers have the fixed spatial arrangement of atoms are called stereoisomers

Stereoisomers that are mirror images of each other are called enantiomers

Pairs of stereoisomers that are not mirror images of each other are called diastereomers

Q. What is the identifying characteristics of stereoisomers?

The identifying characteristic of stereoisomers is that they cannot be interconverted without temporarily breaking one or more covalent bonds

Q. What is asymmetric or chiral?

A carbon atom to which four different atoms or groups of atoms are attached is said to be asymmetric or chiral

Q. how the Configuration is conferred of Isomers

(a) chiral centers, around which substituent groups are arranged in a specific orientation – (b) double bonds, around which there is no freedom of rotation

Carbohydrates

Q. Define Geometic Isomers

Geometric isomers; differ in the arrangement of their substituent groups with respect to the nonrotating double bond (each is a well-defined compound that can be separated from the other, and each has its own unique chemical properties

Q. what is D and L isomerism?

D and L isomerism: • The designation of a sugar isomer as the D form or as the L form is determined by its spatial relationship to the parent compound of the carbohydrates, the glyceraldehyde

Q. How can we determine that which sugar belongs to D or L series?

• (carbon 5 in glucose) determines whether the sugar belongs to the D or L series. • When the —OH group on this carbon is on the right the sugar is the D isomer; • when it is on the left, it is the L isomer

Q. difference btw Recemic and resolution

when equal amounst of dextrorotataroy and levorotatory isomers are present i, the resulting mixures has no optical activity Such a mixture is said to be racemic and separation of optically active isomers from a racemic mixture is called resolution

Q. how cyclic structure is formed

As the two reacting groups, the aldehyde and the alcoholic group, belong to the same molecule, a cyclic structure forms

Q. Difference btw hemiacetals or hemiketals

The formation of ring structures is the result of a general reaction between alcohols and aldehydes or ketones to form derivatives called hemiacetals or hemiketals.

If the alcohol react with aldehydes they form Hemiacetals on other hand when Alcohol reacts with ketones it forms hemiketals.

Q Define Anomers or anomeric carbon

Isomeric forms of monosaccharides that differ only in their configuration about the hemiacetal or hemiketal carbon atom are called anomers The carbonyl carbon atom is called the anomeric carbon

Q. Difference btw Pyran and Furan

The ring structures of monosachhrides are similar to the ring structures of either pyran (six membered ring and are called pyranoses or furan a five membered ring which are knwon as furanoses.

Crystalline glucose is α -D glucopyranose

Q. Define Mutarotaion

the alpha and beta anomers of D-glucose interconvert in a aqueous solution by a process called mutarotation. This mixture contains .

one-third α-D-glucose, • two-thirds β-D-glucose,

Q. how enzymes distinguish α and β forms

α and β forms are NOT mirror images and are referred to as diastereomers • Enzymes are able to distinguish between these two structures and use one or the other preferentially

Q. synthesis of glycogen and cellulose

glycogen is synthesized from αD-glucopyranose, whereas cellulose is synthesized from βD-glucopyranose

Q. Define Epimers with example.

Epimers • Two sugars which differ from one another only in configuration around a single carbon atom are termed epimers • Glucose and Galactose are an example of an epimeric pair which differ only with respect to C4

Q. Function and uses of Pentose sugar.

Pentoses: • D-Ribose is a constituent of nucleic acid RNA and also certain co-enzymes like FAD, NAD & coenzyme A • D-2-Deoxyribose is a constituent of DNA

Q. Function and uses of Hexoses.

Hexoses • D-Glucose (Dextrose, Grape sugar): • Most dietary carbohydrate is absorbed into the bloodstream as glucose formed by hydrolysis of dietary starch and disaccharides, and other sugars are converted to glucose in the liver

Sources

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Sources include fruit juices, hydrolysis of starch, cane or beet sugar, maltose and lactose • Glucose is the major metabolic fuel of mammals

• It is the chief physiological sugar present in normal blood at a fairly constant level • All tissues utilize glucose for energy • Erythrocyte utilize glucose solely for energy purposes and Brain cells rely heavily on glucose

synthesis of all the other carbohydrates in the body, including – glycogen for storage; – ribose and deoxyribose in nucleic acids; – galactose in lactose of milk, in glycolipids

• And in combination with protein in glycoproteins and proteoglycans • Stored as Glycogen in liver and muscles only • Excreted in the urine (glucosuria) in poorly controlled diabetes mellitus as a result of hyperglycemia

Q. Define galactosemia

Hereditary galactosemia as a result of failure to metabolize galactose leads to cataracts

Q. Define lactones

Both aldonic and uronic acids form stable intramolecular esters called lactones

Q. What is GDL and its sources.

Glucono delta-lactone (GDL) is commonly found in honey, fruit juices, personal lubricants, and wine . GDL is neutral

Q. What is honey? Why it has greater sweetness?

Honey is a sugar food substance obtained by the Honey bee produce by the chemical action of insects. Honey gets its sweetness from the monosaccharides fructose and glucose.

Q. Where in the body D Glucuronic acid is formed? Write its uses

In the body, D Glucuronic acid is formed from glucose in liver • It occurs as a constituent of certain polysaccharides • It is of importance in that it conjugates toxic substances, drugs, hormones and even bilirubin And converts them to a soluble non toxic substance, a glucuronide, which is excreted in urine • Oxidation of the carbon at the both ends of the carbon chain

Q. Why monosaccharides are called reducing sugars?

Monosacharides can be oxidized by relatively mild oxidizing agents such as cupric (Cu2+) ion • The carbonyl carbon is oxidized to a carboxyl group • Glucose and other sugars capable of reducing cupric ion are called reducing sugars

Q. What happens in Fehling's and benedicts reaction?

Oxidation of the anomeric carbon (and probably the neighboring carbon) of glucose and other sugars under alkaline conditions is the basis for • Fehling's reaction • Benedicts reaction The cuprous ion (Cu+) produced forms a red cuprous oxide precipitate.

Q. Properties of Monosaccharides

Properties of Monosaccharides • 2. Condensation of phosphoric acid with one of the hydroxyl groups of a sugar forms a phosphate ester, as in glucose 6phosphate Sugar phosphates are relatively stable at neutral pH and bear a negative charge

Q. write name of amino sugars.

The amino sugars include: – D -glucosamine, a constituent of hyaluronic acid – D -galactosamine (also known as chondrosamine), a constituent of chondroitin – D –mannosamine

Q. define Hexosamines.

The Amino Sugars (Hexosamines) are Components of Glycoproteins, Gangliosides, & Glycosaminoglycans

Several antibiotics (e.g, erythromycin) contain amino sugars, which are important for their antibiotic activity

Q. how deoxy sugar is formed?

When oxygen of a –OH group is removed in a monosaccharide, leaving behind only hydrogen, deoxy sugars are formed •

Q. how glycoside is formed

are formed by condensation between the hydroxyl group of the anomeric carbon of a monosaccharide, and a second compound that may or may not (in the case of an aglycone) be another monosaccharide

The monosaccharides may be reduced to form their corresponding alcohols by reducing agents

Examples are – D-Glucose yields DSorbitol – D-Galactose yields D-Dulcitol – D-Mannose yields D-Mannitol – Ribose to ribitol

Q. What is Sorbitol?

Is a sugar alcohol with a sweet taste which the human body metabolizes slowly. It can be obtained by reduction of glucose, changing the aldehyde group to a hydroxyl group.

Q. uses of Sorbitol

Sorbitol: • 35-60% sweetness of glucose • Used as an artificial sweetner • Accumulates in tissues such as the eye lens in diabetes mellitus

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Q. Uses of Mannitol

Mannitol: • Administered intravenously as an osmotic diuretic in acute renal failure • Also used to relieve raised intracranial pressure by forced diuresis

Q. Define Tautomerization

The process of shifting a hydrogen atom from one carbon atom to another to produce enediols is known as tautomerization

When glucose is kept in alkaline solution for several hours, it undergoes isomerization to form D-fructose and Dmannose

Q. Define Osazone formation

Osazone formation: • It is a useful means of preparing crystalline derivatives of sugars called osazones • They are obtained by adding a mixture of phenyl hydrazine hydrochloride and sodium acetate to a sugar solution and heating in water bath for 45 mins Crystals are formed after the solution is cooled slowly • Reaction involves only the carbonyl carbon and the adjacent carbon.

Maltose sunflowershaped • And lactose powder puff shaped

needle shaped craystal arranged like a broom glucososazone . hedgehog or pincushion iwth pins or flower of touch me not plant lactososazone sun flower shaped or petal shaped crasals of maltosazone

Q. write characteristics of osazones.

Osazones have characteristic – Melting points – Crystal structures – Precipitation time – and thus are used in identifying the sugars

Q. write the actions of Acids on Carbohydrates.

Action of acids on carbohydrates • Polysaccharides are hydrolyzed into their constituent monosaccharides by boiling with dilute acids • With concentrated acids the monosaccharides are decomposed Pentoses yield a cyclic aldehyde furfural with 12% HCL • Hexoses are decomposed by hot strong acids to give hydroxy methyl furfural

Q. Characteriscitsc of furfural compounds.

With concentrated acids the monosaccharides are decomposed Pentoses yield a cyclic aldehyde furfural with 12% HCL • Hexoses are decomposed by hot strong acids to give hydroxy methyl furfural

The furfural products thus formed can condense with certain organic phenols (αnaphthol) to form compounds having characteristic colours • This forms basis of certain tests used for detection of sugars

Molisch,s and • Selivanoff,s are examples of such tests

Maltose comes from the hydrolysis of starch (by amylase) • It is in turn hydrolysed to glucose by maltase, which is located on the intestinal brush border Disacharrides

In lactating mammary gland, the lactose is synthesized from glucose by the duct epithelium • Many organisms that are found in milk, e.g., E.Coli convert lactose of milk to lactic acid (by β galactosidase) thus causing souring of milk

Lactase, the specific enzyme which hydrolyses lactose is present in the intestinal brush border

Q . what is sucrose ? write its location in human body

The hydrolysis of sucrose to glucose and fructose is catalyzed by sucrase (also called invertase), which is also present in the intestinal brush border like lactase and maltase

Q. Biomedical Importance of oligosachharides

• Integral membrane proteins contain covalently attached carbohydrate units, oligosaccharides, on their extracellular face • Many secreted proteins such as antibodies and coagulation factors also contain oligosaccharide units

The oligosaccharides participate in molecular targeting and cell to cell recognition

• They also mark the passage of time and determine when the proteins should be taken out of circulation

The human ABO blood groups illustrate the effects of glycosyl- transferases

• Carbohydrates are attached to glycoproteins and glycolipids on the surfaces of red blood cells

• For one type of blood group, one of the three different structures, termed A, B, and O, may be present • These structures have in common an oligosaccharide foundation called the O (or sometimes H) antigen

The A and B antigens differ from the O antigen by the addition of one extra monosaccharide, either Nacetylgalactosamine (for A) or galactose (for B) through an α1,3 linkage to a galactose moiety of the O antigen

Q. Properties of Polysacchrarides

Most carbohydrates found in nature occur as polysaccharides, polymers of medium to high molecular weight

Polysaccharides also called glycans, differ from each other – in the identity of their recurring monosaccharide units – in the length of their chains – in the types of bonds Iinking the units – in the degree of branching

Some homopolysaccharid es serve as storage forms of monosaccharides that are used as fuels • Other homopolysaccharides (cellulose and chitin) serve as structural elements in plants

The most important storage polysaccharides are starch in plant cells and glycogen in animal cells

polysaccharides occur intracellularly as large clusters or granules

Most plant cells have the ability to form starch and starch storage is especially abundant in tubers (underground stems), such as potatoes and in seeds

Heteropolysaccharid es provide extracellular support for organisms of all kingdoms • For example, the rigid layer of the bacterial cell envelope (the peptidoglycan) is composed in part of a heteropolysaccharide built from two alternating monosaccharide units

Starch contains two types of glucose polymers: – Amylose – amylopectin • It is the most important dietary carbohydrate in cereals, potatoes, legumes, and other vegetables

Amylose (13–20%), consists of long, unbranched helical structure of D glucose residues connected by (α1→4) linkages (as in maltose)

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Protien

Q. Define Amino Acids

Proteins are linear polymers built of monomer units called amino acids

Q. On what factor protein function depends

The function of a protein is directly dependent on its three dimensional structure

Q. Biomedical importance of Proteins

BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. What is the remarkability of proteins?

Remarkably, proteins spontaneously fold up into three-dimensional structures that are determined by the sequence of amino acids in the protein polymer

Q. Explain functions of Protein

Proteins contain a wide range of functional groups These functional groups include • alcohols, • thiols, • thioethers, • carboxylic acids, • carboxamides, • and a variety of basic groups. When combined in various sequences, this array of functional groups accounts for the broad spectrum of protein function. Proteins can interact with one another and with other biological macromolecules to form complex assemblies.

Q. What products can be prepared by the Amino Acids?

enzymes, – hormones, – antibodies, – transporters, – muscle fibers

the lens protein of the eye, – feathers, – spider webs, – rhinoceros horn, – milk proteins, – antibiotics, – mushroom poisons etc

Q. How does protein act as assemblies?

The proteins within these assemblies can act synergistically to generate capabilities not afforded by the individual component proteins

Q. Function of a protein as Assemblies?

These assemblies include macromolecular machines that carry out; • the accurate replication of DNA, • the transmission of signals within cells, and many other essential processes

Q. Function of Rigid protein?

Rigid units can function as structural elements in the cytoskeleton (the internal scaffolding within cells) or in connective tissue

Q. Function of Flexible part of proteins

Parts of proteins with limited flexibility may act as • hinges, • springs, and • levers

Q. How many set of Amino Acids

20 amino acids

Which are covalently linked in characteristic linear sequence. • Each of these amino acids has a side chain with distinctive chemical properties

Q. How does cell can produce enzymes?

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Cells can produce proteins with strikingly different properties and activities by joining the same 20 amino acids in many different combinations and sequence

Q. How the light is produced in firefly?

The light produced by fireflies is the result of a reaction involving the protein luciferin and ATP, catalyzed by the enzyme luciferase

Q. Define the composition of protein.

Proteins are polymers of amino acids, with each amino acid residue joined to its neighbor by a specific type of covalent bond termed the peptide bond

Q. what does the term Residue Means?

The term "residue" reflects the loss of the elements of water when one amino acid is joined to another

All of the 20 common amino acids are α amino acids

Q. How many Functional groups a protein contain.

They have a carboxyl group and an amino group bonded to the same carbon atom (the α carbon)

Q. How Amino acids are different from each other's

They differ from each other in their side chains, or R groups, which vary in – structure, – size, – electric charge, – and which influence the solubility of the amino acids in water

Q. Define standard Amino Acids

The 20 amino acids that constitute the monomer units of proteins are the standard amino acids as the genetic code specifies only these 20 L -α-amino acids

Q. List the Amino acids which are produced by modification

– conversion of peptidyl proline and lysine to – 4-hydroxyproline and –

5-hydroxylysine – the conversion of peptidyl glutamate to carboxyglutamate

the methylation, – formylation, – acetylation, – prenylation, and – phosphorylation of certain aminoacyl residues

Q. list uncommon Amino acids.

uncommon amino acids – 4-hydroxyproline, a derivative of proline –

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5-hydroxylysine, derived from lysine • The former is found in plant cell wall proteins, and both are found in collagen

6-NMethyllysine is a constituent of myosin, a contractile protein

• γ -carboxyglutamate, found in the blood clotting protein prothrombin and in certain other proteins that bind Ca2+ as part of their biological function

Q. List additional Amino Acids found in cell.

Some 300 additional amino acids have been found in cells but not as constituents of proteins • Examples include – Ornithine and citrulline (intermediates in urea cycle)

Taurine (found in bile acids) – δ-Aminolevulinic acid (intermediate in haem synthesis)

Q. What is called D Amino Acids and its examples.

D- AMINO ACIDS • D-amino acids are also nonstandard amino acids that occur naturally and include – free D- serine, and D-aspartate in brain tissue. D-alanine & D-glutamate in the cell walls of gram positive bacteria • D-amino acids are also found in some antibiotics

Q. Selenocysteine, the 21st L-α-Amino Acid?

• Selenocysteine is an L-α-amino acid found in a handful of proteins, including certain peroxidases and reductases where it participates in the catalysis of electron transfer reactions

Q. how modification occurs in Serine

Modification to a serine that occurs while the serine is bound to a unique RNA. The hydroxyl group of serine is replaced by a selenium atom. The selenocysteine is then inserted into a protein as it is being synthesized

• Since selenocysteine is inserted into polypeptides during translation, it is commonly referred to as the "21st amino acid

selenocysteine is not specified by a simple three-letter codon

Q. Which Amino acid is referred as 22

22nd Amino Acid • Pyrrolysine (abbreviated as Pyl or O) is a naturally occurring, genetically coded amino acid used by some methanogenic archaea.

Q. how many stereoisomers Amino acids contain.

The α-carbon atom is thus a chiral center and thus amino acids have two possible stereoisomers

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. How many convention are used to identify carbon in Amino acids?

Two conventions are used to identify the carbons in an amino acid The additional carbons in an R group are commonly designated β, γ, δ and so forth, proceeding out from the α carbon

carbon atoms are simply numbered from one end, giving highest priority (C-1) to the carbon with the substituent containing the atom of highest atomic number

carboxyl carbon of an amino acid would be C-1 and the α carbon would be C-2

In some cases, such as amino acids with heterocyclic R groups (such as histidine), the Greek lettering system is ambiguous and the numbering convention is therefore used

Leucine thus has δ1 and δ2 carbons

Q. Define zwitterion

The form of an amino acid that has both a positive and a negative charge is called a zwitterion

Amino acids in solution at neutral pH exist predominantly as dipolar ions (zwitterions

Q. Define Acidic and Basic Amino Acids.

In this form, the amino group is protonated (–NH3+) • and the carboxyl group is deprotonated (–COO-) • A zwitterion can act either as an acid (proton donor) or as a base (proton acceptor)

Q. Define Amphoteric or ampholytes.

Substances having this dual nature are amphoteric and are often called ampholytes The ionization state of an amino acid varies with pH

Q. what happens at physiological pH to Amino Acids?

At physiological pH, the carboxyl group is dissociated , forming the negatively charged carboxylate ion (-COO-) and the amino group is protonated (NH3+)

Q. Define Alanine property.

A simple monoamino monocarboxylic - amino acid, such as alanine, is a diprotic acid when fully protonated—it has two groups, theCOOH group and the - NH3+ group, that can yield protons.

Each acid has a characteristic tendency to lose its proton in an aqueous solution

The stronger the acid, the greater its tendency to lose its proton

Q. Define the tendency of an Acid to lose proton

The tendency of any acid (HA) to lose a proton and form its conjugate base (A-) is defined by the equilibrium constant (Keq) for the reversible reaction •

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HA ⟶ A- + H+

Q. Define Ionization constant

Equilibrium constants for ionization reactions are usually called ionization constants or acid dissociation constants, often designated pK The stronger the tendency to dissociate a proton, the stronger is the acid and the lower its pKa The stronger the acid, the lower its pKa. At the midpoint of the titration, the concentrations of the proton donor and proton acceptor are equal, and the pH is numerically equal to the pKa

Q. Define pKa

pKa is the measure of the tendency of a group to give up (donate) a proton with the tendency decreasing ten-fold as the pKa increases by one unit The pKa for the most acidic group (COOH) is pK1, whereas the pKa for the next most acidic group (NH3+) is pK2. The dipolar form persists until the pH approaches 9, when the protonated amino group loses a proton

Alanine in acid solution pH less then 2 its net charge is +1

Alanine in neutral solution pH approximately 6 its net charge is zero

alanine in basic solution (pH greater than 10) net charge is -1

Q. Glycine is diprotic acid. Justify ? OR write Characteristics of Glycine

A simple amino acid e.g. glycine is a diprotic acid when fully protonated • This means that it has two groups, the COOH and the NH3+ group that can yield protons

The second piece of information is Glycine acid has two regions of buffering power

glycine is not a good buffer at the pH of intracellular fluid or blood, about 7.4

Q. Define Isoelectric point or Isoelectric pH

The characteristic pH at which the net electric charge is zero is called the isoeleetric point or isoelectric pH, designated pI

Alanine has only two dissociable hydrogens (one from α carboxyl & one from α amino grou

Q. Define Buffers

A buffer is a solution that resists change in pH following the addition of an acid or base

Histidine has got 3 dissociable hydrogens

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. why Histidine is found in Intra or extra cellular fluids of animals?

Only histidine has an R group (pKa = 6.0) providing significant buffering power near the neutral pH usually found in the intracellular and extracellular fluids of most animals

Q. Define Aromatic Amino Acids with examples

The aromatic amino acids have been grouped together because they all contain ring structures with similar properties, but their polarity differs.

Examples Phenylalanine – Tyrosine – Tryptophan

The aromatic ring is a six-membered carbon– hydrogen ring with three conjugated double bonds (the benzene ring or phenyl group)

Q. Define Benzene Compound.

Benzene is an organic chemical compound with the chemical formula C6H6. Its molecule is composed of 6 carbon atoms joined in a ring, with 1 hydrogen atom attached to each carbon atom. Benzene ring determine whether the amino acid side chain engages in polar or hydrophobic interactions

Q. Enlist of Amino acids that are Aromatic

Phenylalanine – Tyrosine – Tryptophan – with their aromatic side chains, are relatively nonpolar (hydrophobic). – All can participate in hydrophobic interactions.

phenylalanine, the ring contains no substituents, and the electrons are shared equally between the carbons in the ring, resulting in a very nonpolar hydrophobic structure in which the rings can stack on each other In tyrosine, a hydroxyl group on the phenyl ring engages in hydrogen bonds, and the side chain is therefore more polar and more hydrophilic • Tryptophan is therefore also more polar than phenylalanine

Tyrosine and tryptophan are significantly more polar than phenylalanine, because of the tyrosine hydroxyl group and the nitrogen of the tryptophan indole ring

Q. write characteristics of Aliphatic polar uncharged R group

The R groups of these amino acids are more soluble in water, or more hydrophilic, than those of the nonpolar amino acids. Because they contain functional groups that form hydrogen bonds with water

Q. Enlist Aliphatic Amino Acids

This class of amino acids includes • serine, threonine, • cysteine, • asparagine, and • glutamine. These Amino acids have zero net charge at neutral pH

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Serine & threonine of this class contain a polar hydroxyl group

side chains of asparagine & glutamine contain a carbonyl group & amide group, both of which can participate in hydrogen bonding

The polar hydroxyl groups of serine & threonine serve as a site of attachment for phosphate groups

The amide group of asparagine & the hydroxyl group of serine & threonine serve as a site of attachment for oligosaccharide chains in glycoproteins

Amino acids with side chains that contain an amide group (asparagine and glutamine) or a hydroxyl group (serine and threonine) can be classified as aliphatic, polar, uncharged amino acids

Q. Enlist Positively Charged (Basic) R Groups

Lysine, which has a second primary amino group at the ε position on its aliphatic chain – Arginine, which has a positively charged guanidinium group – Histidine, which has an aromatic imidazole group Histidine is therefore weakly basic & the free amino acid is mainly uncharged at physiologic pH

Q. Define Negatively Charged (Acidic) R Groups

These amino acids are proton donors • At neutral pH, the side chains of these amino acids are fully ionized, containing a negatively charged carboxylate group • (--COO-

Humans have no dietary requirement for protein, per se, but, the protein in food does provide essential amino acids.

Nine of the twenty amino acids needed for the synthesis of body proteins are essential-that is, they cannot be synthesized in humans at an adequate rate

Q. Define essential Amino Acids write their names

Essential amino acids cannot be made by the body. As a result, they must come from food. The nine essential amino acids are: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.

Q. Enlist non-essential amino acids

Alanine, Arginine, Asparagine, Cysteine, Glutamate, Glutamine, Glycine, Proline and serine

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. How amino Acids are can be classified

Amino acids can be classified as glucogenic or ketogenic based on what intermediates are produced during their catabolism

Q. Define Glucogenic Amino Acid.

Glucogenic amino acids • Amino acids whose catabolism yields pyruvate are termed glucogenic or glycogenic These intermediates are substrates for gluconeogenesis and, therefore, can give rise to the net formation of glucose or glycogen in the liver and glycogen in the muscle

Q. Define Ketogenic amino acids

Amino acids whose catabolism yields either acetoacetate or its precursor, (acetyl CoA or acetoacetyl CoA) are termed ketogenic. Examples are.

Leucine and lysine are the only exclusively ketogenic amino acids found in proteins

Q. Define Classification of Protiens

Different classifications of proteins are based on their: 1. Shape and Size 2. Biological actions/ Functions 3. Solubility and physical properties 4. Quality

Q. Define catalytic Proteins. Catalytic Proteins: These specialized proteins are called enzymes which catalyze the biochemical reactions

Q. write the function of Protective Proteins

a) Immunoglobins (Igs) • These freely circulating proteins protect the body from invading microbes such as bacteria or viruses by inactivating or killing them through various mechanisms.

b) Fibrinogen • This forms fibrin clot and stops bleeding from wounds

Q. writes the function of Regulatory Proteins

Hormones control genetic expression, cellular signalling and biochemical reactions catalyzed by enzymes. Enzymes are either activated or inactivated through modification of their structure.

Examples of protein hormones are – growth hormone – Insulin – Glucagon – Somatostatin

Q. Write the function of Structural Proteins:

These proteins form various body structures e.g. – Collagen – Elastin – Keratin

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Q. Write the function of Transport Protien.

Transport Proteins: • These proteins transport various substances from one part of the body to the other e.g. – Hemoglobin transport O2 from lungs to tissues and CO2 from tissues to lungs – Transferrin transports iron

Q. Write the function of contractile proteins.

Contractile Proteins: • These proteins are involved in muscle contraction and relaxation – Myosin of thick filaments – Actin of thin filaments of skeletal muscles

Q. Write function of Respiratory Protiens.

Respiratory Proteins. Heme Containing proteins are involved in the funtion of respiration e.g Hemoglobin Myoglobin cytochromes

Q. write the functions of Digestive Protein.

Digestive protein. these proteins are digestive enzymes which digest our food material such as carbohydrates, Proteins, lipids examples Amylase , Pepsin Lipases etc

Q. Write the function of Toxin proteins

Toxin proteins , these proteins are hydrolytic enzymes found in the venom of poisonous snakes, sting of bees and insects and hydrolyze the compounds forming the structure of the cell membrane.

Q. Write the function of Storage proteins.

Storage proteins these proteins store some specific elements or compounds with them. This is because of the presence of the many binding sites in them for the particular element Example Ferritin stores iron and ceruloplasmin stores copper

Q. Define Peptide bond

Two amino acid molecules can be covalently joined through an amide linkage, termed a peptide bond. This linkage is formed by removal of the elements of water from the α-carboxyl group of one amino acid and the α-amino group of another Almost all peptide bonds in proteins are trans

Q. Explain the Types/Structure of Proteins

The Primary Structure •

A description of all covalent bonds (mainly peptide bonds and disulfide bonds) linking amino acid residues in a polypeptide chain is its primary structure. The most important element of primary structure is the sequence of amino acid residues.

Secondary structure •

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Secondary structure refers to particularly stable arrangements of amino acid residues giving rise to recurring structural patterns

Tertiary structure •

Tertiary structure describes all aspects of the three-dimensional folding of a polypeptide

Quaternary structure •

When a protein has two or more polypeptide subunits, their arrangement in space is referred to as quaternary structure

Q. Define the sequence of Primary protein.

The primary structure of a protein refers to the linear sequence of amino acids in the polypeptide chain

Q. How end of the Polypeptide chain referred?

The two ends of the polypeptide chain are referred to as the carboxyl terminus (C-terminus) and the amino terminus (N-terminus) based on the nature of the free group on each extremity.

Q. Role of Primary structure of Protein?

The primary structure of a protein determines how it folds up into its unique three dimensional structure, and this in turn determines the function of the protein

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Q. Sequence of Amino acids are Specified by?

Proteins have unique amino acid sequences,that are specified by genes

Proteins are encoded by one or more specific sequences of three nucleotides in DNA or RNA.

Q. why it is important to understand the structure of Primary protein?

Understanding of the primary structure of proteins is important because many genetic diseases result in proteins with abnormal amino acid sequences which cause loss or impairment of normal function.

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Q. What happens if there is single Amino Acid changed in sequence of protein?

The defect can range from a single change in the amino acid sequence (as in sickle cell anemia) In Sickle cell anemia a Glutamate residue is replaced by Valine at position 6 of beta chain of Hemoglobin, resulting in decreased functioning and increased fragility of Hb

Q. What if the large portion of polypeptide is removed or deleted? Or Q How Duchenne Muscular Dystrophy is caused?

to deletion of a larger portion of the polypeptide chain (as in most cases of Duchenne muscular dystrophy) Duchenne Muscular dystrophy results from a large segment of gene deletion in X chromosome, resulting in small truncated dystrophin protein

Primary structure is altered, the function of the protein may also be changed

Q. writes the types of Secondary structure of protein.

There are a few types of secondary structure that are particularly stable and occur widely in proteins • The most prominent are the α helix and β conformations.

Q. Define α helix structure of secondary protein.

The simplest arrangement the polypeptide chain can assume, given its rigid peptide bonds (but free rotation around its other, single bonds), is a helical structure, called the α helix. Within the α helix, every peptide bond (except those close to each end of the helix) participates in such hydrogen bonding

Q. Write properties of Amino acids found in α helix

Amino acids most commonly found in alpha helices are non-polar with aliphatic side chains • Alanine shows the greatest tendency to form α helices in most experimental model systems

Q. How the α helix can be disturbed or destabilize?

The bulk and shape of Ser, Thr, and Cys residues can destabilize an α helix if they are close together in the chain.

Amino acids with charged R groups such as Aspartate, Lysine residues can also disrupt the helix

In proline, the nitrogen atom is part of a rigid ring, and rotation about the N-C bond is not possible • Thus, a proline residue introduces a destabilizing kink in an α helix

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Q. give example of group of proteins contain α-helices

A very diverse group of proteins contains α-helices

Example

- keratins are a family of closely related, fibrous proteins whose structure is nearly entirely αhelical. • They are a major component of tissues such as hair, nails, hoofs and skin. Hemiacetals and Hemiketals
- myoglobin, whose structure is also highly α-helical, is a globular, flexible molecule
- Nearly all trans membrane proteins contain alpha helices in their membrane spanning domains

Q. Define β Sheets

β Sheets are a second type of regular secondary structure that maximizes hydrogen bonding between the peptide backbones. The zigzag polypeptide chains can be arranged side by side to form a structure resembling a series of pleats. This arrangement called a β sheet.

Clusters of twisted strands of sheet form the core of many globular proteins

Q. Define Beta Bands.

Beta-bends are short regions usually involving four successive amino acid residues. • They often connect strands of antiparallel betasheets. β-Bends were given this name because they often connect successive strands of antiparallel βsheets

β-Bends reverse the direction of a polypeptide chain, helping it form a compact, globular shape. • The structure is a 180 degree turn involving four amino acid residues

The carbonyl oxygen of the first residue forms a hydrogen bond with the amino-group hydrogen of the fourth residue.

Glycine and Proline residues often occur in β turns • Glycine because it is small and flexible

Q. Define Motif.

A motif also called a super secondary structure is simply a recognizable folding pattern involving two or more elements of secondary structure and the connection(s) between them Structural motifs are intermediate between secondary and tertiary structures

Q. Define Domain and its function

The tertiary structure of large complex proteins is often described in terms of physically independent regions called structural domains

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A domain is a section of protein structure sufficient to perform a particular chemical or physical task such as binding of a substrate or other ligand

Q. What Molecular forces responsible of Tertiary structure of proteins

Molecular forces that stabilise three dimensional tertiary structure include: • Electrostatic Interactions • Hydrophobic interactions • Disulphide bridges • Hydrogen bonding

Q. Define Electrostatic Interaction

It's a force between two opposite charges like attraction between negative ion and positive ion it plays an important role in protein folding

Q. Define Disulfide Bridges

Disulfide Bridges • The amino acid cysteine in a protein can form a covalent disulfide bond with another cysteine molecule through spontaneous (nonenzymatic) oxidation of their sulfhydryl groups

Q. Define hydrogen bonds in protein structure.

Hydrogen bonds • Hydrogen bonds in which a hydrogen atom is shared by a nitrogen (or oxygen) in the peptide backbone and an oxygen atom in an amino acid side chain.

Q. Define Quaternary Structure.

The arrangement of protein subunits in three-dimensional complexes constitutes quaternary structure

Q. Difference btw Multimer and Protomer

A multi subunit protein is also referred to as a multimer, with the prefixes "homo" or "hetero" used to describe identical or different subunits, respectively.

The repeating structural unit in such a multimeric protein is protomer.

Q. What are the Advantage of Sub units in Quaternary Structure?

A multisubunit structure has many advantages besides increased stability.

• It may enable the protein to exhibit cooperativity between subunits in binding ligands (illustrated later with hemoglobin)

Or it may form binding sites with a high affinity for large molecules (illustrated with antigen binding to the immunoglobulin molecule IgG).

An additional advantage of a multi-subunit structure is that the different subunits can have different activities and cooperate in a common function

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For example enzymes that have regulatory subunits or exist as multiprotein complex, such as Pyruvate Dehydrogenase

E1 , pyruvate dehydrogenase; E2, dihydrolipoyl transacetylase; and

E3,dihydrolipoyl dehydrogenase

Q. Define Protein Folding or protein structure.

Protein folding is the process by which a protein structure assumes its functional shape or conformation. It is the physical process by which a polypeptide folds into its characteristic and functional three dimensional structure from random coil

Q. What are the Requirements of Protein to enable its function?

It is the physical process by which a polypeptide folds into its characteristic and functional threedimensional structure from random coil. Moreover, The three dimensional structure must have an external surface appropriate for its environment (e.g., plasma proteins contain polar amino acids on the surface to remain soluble in an aqueous environment

Q. Define Native protein

A protein is called a native protein if its amino acid composition and molecular conformation are unchanged from that found in natural states.

Q. Explain Protein folding

Protein folding in cells takes place in an orderly and guided fashion.

• Protein folding generally occurs via a stepwise process

In the first stage, as the newly synthesized polypeptide emerges from the ribosome, short segments fold into secondary structural units that provide local regions of organized structure Then, each element of secondary or super-secondary structure facilitates proper folding by directing the folding process toward the native conformation and away from unproductive alternatives. This step-wise folding of the proteins is dictated by thermodynamics resulting in a formation of native form, which is also the most energetically favored form.

Q. What is the change in energy? When pressure is constant write is equations.

The free energy change for a process at constant pressure is: • $\Delta G = \Delta H - T\,\Delta S$ • ΔG = Free Energy

• ΔH = Enthalpy

• ΔS= Entropy

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. Define Entropy

Entropy is a measure of the randomness or disorder in a system. Entropy of a system always tend to increase to a maximum value

Difference in energy (free energy) between folded (native) and unfolded (denatured) state is small, 5-15 kcal/mol

Q. on what factors the protein stability is depend on?

The stability of the protein depends on the solvent–solvent, protein–solvent, and protein–protein interactions.

Q. Name factors that influence free energy of protein molecules

• (1) the hydrophobicity, • (2) hydrogen bonds, • (3) electrostatic interactions, and • (4) the conformational entropy due to the restricted motion

Q. Define the second law of thermodynamics

According to Second Law of Thermodynamics: The entropy of a system will tend to increase to a maximum value

Q. Define Kinetic Barriers?

As the protein folds and refolds while it is searching for its native low energy state, it passes through many high-energy conformations that slow the process These high energy conformations are called kinetic barriers

Q. How cells over come to Kinetic Barriers? Or What is chaperones?

Cells employ auxiliary proteins to overcome these kinetic barriers. These auxiliary proteins are called chaperones. • Chaperone use energy provided by ATP hydrolysis to assist in the folding process

Q. Write the function of Chaperones

Chaperones participate in the folding of over half of mammalian proteins. • They prevent immature folding of the nascent polypeptide and help in the final native protein formation.

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. What is HSP70 and HSP60

Hsp70 family of chaperones binds short sequences of hydrophobic amino acids in newly synthesized polypeptides

The hsp60 family of chaperones, sometimes called chaperonins, differs in sequence and structure from hsp70 and its homology.

Hsp60 acts later in the folding process, often together with an hsp70 chaperone

Hsp60 chaperonins form a multi-subunit barrel-shaped structure • The unfolded protein fits into the barrel cavity that excludes water and serves as a template for the folding process

Q. Explain misfolding of proteins. Or How misfolding of proteins occur?

Misfolding of proteins may occur spontaneously

• or caused by a mutation in a particular gene, producing an altered protein

• In addition some apparently normal proteins can, after abnormal proteolytic cleavage, take on a unique conformational state • That leads to the formation of long fibrillar protein assemblies consisting of β pleated sheets

Many conditions, including

Q. Disease caused by misfolding of proteins

• Alzheimer's disease • Type 2 diabetes, • Huntington's disease and • Parkinson's disease, arise from a common misfolding mechanism.

In most cases, a soluble protein that is normally secreted from the cell is secreted in a misfolded state • and converted into an insoluble extracellular amyloid fiber. • The diseases are collectively referred to as amyloidoses.

Q. Define Amyloidosis and explain with examples

Amyloidosis is a generic term that refers to the extracellular tissue deposition of fibrils composed of low molecular weight of a variety of proteins misfolded

immunoglobulin light chain

Examples of organspecific amyloidoses include: • Alzheimer's disease due to deposition of amyloid-b protein cleaved from amyloid precursor protein (APP).

Alzheimer's is a type of dementia that causes problems with memory, thinking and behavior.

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Islet amyloid polypeptide (IAPP) is commonly seen in diabetes mellitus type 2 and is caused by deposition of amylin in pancreatic islets.

Q. Define protein denaturation.

A loss of three dimensional structures sufficient to cause loss of function is called denaturation.

Q. Define Denaturing Agent.

Denaturing agents can disrupt the tertiary and secondary structure of a protein and destroy the protein' biological function

Q. How change in pH cause the Denaturation of protein?

Extremes of pH alter the net charge on the protein, causing disruption of electrostatic interactions • And the disruption of some hydrogen bonding

Q. Give examples of Denaturation of Protein from daily life.

When milk curdles, the acidity increases. • Thermal denaturation by cooking. • Mechanical denaturation when whisking an egg. • Perming hair breaks then reforms the disulphide bonds.

A classic example of denaturing in proteins comes from egg whites

Q. Define the process called Renaturation of Proteins.

Regain their native structure and their biological activity if returned to conditions in which the native conformation is stable this process is called renaturation.

A classic example is the denaturation and renaturation of ribonuclease A

Q side chain importance of alanine, valine and leucine

The Alanine side chain is very non-reactive, and is thus rarely directly involved in protein function. However it can play a role in substrate recognition or specificity, particularly in interactions with other non-reactive atoms such as carbon.

valine consist of a neutral side chain; hence it can show three possible structures in different mediums. In acidic medium, it exists as positive ion and in basic medium as a negative ion. One structure is overall neutral and contains two opposite charges called as **zwitterio**

Leucine is a branched-chain amino acid (BCAA) since it possesses an aliphatic side-chain that is non-linear.

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Q. Give an example of a protein that refolds.

Purified ribonuclease A denatures completely in a concentrated urea solution in the presence of a reducing agent. When the urea and the reducing agent are removed, the randomly coiled, denatured ribonuclease spontaneously refolds into its correct tertiary structure, restoring its catalytic activity.

Q. Define Ligand

A molecule bound reversibly by a protein is called a ligand. • A ligand may be any kind of molecule, including another protein

Examples

- in oxygen transport oxygen is the ligand that binds with hemoglobin,
- antigen is the ligand which binds with the antibody,
- hormone which binds with the receptor

ligand is able to bind to proteins by weak interactions such as ionic bonds, hydrogen bonds, Van der Waals interactions, and hydrophobic effects

A ligand binds at a site on the protein called the binding site, which is complementary to the ligand in – size, – shape, – charge, – hydrophobicity

The structural adaptation that occurs between protein and ligand is called induced fit.

Q. writes the importance of reversible binding

Reversible binding of ligands is essential for the function of gloubular proteins – Specificity of ligands and binding sites – Ligand binding is often coupled to conformational changes, sometimes quite dramatic (Induced Fit)

In multisubunit proteins, conformational changes in one subunit can affect the others (Cooperativity) – Interactions can be regulated 2. Illustrated by: – Hemoglobin, antibodies, and muscle contraction.

Q. Difference between Myoglobin and Hemoglobin

Myoglobin is composed of a single polypeptide chain that has one O2 binding site. • Hemoglobin is a tetramer in which each subunit has a strong sequence homology to myoglobin and contains an O2 binding site. Hemoglobin is a tetramer composed of two different types of subunits (2α and 2β polypeptide chains, referred to as two αβ protomers.

Q. Write the Role of Hemoglobin in our body.

The tertiary structure of oxygen binding globins consists of; • Eight α-helices. • The helices create a hydrophobic O2 binding pocket containing; • tightly bound heme with an iron atom Ferrous (Fe2+) in its center. This iron bound heme is an example of prosthetic group.

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Q. Define Prosthetic group.

A prosthetic group is a compound permanently associated with a protein and contributes to the protein's function

The prosthetic group may be organic (vitamin, sugar, or lipid) or inorganic (like metal ion),

Q. Explain Heme and Its structure.

Heme consists of a complex organic ring structure, protoporphyrin IX, to which is bound a single iron atom in its ferrous (Fe2+) state. The iron atom has six bonds, • four to nitrogen atoms that are part of the flat porphyrin ring system • and two perpendicular to the porphyrin. Negatively charged propionate groups on the porphyrin ring interact with; • Arginine and • Histidine side chains from the hemoglobin. The hydrophobic; • methyl and • vinyl groups • interact with hydrophobic amino acid side chains from hemoglobin.

Iron in the Fe2+ state binds oxygen reversibly • But in the Fe3+ (Ferric) state it does not bind oxygen

Q. What prevent the Fe2+ into Fe3+

The coordinated nitrogen atoms (which have an electrondonating character) help in preventing the conversion of the heme iron to the ferric (Fe3+) state

Q. How many electrons can Iron donate?

Iron is a transition metal & because its orbitals are so close energy wise they tend to give up either 2 or 3 electrons at time

About 78% of the amino acid residues in the myoglobin are found in α helices with bends in between.

Histidine is a generally considered to be a polar amino acid

Q. How Heme is linked with Myoglobin and hemoglobin?

In myoglobin and hemoglobin, heme is covalently linked with histidine F8(eighth residue of F helix), because of covalent bond this histidine is closer to heme

Q. Explain the structure and Function of Hemoglobin

Hemoglobin is found exclusively in red blood cells, where its main function is to transport oxygen from the lungs to the capillaries of the tissues.

Hemoglobin A, the major hemoglobin in adults, is composed of four polypeptide chains – Two alpha (α) chains – Two beta (β) chains

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Which can be seen as a protein of two identical dimers (αβ)1 and (αβ)2 • The two polypeptide chains within each dimer are held tightly together, primarily by hydrophobic interactions

Inter-chain hydrophobic interactions form strong associations between α-subunits and β-subunits in the dimers

Ionic and hydrogen bonds also occur between the members of the dimer • In contrast, the two dimers are able to move with respect to each other, being held together primarily by polar bonds However, the tetrameric hemoglobin molecule is structurally and functionally more complex than myoglobin

hemoglobin can transport CO2 from the tissues to the lungs, and carry four molecules of O2 from the lungs to the cells of the body

In infants, made up of 2 alpha chains and 2 gamma chains. HbA2: (alpha2delta2)

Q. Define Cooperative binding of oxygen

Cooperative binding of oxygen means that the binding of oxygen to one heme group enables an oxygen binding to the second heme group of the same hemoglobin molecule

T= Taut: low oxygen affinity; R=Relaxed: high oxygen affinity

Reversible binding

In the T subunits, the binding sites are hindered • And in the R state the binding sites are open

Q. Comparison of oxygen binding to myoglobin and hemoglobin

Myoglobin can bind only one molecule of oxygen. • Because it contains only one heme group	hemoglobin can bind four oxygen molecules-one at each of its four heme groups
myoglobin has a higher oxygen affinity	Hemoglobin has low oxygen Affinity
P50 is approximately 1 mm Hg for myoglobin	26.6mm Hg for hemoglobin

1 torr= 1mmHg

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Q. What is called P50

The partial pressure of oxygen needed to achieve half-saturation of the binding sites is called (P50). Myoglobin can load oxygen readily at the pO2 of the lung capillary bed (100 mm Hg)

Sigmoidal or sigmoid, literally means S-shaped

The net effect is that the affinity of hemoglobin for the last oxygen bound is approximately 300 times greater than its affinity for the first oxygen bound

Q. what are the Allosteric effects? OR What do you know about Allosteric Amino Acids

Apart from Oxygen, ability of hemoglobin to reversibly bind oxygen is affected by – the pH of the environment – the pCO2 ; and – the availability of 2,3bisphosphophoglycerate

In Greek, Allo means other and Steric means Site.

The binding of oxygen to myoglobin is not influenced by the allosteric effectors of hemoglobin

Q. What is the function of Hemoglobin except O2 transferring?

In addition to transporting O2 from the lungs to the peripheral tissues, • hemoglobin transports CO2, the by product of respiration, • And protons from peripheral tissues to the lungs

Hemoglobin carries CO2 as carbamates formed with the amino terminal nitrogens of the polypeptide chains

Carbamates change the charge on amino terminals from positive to negative, favoring ionic interaction formation between the α and β chains • Hence, favoring the

Stabilization of taut form of deoxyhemoglobin

Hemoglobin carbamates account for about 15% of the CO2 in venous blood

The remainder of the CO2 is transported as dissolved • HCO3- (80 to 85%) and • dissolved CO2 (<5%)

Q. what are the modes of CO2 Transport?

Modes of CO2 transport

1: Dissolved CO2; 2: Dissolved bicarbonate 3: carbamate form

Q. how bicarbonate is formed? Write name of its enzyme

Bicarbonate is formed in erythrocytes by the hydration of CO2 to carbonic acid (H2CO3) • This process is catalyzed by carbonic anhydrase

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Q. At the pH of venous blood, H2CO3 dissociates into;

• Bicarbonate and • a proton

Deoxyhemoglobin binds one proton for every two O2 molecules released, contributing significantly to the buffering capacity of blood

Q. What is called Bohr Effect

Oxygen and H+ are not bound at the same sites in hemoglobin. • However binding of proton, helps stabilize deoxyhemoglobin in the T state. This reciprocal coupling of proton and O2 binding is termed the Bohr effect

Hemoglobin transports about 40% of the total H+ • And 15% to 20% of the CO2 formed in the tissues to the lungs and the kidneys.

Q Define the Term Affinity and how does it change.

The term "affinity" is used to describe oxygen's attraction to hemoglobin binding sites. Affinity changes with: – variation in pH, – temperature, – CO2 and, – 2,3,-BPG

Traditionally the curve starts with: – pH at 7.4, – temperature at 37 Centigrade, and – PaO2 at 40. • Changes from these values are called "shifts"

Q. what results deprotonation of HC3

• The increase in pH, • exhalation of CO2 • and oxygenation of Hb; • all result in; deprotonation of His HC3 of Hb.

The differential pH gradient (lungs having a higher pH, tissues a lower pH) favors the unloading of oxygen in the peripheral tissues, • And the loading of oxygen in the lung

Q. Difference between Positive Cooperativity and Negative allostery.

Binding of oxygen to facilitate other molecule of oxygen is called positive cooperativity.

Whereas, binding of carbon dioxide and proton to release oxygen is called negative allostery, in which; increased CO2 and H+ ion favor oxygen unloading

Q. Define the function of BPG

bisphosphoglycerate • The interaction of 2,3 bisphosphoglycerate (BPG) with hemoglobin further refines the function of hemoglobin. • 2, 3 BPG is an alternate product of glycolysis and its concentration increases in RBCs in states of low oxygen delivery to the tissues. • It is a negatively charged molecule which increases the stability of taut form of hemoglobin

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BIO-202 Biochemistry MCQS and Notes (MID Term)

Q. at sea level the binding of oxygen percentage will be?

At sea level, the binding of oxygen to hemoglobin is regulated such that the amount of oxygen delivered to the tissues is nearly 40% of the maximum that could be carried by the blood.

Q. Which place the BPG binds to Hb

The site of BPG binding to Hb is the cavity between the beta subunits This cavity is lined with positively charged amino acid residues that interact with the negatively charged groups of BPG

Q. Explain the disease Sickle cell Anemia? How does it occurs

Sickle Cell Anemia is a molecular disease of hemoglobin. • It demonstrates the importance of amino acid sequence in hierarchical structure of globular proteins, and thus their biological functions Sickle cell anemia is a genetic disorder caused by a single nucleotide alteration (a point mutation) in the β-globin gene. • This results in the production of altered hemoglobin. The point mutation in the DNA sequence result in the replacement of; • Glutamate residue with Valine residue • At position 6 of the β chain of hemoglobin. Sickle-cell anemia occurs in individuals who inherit the allele for sickle-cell hemoglobin from both parents. • The resulting hemoglobin α2βs2, is referred to as HbS. The RBCs of these individuals are fewer and also abnormal. • In addition to an unusually large number of immature cells, the blood contains many long, thin, sickle shaped RBCs

Q. What is called sickle cell trait?

Individuals who receive the HbS allele from only one parent (i.e. heterozygous) experience a milder condition called sickle-cell tra

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