

Amino Acids



Protein





DEFINITION OF AMINO ACID

T

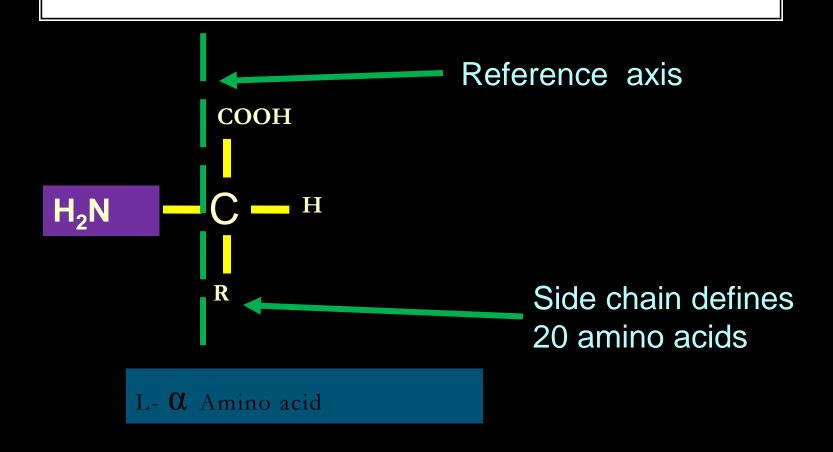
Contains N in addition to C, H, O

Contains at least two functional groups -COOH and -NH₂ attached to ALPHA -C atom

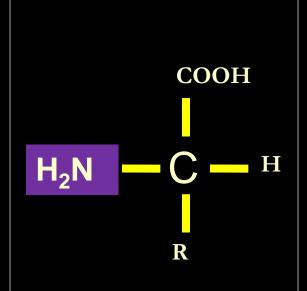
They are building blocks of proteins

Essential for life

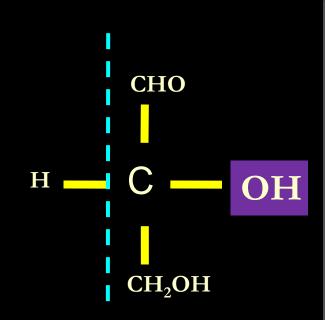
GENERAL STRUCTURE OF A - AMINO ACID



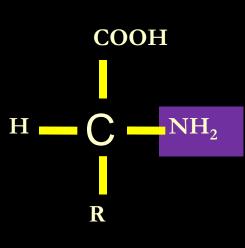
STRUCTURE OF A - AMINO ACID WHAT IS D & L FORM



L- Amino acid



D- Glyceraldehyde



D- Amino acid

TYPES OF AMINO ACIDS

- α Amino acids
 - β Amino acids
 - y -- Amino acids
- L Amino acids -
- D Amino acids -

FUNCTIONS OF AMINO ACIDS

Components of peptides

components of lipids

precursors of NT or

hormones

Glucogenic

Nitrogen base synthesis

FUNCTIONS OF AMINO ACIDS

intermediate of

metabolic reactions

active site

- 8. buffers
 - 9. Transport

10. Detoxification agents

VARIOUS WAYS OF CLASSIFICATION

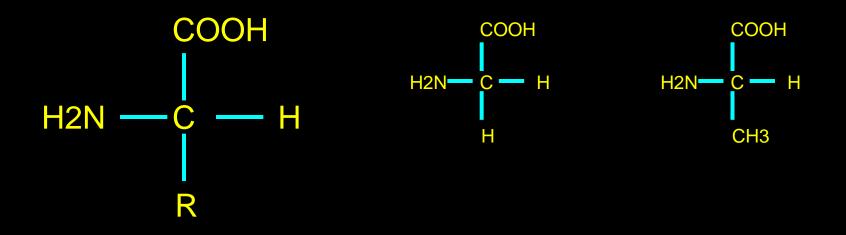
Based on their presence in protein

Based on R Group (side chain)

Based on Nutritional value

Based on metabolic fate

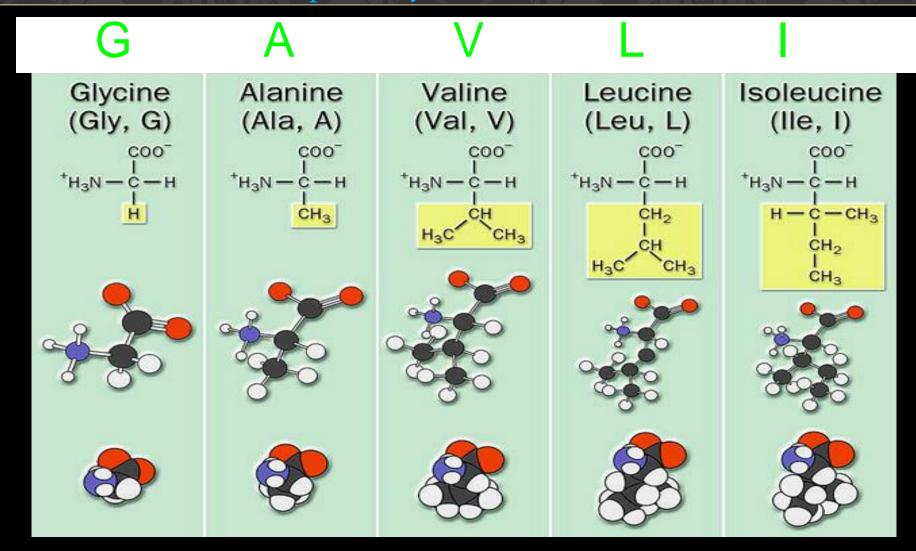
CLASSIFICATION BASED ON R GROUP (SIDE CHAIN)



BASED ON R GROUP / SIDE CHAIN

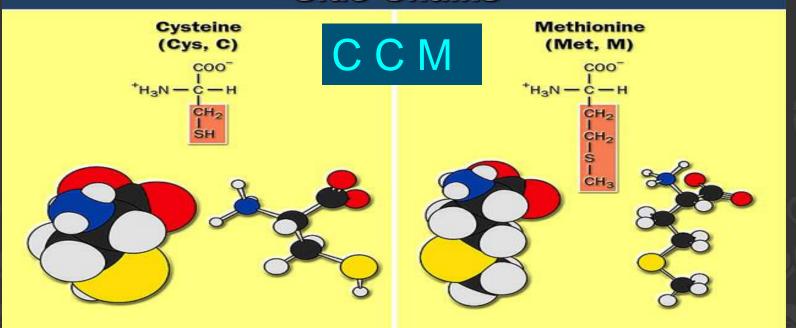
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A = Aliphatic amino acids
    S = Sulphur containing amino acids
H = Hydroxyl group containing amino acid
         A = Aromatic amino acids
A
           B = Basic amino acids
\mathbf{B}
          A = Acidic amino acids
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Aliphatic amino acids Contains open hydrocarbon side chain



Sulfur containing amino acids Contains sulfur atom in their side chain

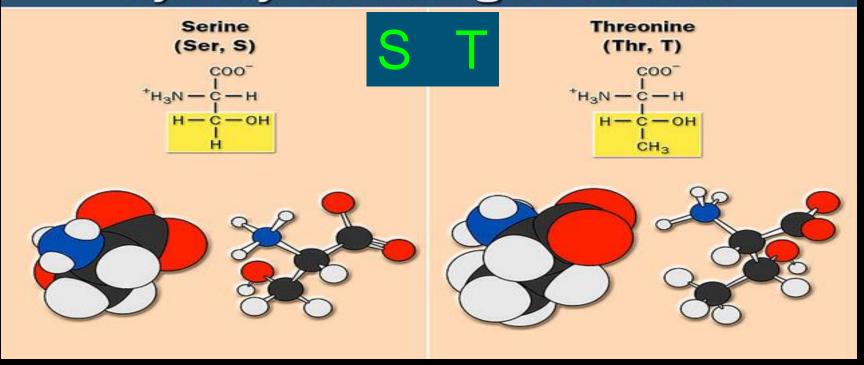
Amino Acids with Sulfur-containing Side Chains



Hydroxyl group containing amino acids:

Contains hydroxyl / alcohol group in side chain

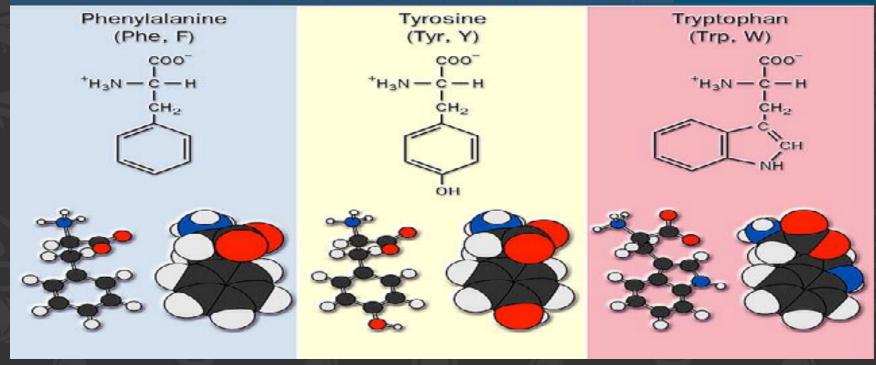
Amino Acids with Hydroxyl-containing Side Chains



Aromatic amino acids Contains closed ring hydrocarbon / Phenyl ring as side chain

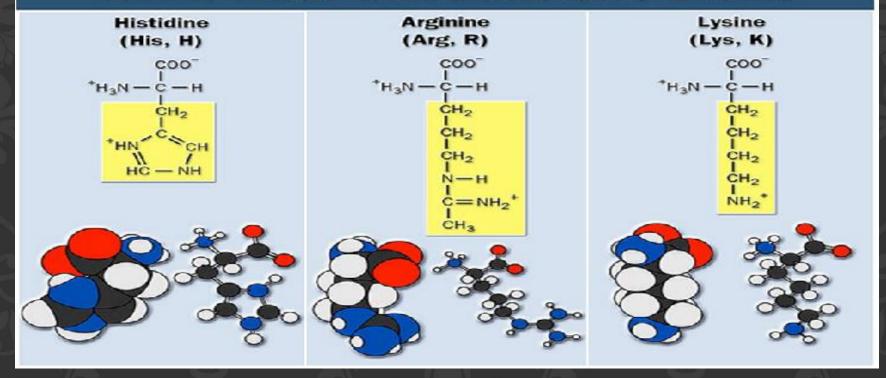
Aromatic Amino Acids





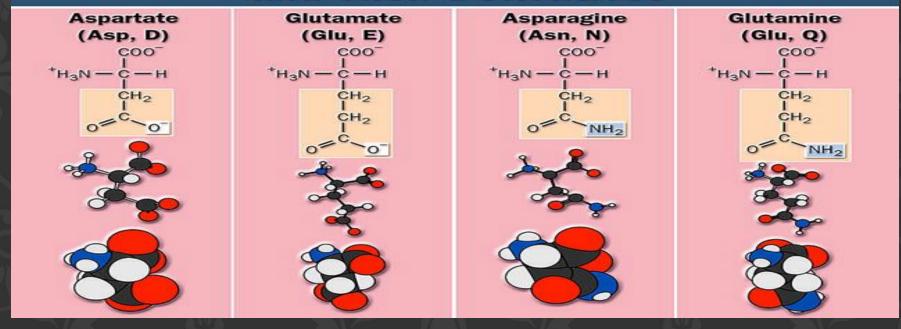
Basic amino acids Contains more than 1 NH₂ groups in side chain --- H A L

Amino Acids with Basic Side Chains



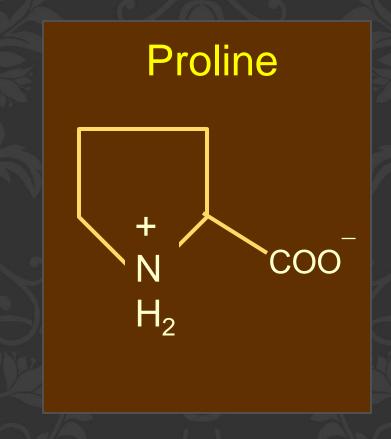
Acidic amino acids Contains COOH group OR their amides in their side chain--- A G A G

Amino Acids with Acidic Side Chains and Their Derivatives



Imino acids

Contains secondary amino group in the molecule



Aliphatic — A

Sulphur containing

Hydoxyl group

Acidic

Basic

Aromatic

Imino

CLASS 2 **CLASSIFICATION OF AMINO ACIDS CONTINUE...**

BASED ON THEIR PRESENCE IN PROTEIN MOLECULE

BASED ON THEIR PRESENCE IN PROTEIN & DNA CODE AVAILABILITY

PROTEINOGENIC amino acids

Also called as STANDARD amino acids

NON PROTEINOGENIC

amino acids

Also called as METABOLIC amino acids

PROTEINOGENIC amino acids

The amino acids that are included in the genetic

Code are described as "PROTEINOGENIC."

These amino acids can be incorporated

into proteins through translation.

EX. Glycine, Alanine, Valine, Leucine, Isoleucine, serine, Threonine,

Methionine, Cysteine, Aspartic acid, Glutamic acid, Histidine, Arginine, Lysine

NON- PROTEINOGENIC amino acids

Amino acids arise during

- A. metabolic reactions Ornithine, citruline, taurine
- B. As result of enzymatic modifications of amino acid residues in peptides or proteins Cystine, Hydroxyproline
- C. The "biogenic amines" synthesized from α- amino acids by decarboxylation.

They don't have genetic Code

BASED ON NUTRITIONAL REQUIREMENT

CLASSIFICATION BASED ON NUTRITIONAL VALUE

Essential amino acids or non-dispensable amino acids

Non-Essential amino acids or Dispensable amino acids

MATT VIL PHLY

NON ESSENTIAL AMINO ACIDS

They are required by the body

Can be synthesized in the body

Not required to be supplemented through diet

- A Alanine
- A Asparagine
- A Aspartate
- C Cysteine
- **G** Glutamate
- **G** Glutamine
- **G** Glycine
- P Proline
- S Serine
- **T** Tyrosine

ESSENTIAL AMINO ACIDS

- Methionine \mathbf{M}
- Arginine
- Threonoine
- Tryptophan
- Valine
- Isoleucine
- Leucine
- Phenylalanine Histidine H Ly Lysine

Must be

ESSENTIAL AMINO ACIDS

Absolute essential

Not at all synthesized in the body 100% supply through diet

Semi essential

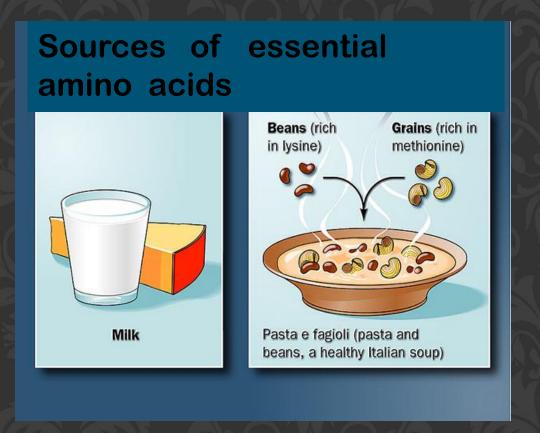
Small quantity synthesized in body

Not sufficient to meet the metabolic need

Partly supplied through diet

Ex Histidine Arginine

Complete proteins
Milk casein,
egg albumin,
animal proteins
contains all EAA



Cysteine spare Methionine and Tyrosine spare phenylalanine

In PKU Tyrosine becomes essential amino acid.



Blend diet





WHY EAA ARE REQUIRED?

proper growth

nitrogen balance

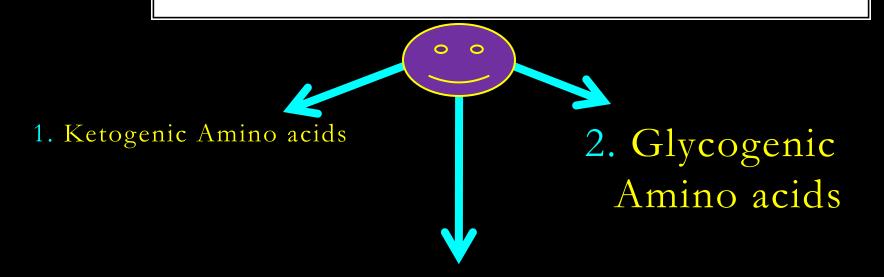
To synthesize

new protein

quality protein

PEM

CLASSIFICATION BASED ON METABOLIC FATE



3. Ketogenic and Glycogenic amino acids

KETOGENIC AMINO ACIDS

Leucine, Lysine

GLYCOGENIC AMINO ACIDS

Glycine, Alanine, Threonine, Cysteine, Valine, Methionine,
Aspartate, Glutamiate

GLYCOGENIC AND KETOGENIC AMINO ACIDS

acetoacetate,

Acetyl CoA,

fumarate

pyruvate

propionate

Phe, Tyr, Trypto

Isoleucine

Phe & Tyr

Tryptoaphane

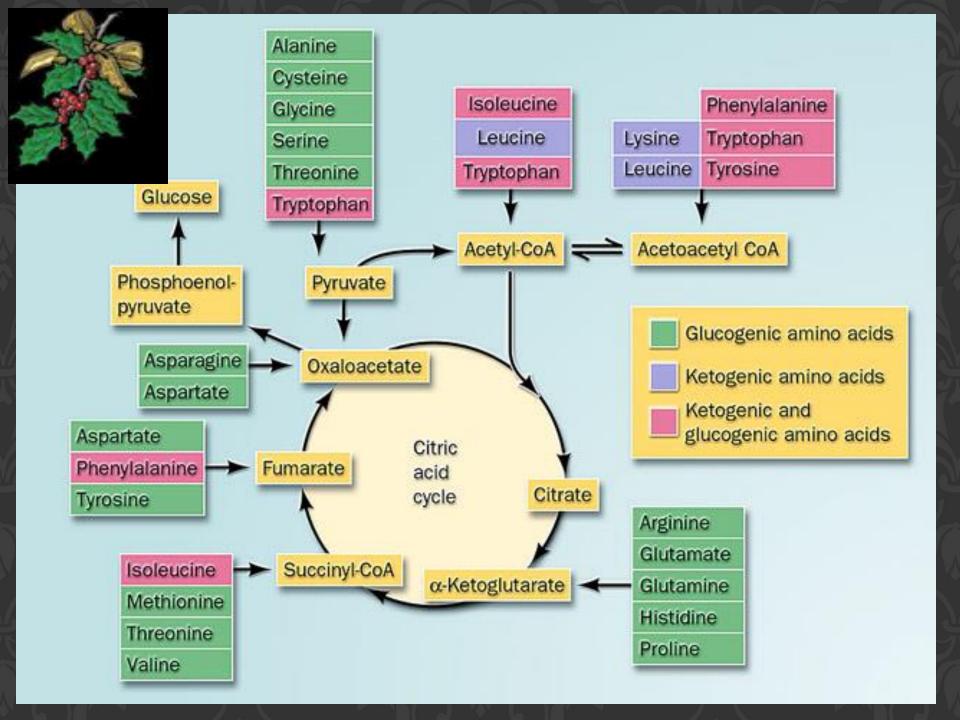
Isoleucine

Phenylalanine

Tyrosine

Tryptophan

Isoleucine



VARIOUS WAYS OF CLASSIFICATION

Based on their presence in protein

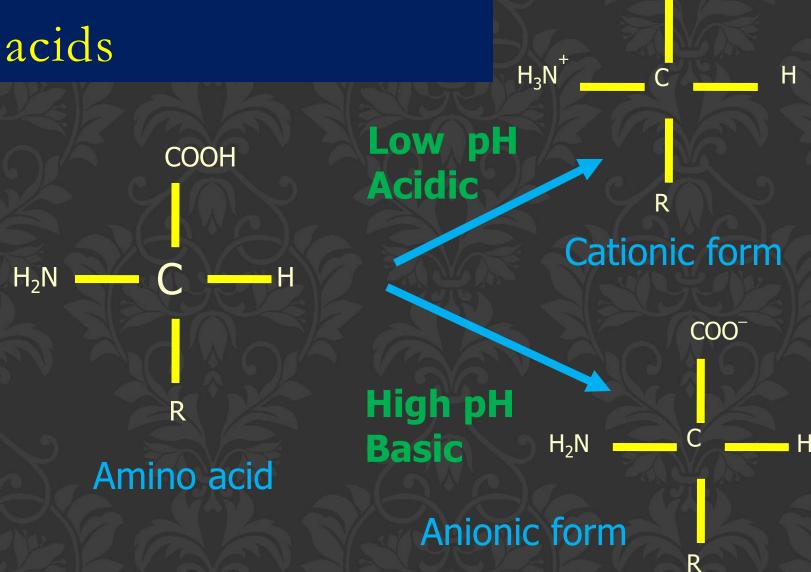
Based on R Group (side chain)

Based on Nutritional value

Based on metabolic fate

Class 3 Reactions amino acids

Ionization of amino



COOH

What is Zwitter ion?

What is Amphoteric molecule?

What is Isoelectric pH?

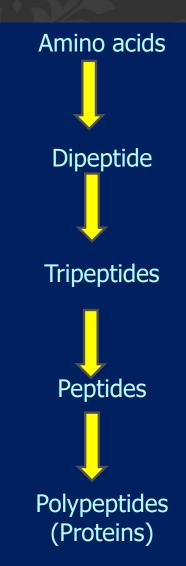


Peptide bond

PEPTIDE BONDS

Different types of amino acids undergo polymerization by peptide bond formation

Peptide bonds are important part of protein structure. If they are broken or hydrolyzed it degrade protein



H H H₂N COOH H · OH FORMA' R R НО Н ◆ Η Η IICOOH H_2N R R

PEPTIDES

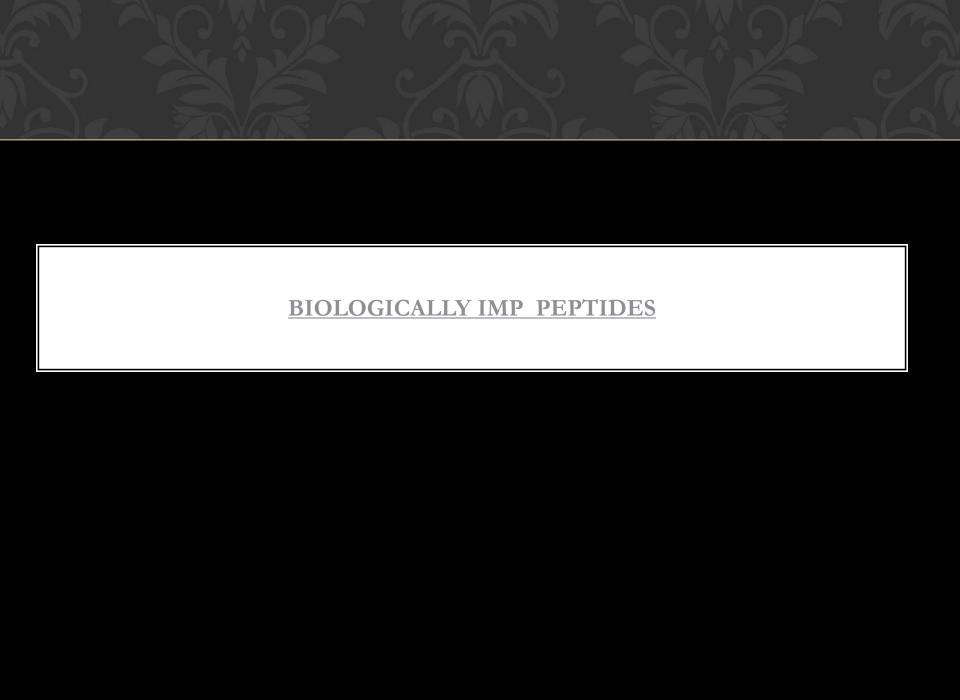
Composed of small number of amino acids

Linkage is peptide bonds

Synthesized in body

Have specific function

Digestion of protein also leads



EXAMPLES AND BIOMEDICAL IMPORTANCE

Hormone: Insulin, glucagon, Vasopressin, Oxytocin

Antioxidant: Glutathione

Antibiotics: Gramicidin S

Anti-tumor drug: Bleomycin

Sweetening agent: Aspartame

BIOLOGICALLY IMP PEPTIDES

<u>Glutathione</u>

Tripeptide: Glutamic acid, Cysteine and Glycine

Reduced form as GSH

Oxidised form as GS-SG

Characterised by Gama peptide bonds,

not digested by peptidase

Found in all cell except nerve cell

Biological antioxidant, Amino acid absorption

BIOLOGICALLY IMP PEPTIDES Glutathione

Functions:

- 1. Coenzyme in oxidation reduction reaction
 - 2. Maintains Red Cell Membrane integrity
 - 3. Protects HB against Oxidation
 - 4. Free radical and peroxide scavanging
 - 5. Detoxication

Hemolytic anemia due to G6PD deficiency

INSULIN

from β cell of pancreas

Contains 30 + 21 amino acids

Hypoglycemic Hormone

Glucagon

- from α cell of pancreas
- Contains 29 amino acids
- Hyper glycemic hormone

ANGIOTENSIN

Angles

Angiotensinogen to angiotensin I by Renin (10 AAs)

Angiotensin I to II by ACE (Angiotensin converting enzyme)

Angiotensin II active form Have 8 AAs

Vaso-constructor increase arterial pressure

Increase synthesis of Aldosteron -Na+ retention

ACE inhibitors used as antihypertensive & CCF

OXYTOCIN

Hormone of posterior pituitary
Contains 9 amino acids
Stimulates contraction of uterus

Vasopressin (ADH)

- Hormone secreted by posterior pituitary
- Contains 9 amino acids
- Decreases GFR and retains body water
- Increases Blood pressure

CORTICOTROPIN

Hormone of Anterior pituitary
Contains 39 amino acids
Stimulates adrenal cortex for secretion of steroid hormones

TRH

- Hypothalamic hormone
- Contains 3 amino acids
- Stimulates release of thyrotropin from anterior pituitary

GASTRIN

Local hormone from Stomach Stimulates production of gastric juice

Secretin

- G I Peptide
- Stimulates secretion of pancreatic juice

BRADYKININ

Contains 9 amino acids

Formed in blood

Power full vasodilator

Causes contraction of smooth muscles

Stimulates pain receptors

Enkephalins

- Peptide formed in CNS
- Binds to certain receptors in brain and induces analgesia (Killing pain sensation)

KALLIDIN

Contains 10 amino acids

Power full vasodilator

<u>Aspartame</u>

- Di-peptide,
- Neutra sweet, artificial sweetener
- L aspartyl phenylalanyl methyl ester
- Not suitable for phenylketourics.

IMPORTANT REACTIONS OF AMINO ACIDS

DEAMINATION

Removal of amino group from amino acid by enzyme to forms keto acid

Deamination: 1. Oxidative deamination

2. Non oxidative deamination

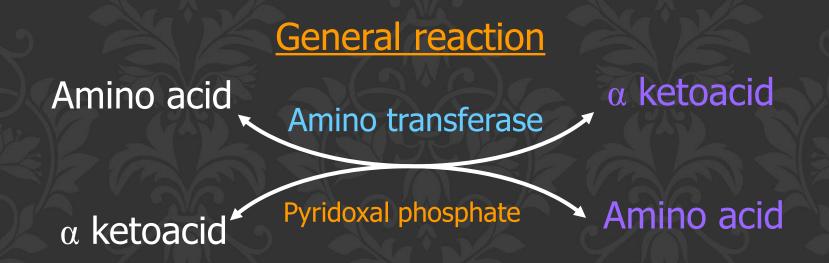
Glutamate $\begin{array}{c} \text{Amino acid deaminase} \\ \alpha \text{ keto glutarate} \\ \text{NH}_2 \end{array}$

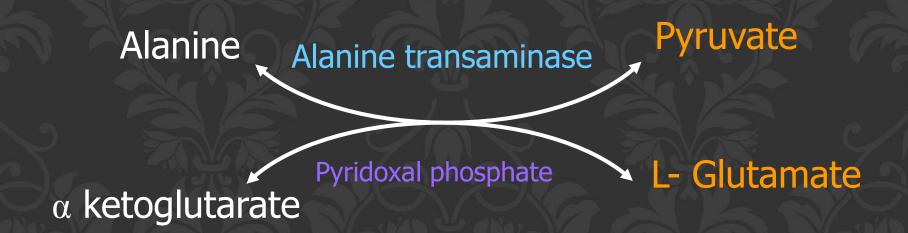
TRANSAMINATION

- Transfer of amino group of one amino acid to a keto acid
- Result in formation of new amino acid and a keto acid
 - □Enzymes: Transaminase or

Amino transferase

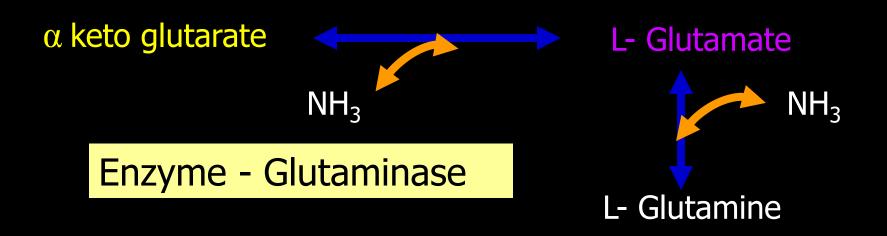
- □Coenzymes : Pyridoxal phosphate
- □Advantage: Non essential amino acid synthesis
 - □Interconversion of amino acids





REACTION WITH AMMONIA

Acidic amino acids reacts with NH_3 to form amide. They are part of protein structure Serve as source of Nitrogen



DESULPHURATION

Sulphur containing ammo acid during their catabolism oxidises sulph-hydryl group to form keto acid.

COOH Desulphurase
$$COOH$$
 $COOH$ COO

DECARBOXYLATION

Removal of coo group to form amines

Enzymes: Amino acid decarboxylase

Coenzyme: Pyridoxal phosphate

Glutamate		GABA
		Neurotransmitter
Histidine	Decarboxylase	Histamine
	PLP	Effect on BP, Allergic cond
	CO_2	
Tyrosine		Tyramine
		Contracts uterus
Tryptophan		Tryptamine
		Serotonin, NT

COLOUR REACTIONS OF AMINO ACIDS

Biuret reaction	Peptide bonds
Ninhydrine reaction	Free amino groups
Xanthoproteic reaction	Aromatic amino acids
Millon's reaction	Tyrosine
Hopkins – cole reaction	Tryptophan – indole ring
Sakaguchi's reaction	Arginine – guanidino group
Nitroprusside reaction	Free SH group
Pauly's reaction	Histidine – imidazole group
Lead acetate reaction	SH group

BIOLOGICALLY IMPORTANT COMPOUNDS FROM AMINO ACIDS

Glycine	Heme, Purine base, Bile salt, Glutathione
Aspartic and Glutamic acid	Purine, pyrimidine bases
Tyrosine	Thyroxine, Adrenaline, Melaniine, Tryptamine
Tryptophane	Niacin, Serotonin
Arginine, Methionine, Glycine	Creatine

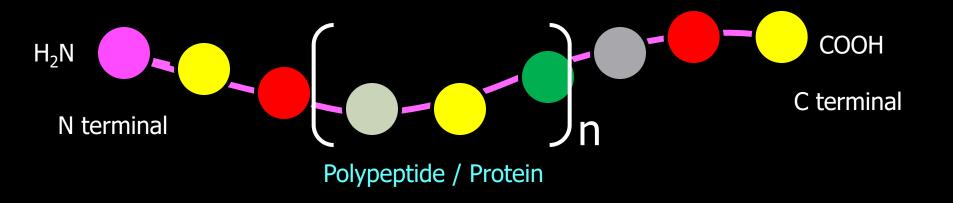
- 1. Describe biomedical significance of five biologically active peptides.
- 2. List two examples of dipeptide and their biomedical importance.
- 3. List amino acids present in glutathione. Write its significance.
- 4. What is ADH? Write its function.
- 5. Define Zwiter ion and write its significance.
- 6. Explain amphoteric nature of amino acid.
- 7. List Branched chain and Aromatic amino acids.
- 8. Describe classification of amino acids.

CLASS 4

Classification based on Nutritional Value & Shape of proteins

PROTEINS

Contains C, H,O, N, AND P,S Mixed polymer of amino acids Linked together by peptide bonds



CLASSIFICATION OF PROTEINS

- 1. Based on Functions
- 2. Based on Nutritional value
- 3. Based on Shape & Structure
- 4. Based on Chemical composition

CLASSIFICATION BASED ON

NUTRITIONAL VALUE

Nutritional value is determined by the presecence of essential amino acids

- 1. Complete Proteins 1st class proteins
- 2. Incomplete Proteins
- 3. Partially Incomplete Proteins

CLASSIFICATION BASED ON

NUTRITIONAL VALUE

- Complete Proteins 1st class proteins
- All essential amino acids present in proper proportion
 - Good for health and balanced growth
 - Egg protein, Milk proteins, Fish, meat, cheese

- Incomplete Proteins
- Lack one or more essential amino acids
- Can not support expected growth and health completely
- Proteins from plants and cereals, beans, nut, Gelatin
- Food blend is the solution

PARTIALLY INCOMPLETE PROTEINS

Proteins contains essential amino acids but not enough to meet the metabolic need of organism

EX: Proteins from Wheat, Rice, Corn

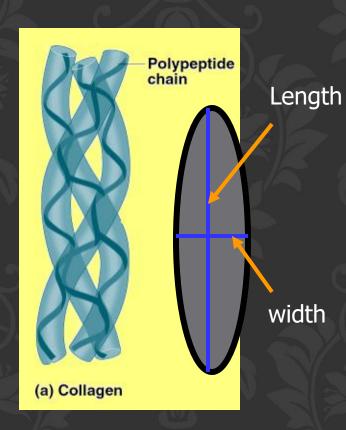
Classification based on Physical Shape and Structure

Over all shape is determined on the basis of AXIAL RATIO
i.e. Length / Width ratio

Classification based on

Physical Shape and Structure

Fibrous Proteins



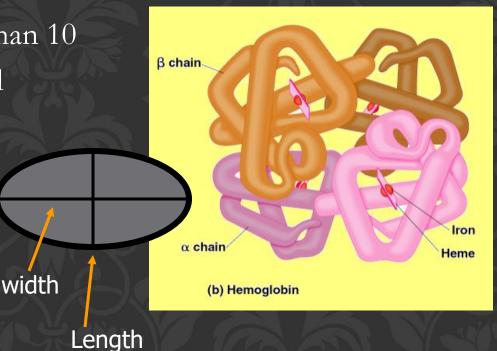
- Fibrous Proteins
- Axial ratio more than 10
- Length: width ratio is more than 10
- Molecules are elongated
- Show helix, H bond, covalent bond
- Play structural role
- Myosin, Actin, Keratin, Fibrin, Collagen,
 Elastin, Tropomyosin

Classification based on

Physical Shape and Structure

- Globular Proteins
- Axial ratio generally 3 or 4
- Length: width ratio is less than 10
- Molecule is Spherical / Oval
- Easily soluble in water,Digestible
- Play dynamic functions
- Albumin, Globulin, Protamines,
- Enzymes

Globular Proteins



Classification based on

Physical Shape and Structure

- Fibrous Proteins
- Play structural role
- Insoluble in water,non -digestible
- Myosin, Actin, Keratin, Fibrin, Collagen, Elastin

- Globular Proteins
- Soluble in water, digestible
- Play dynamic functions
- Albumin, Globulin, Protamines

FUNCTIONS OF FIBROUS PROTEIN

Mechanical function

Provide strength contractile character Provide net work for calcification of bone

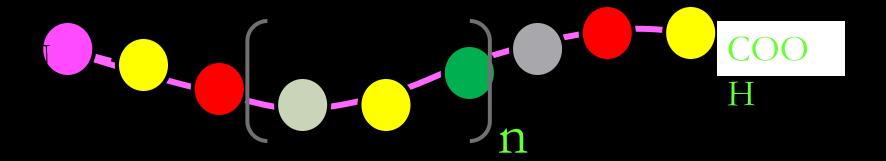
FUNCTIONS OF GLOBULAR PROTEIN

Dynamic proteins

Enzymes
Hormones
Carrier proteins
Nutritive and oncotic pressure

NEXT CLASS FUNCTIONAL CLASSIFICATION OF PROTEIN

PROTEINS



CLASSIFICATION OF

PROTEIN

BASED ON FUNCTION

Hi! Genetic Structure Of cat

Was Contractile

Hence Transported For

Protection, but

Eaten up (Nutritional)



They regulate metabolic pathways by fine tuning

E.g. Insulin, Glucagon, Growth hormone

TMMUNO PROTETN

Immunoglobulins and Antibodies are proteins synthesized against antigen.

They provide immunity and help in defence.

E.g. Immunoglobulins -G,A,M,D,E, Acute phase proteins.

GENETIC

Basic proteins, always found in association with Nucleic acid-DNA.

It provide stability to the DNA structure,

E.g. Nucleoproteins (Histones), Repressor proteins, Inducer proteins, SSBP.

STRUCTURAL

This class of protein provides structural trame work for cell and organs.

E.g. Keratin, Collagen, Actin, Myosin, Elastin, Fibroin,



Class of protein act as catalyst in metabolic reactions and speed up the reaction rate.

E.g. Amylase, Pepsin, Trypsin, Lipase.

CONTRACTIL Class of protein responsible for movement.

E.g. Actin, Myosin, Tubulin, Flegella, cilia.

TRANSPORT PROTEIN

Protein which help in transport of molecules and metabolites inside the cell or across the cell.

E.g. Hemoglobin, Ceruloplasmin, Transferin, Lipoproteins, Albumin, RBP, TBPA,

PROTECTIVE PROTEIN

Some proteins provide protection.

E.g. Fibrinogen, Prothrombin, Receptor proteins,

NUTRITIVE PROTEIN

Some proteins provide good nutrition when consumed in proper amount.

E.g: Casein, Albumin, Lactalbumin, Gliadin, Oricin,

Any Question?

Please read and come....

CLASS 6

Chemical Classification

Proteins

PROTEINS

Contains C, H,O, N, AND P,S Mixed polymer of amino acids Linked together by peptide bonds

Classification based on Chemical composition

CLASSIFICATION BASED ON

CHEMICAL COMPOSITION

Simple proteins

Contains only amino acids

Conjugated proteins

Contains amino acids and non protein part called prosthetic part

Derived proteins

Hydrolysed, degraded or denatured product of simple or conjugated protein

Composed of only amino acids, linked by peptide bonds **Albumins** Histones Globulins **Prolamines** Albuminoids /Scleroprotein **Protamines** Globins **Glutelins**

A

Albumins:

Soluble in water, Heat coagulated, Precipitated at full saturation

EX: Serum Albumin, Ovalbumin, Lactalbumin

G

Globulins:

Soluble in water & in dilute salt solutions Coagulated by heat, Precipitated at half saturation, EX: Serum Globulins, Ovoglobulin, Lactglobulin, Legumin of pea

A

Albuminoids / Scleroproteins:

Insoluble in water, Salt solution, Acid, Alkali Not coagulated by heat, not precipitated EX: Collagen, Keratin, Elastin,

G

Globins:

Soluble in water, dilute acid and alkali Soluble in neutral salt solutions
Not Coagulated by heat, Basic proteins
EX: Globins of Hemoglobin and Myoglobin

Histones:

Basic proteins rich in histidine, Soluble in water, mainly found in association with nucleic acid and gives stability to the genetic material, not coagulated

EX: Histones of nucleoproteins, Thymus

Protamine:

Basic protein, Soluble in water, Dilute alkali and dilute acid, Not Coagulated by heat, Relatively small proteins, rich in Arginine and Lysine, EX: Zinc insulinate, Nucleo-protein of sperm, Salmine

P

Prolamines:

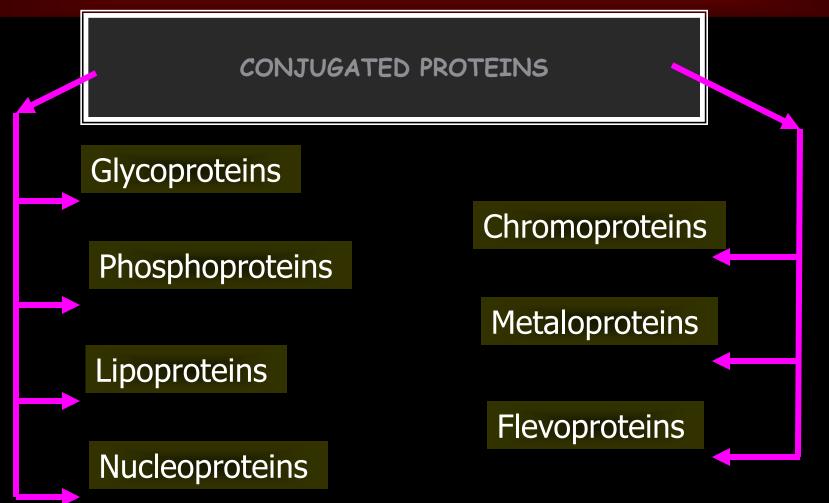
Insoluble in water, soluble in dilute alcohol, Not coagulated by heat EX: Proline rich protein of plants deficient in lysine, Gliadin of wheat, Zein of maize

G

Glutelins:

Insoluble in water, Soluble in salt solutions
Coagulated by heat, Found in plants
EX: Glutelin of wheat, Oryzenin of rice

Proteins linked to non-protein groups called prosthetic groups



-CONJUGATED---PROTEINS

Glycoproteins:

Carbohydrate as prosthetic group EX: Ovomucin, Ovomucoid, mucoprotein, Blood group antigen, receptors on cell membrane

Phosphoproteins:

Phosphate / phosphorus as prosthetic group EX: Casein, Ovo-vitelline

CONJUGATED PROTEINS

Lipoprotein:

Lipid in association of apo-protein

Lipid is prosthetic group

EX: Chylomicrone, VLDL, HDL, Membrane

lipoproteins, milk protein

Nucleoprotein:

Nucleic acid or nucleotide as the prosthetic group

EX: Histones, nucleoprotein of thymus & sperm

CONJUGATED PROTEINS

Chromo-proteins:

Protein in association with coloured prosthetic group, It impart colour to the proteins EX: Hemoglobin, Visual purple,

Metalo-proteins:

Protein in association with metal ions
Metal activates the protein enzymes
EX: Zinc insulinate, Hemoglobin, Myoglobin,
Cytochroome, Carbonic unhydrase, Tyrosinase

CONJUGATED PROTEINS

Flavoproteins:

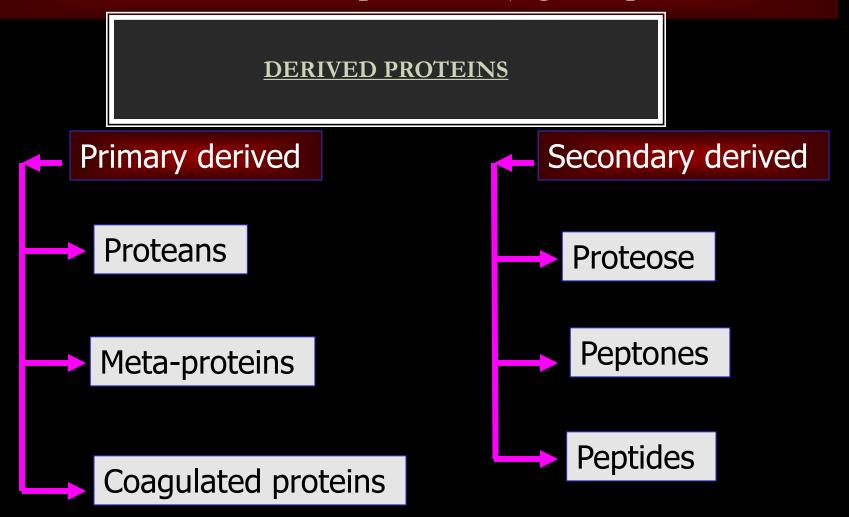
Riboflavin (Vitamin B2) in association with proteins

EX: Riboflavin yellow (yellow enzyme of whey), Flavanoids of liver and kidney

FUNCTIONS OF CONJUGATED PROTEINS

Hemoglobin	Heme	Transport of O ₂ CO ₂
Cytochrome	Heme	Electron transport
Rhodopsin	Retinal	Vision
Casein	Phosphrous	Complete protein, High BVP
Lipoprotein	Lipid	Lipid transport & cell membrane
Ferritin	Iron	Iron storage normal form
Transferrin	Iron	Transport Iron
Ceruloplasmin	Copper	Transport copper, Enzyme

Products obtained by hydrolysis, degradation or denaturation of simple or conjugated proteins



DERIVED PROTEINS

Products obtained by hydrolysis, degradation or denaturation of simple or conjugated proteins

Primary derived

Proteans

Earliest product of protein hydrolysis, Ex. Fibrin of fibrinogen

Meta-proteins

Product formed by concentrated acid or alkali,

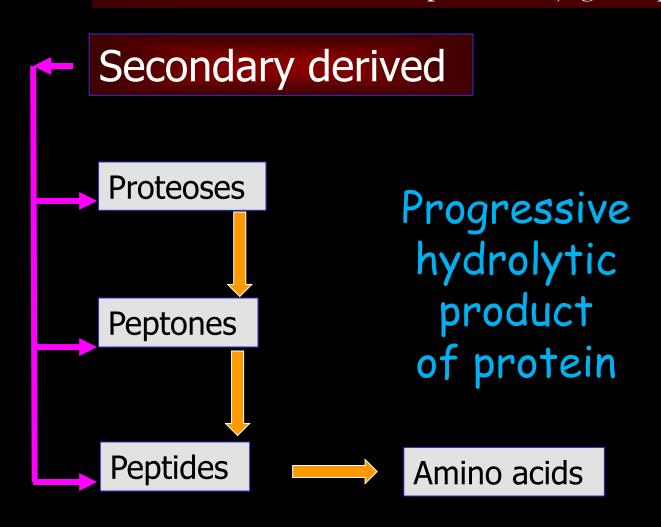
Ex. Paracaseinate, Acid metaprotein

Coagulated proteins

Product of denatured protein, Ex. Coagulated Albumin,

DERIVED PROTEINS

Products obtained by hydrolysis, degradation or denaturation of simple or conjugated proteins



Proteins

Simple

Conjugated

Derived

Albumin

Globulin

Albuminoid

Globin

Histone

Protamine

Prolamine

Glutelin

Glycoproteins

Phosphoproteins

Lipoproteins

Nucleoproteins

Chromo-proteins

Metalo-proteins

Flevo-proteins

Proteans

Meta-proteins

Coagulated proteins

Proteoses

Peptones

Peptides

QUESTIONS

- 1. Define proteins. Write classification of protein based on chemical composition.
 - 2. What is simple protein? Name subclass with examples.
- 3. What is conjugated proteins? Name subclass with examples.
 - 4. What is derived proteins? Name subclass with examples.
- 5. Name any five conjugated proteins and write their functions.
 - 6. Name products of protein hydrolysis.

FAILURE CAN NOT DEFEAT THE MAN WHO IS EAGER TO TRY AGAIN



Why variety of proteins?



- two amino acids
 - dipeptide.
 - many amino acids
 - polypeptide
 - different linear
- sequences variety

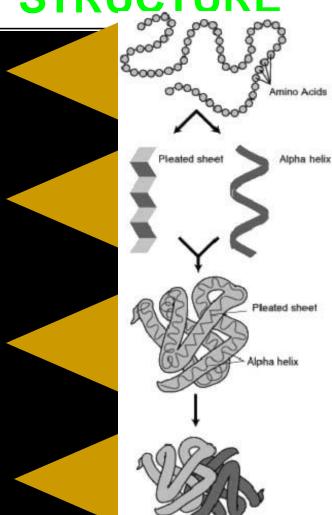


Question is --How are they organised?

ORGANIZATION OF PROTEIN STRUCTURE



FRUCTURE



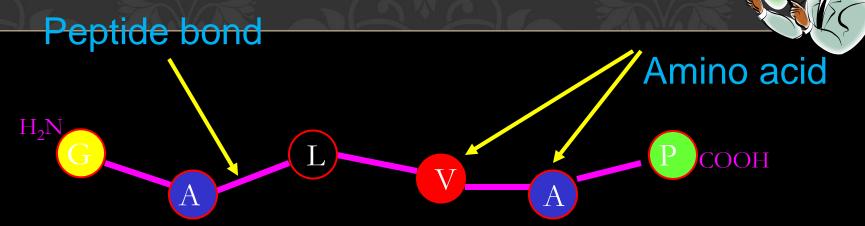
Assembly

Folding

Packing

-Interaction

Primary structure of protein



NH₂ -COOH

needs folding

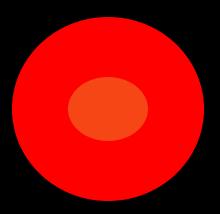
PRIMARY STRUCTURE DEFECT



6th aa is Glu

Replaced by Valine

Sickel cell





PRIMARY STRUCTURE DEFECT



Insulin from different sources Causes antibody and
--

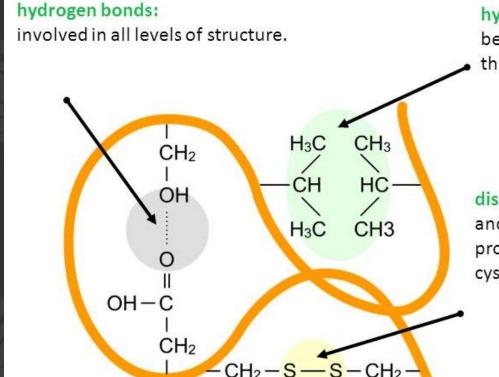
immunological reactions.

	A8	A9	A10	B30
Human	Thr	Ser	Ile	Thr
Pig	Thr	Ser	Ile	Ala
Cow	Ala	Ser	Val	Ala

Poly peptide chain organise itself by folding

to become functional 3D molecule

This folding is stabilized by several types of bond



hydrophobic interactions:

between non-polar sections of the protein.

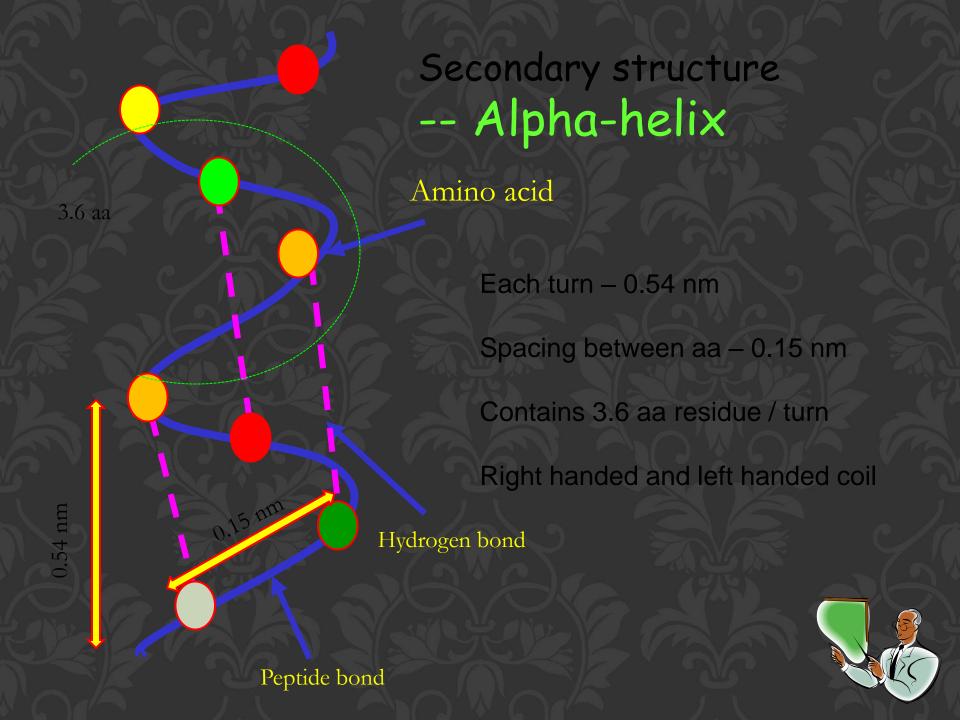
disulfide bonds: one of the strongest and most important type of bond in proteins. Occur between two cysteine amino acids.

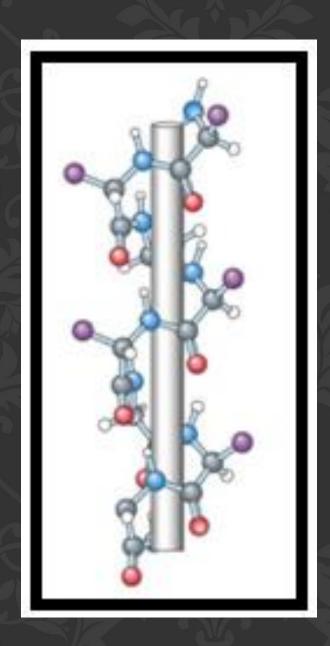


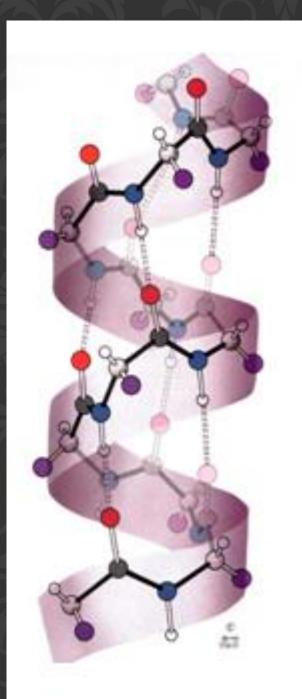
SECONDARY STRUCTURE OF PROTEIN



- 1. The alpha-helix and
- 2. The beta-pleated sheet.



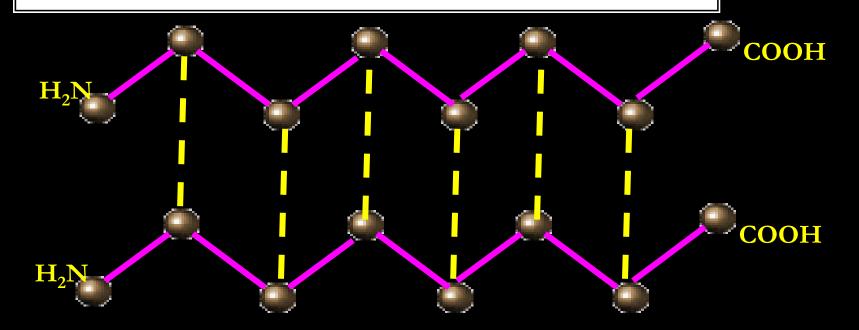






SECONDARY STRUCTURE BETA PLEATED SHEET

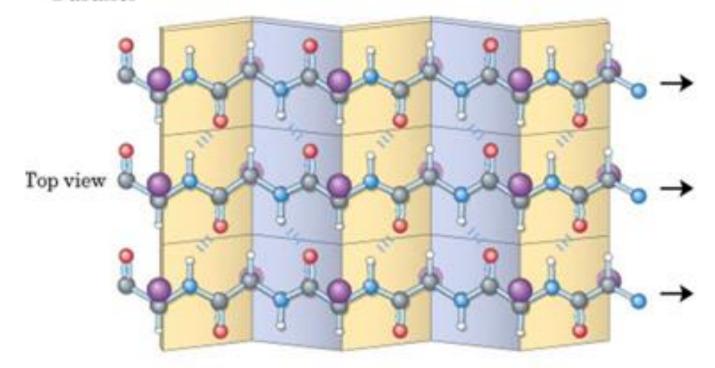




Two peptide chains run parallel Hydrogen bonds Hold shape together Example Silk fibre



Parallel



HYDROGEN BONDS STABILITY OF 2° STRUCTURE

alpha-helices beta pleated

SECONDARY STRUCTURES



A Protein will have both the forms of folding in their molecule

Beta-pleated sheet Random Coil Alpha-Helix The secondary structure is observed in a localised portion of a protein.

Bend or Knick
Glycine or Proline

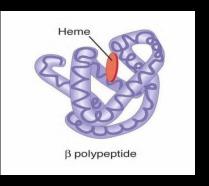
Strength of protein-Spider web can trap small insects, worms and even bird or small animal





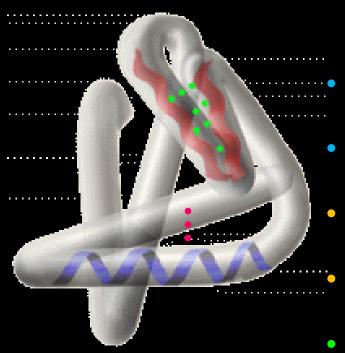
TERTIARY STRUCTURE OF PROTEIN





TERTIARY STRUCTURE

Non-linear, 3 dimensional, Global but



restricted to the amino acid polymer.

Formed and stabilized by

Hydrogen bonding,

Covalent (e.g. disulfide) bonding

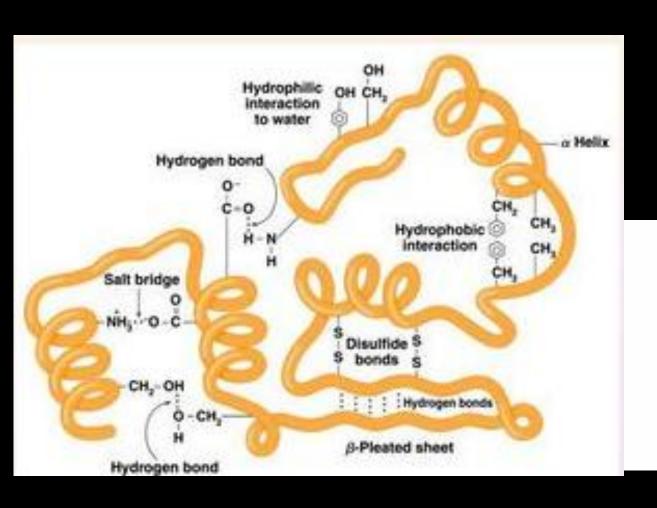
&

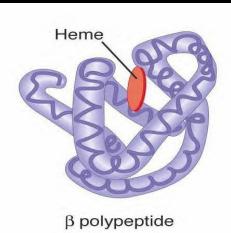
Hydrophilic exposure to solvent



TERTIARY STRUCTURE OF PROTEIN



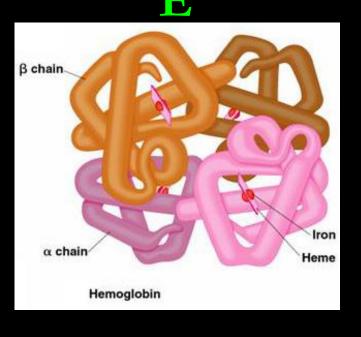




- non-linear, 3 dimensional
- global, and Formed by distinct oligomers

- Stabilized by hydrogen bonding,
- covalent bonding,
- hydrophobic packing and
- hydrophilic exposure
- Thermodynamically favorable,
- functional structures
- occur frequently



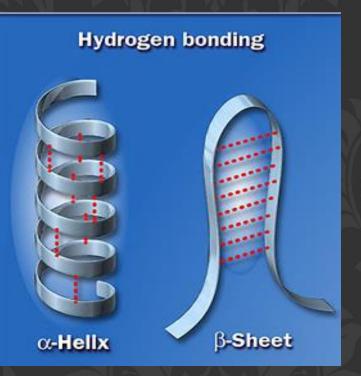


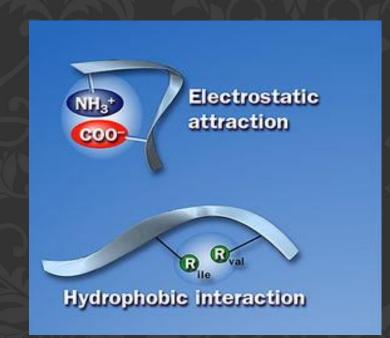


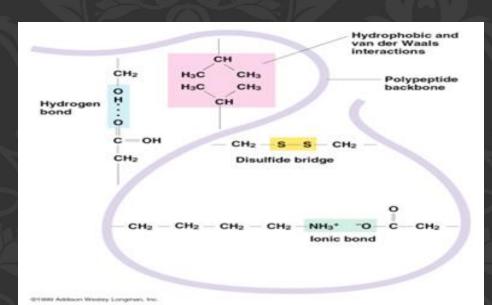
BONDS RESPONSIBLE FOR THE STABILITY OF PROTEIN STRUCTURE.

BONDS RESPONSIBLE FOR THE STABILITY OF PROTEIN STRUCTURE.

- 1. Covalent bonds and
- 2. Non-covalent bonds.









COVALENT BONDS

Peptide bonds:

A

COVALENT BONDS

Disulfide bond:

1] Hydrogen bonds:

Intra or Inter peptide)

Hydrophobic interactions:

Electrostatic bonds or Salt Bridges:

Van der waal's forces:

What happen if bonds other than peptide bonds of protein are broken?

DENATURATION OF PROTEINS
AND
ITS SIGNIFICANCE.

DEFINITION DENATURATION OF PROTEINS:

Disorganisation of secondary, tertiary and quaternary structure of native proteins, without any change in primary structure.

DENATURING AGENTS:

Physical agents:

Heat, UV light, mechanical shaking, Cooling

Chemical Agents:

Acids, Alkali, heavy metal, Organic Solvents and Alkaloids.

DENATURATION OF PROTEINS LEADS TO

- 1. Unfolding of native protein structure
- 2. Rupture of ionic, hydrogen bonds hydrophobic and hydrophilic interactions.
 - 3. Becomes more susceptible to proteolytic enzyme
 - 4. Protein becomes insoluble in solutions.
 - 5. Precipitated or coagulated.
 - 6. Loses of its biological function and property.

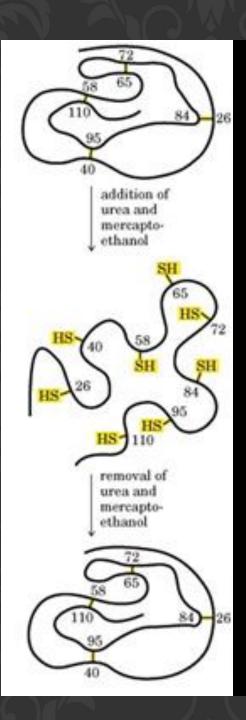
EXAMPLES OF DENATURED PROTEINS

- 1. Curdling of milk.
- 2. Preparation of egg omlet.
 - 3. Formation of paneer.
- 4. Formation of Para caseinate in stomach.
 - 5. Inactive / dormant enzymes.
 - 6. Heat inactivated vaccines.
- 7. Precipitation of protein by neutral salt, alcohol, acetone.

SIGNIFICANCE OF DENATURATION

- 1. Digestibility is increased.
- 2. Plasma proteins can be fractionated and Purified.
- 3. Property used in heavy metal poisoning as anti dot technique.
 - 4. Preservation of food items and biological samples





Native state Catalytically active

Reversible
Denaturation of
Ribonuclease

Unfolded state Inactive, Disulphide cross links reduced to yield Cys residue

Native state
Catalytically active
Disulphide cross links reformed

PROTEIN FRACTIONATION

1.

2.

3.

4.

5.

6.

7.

8.

Thank you

