①

Chapter - 9 Biomolecules → All C- comp. from living tissues

1. Chemical Analysis :→ Living Tissue + Cl_3CCOOH $\xrightarrow[\text{it}]{\text{Grind}}$ Thick slurry

Strain through cotton/cheese cloth → Two fract^{n}s

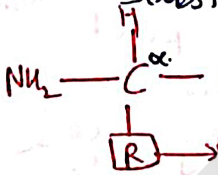
- Acid soluble pool (filtrate)
  - Bio → 1000s. of organic comp.
  - → Inorganic comp. like SO_4^{2-}s, PO_4^{3-}s, etc. → 18-800 Da mole. wt.
- Acid insoluble fract^n (Retentate) →
  - proteins
  - polysaccharides
  - Nucleic acid
  - → Molec wt → >10,000 Da except Lipids (<800 D)

② **Tables** :→ % wt in Human body :→ Imp. Topic Table **O > C > N > Ca > H** > S > Na > Mg.

65 % ; 18.5 % ; 3.3 % ; 1.5 %

③ **Amino Acids (AA)** : Substituted methanes. (CH_4).

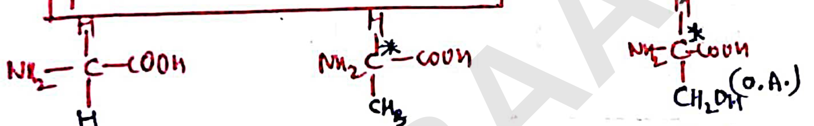
α-Amino acid :→



R → Variable → based on this nature → diff AA.

Proline → Imino acid

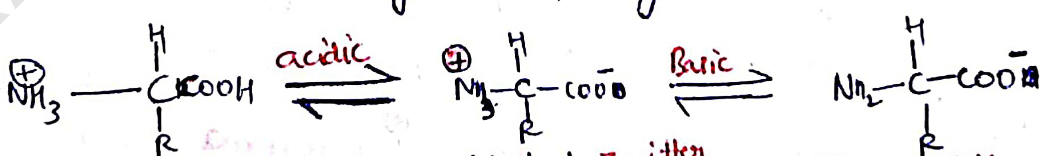
Proteinaceous aa → 20



only optically inactive ← glycine ; Alanine (O.A.) ; Serine (O.A.)

* Physical & Chemical properties of aa → Essentially of NH_2, Carboxyl & R gps.

* Types :→
1) Acidic (2) → Glutamic & Aspartic a.
2) Basic (3) → Lysine, arginine,
3) Neutral ( ) → Valine, glycine.
4) Aromatic → Tryptophan, Phenylalanine, Tyrosine.



acidic ⇌ Basic ; Neutral Med. ; Zwitter ion ; Amphiprotic

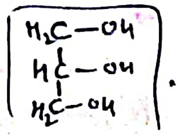
④ * **Lipids** :→ Water insoluble generally

a) **Simple Lipids** :→ 1) **Fatty acids** :→ carboxyl gp + R gp. [R → $-CH_3$, $-C_2H_5$, ... → C (1-19C)]

e.g. Palmitic acid [16C], Arachidonic acid [20C].

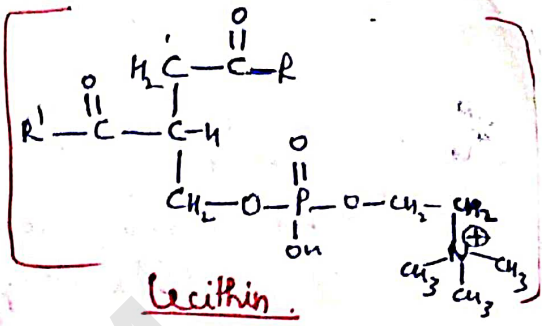
Fatty acid → Saturated / → Unsaturated e.g. Arachidonic acid.

b) **Glycerol** → Trihydroxy propane



(2) c) Esters of fatty ā & Glycerol → Glycerides
- Monoglycerides
- Diglycerides.
- Triglycerides

Glycerides → * oils, * Fats (High M.P.)


Lecithin.

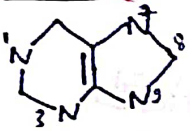
2. Conjugate Lipids :- eg. Phospholipids (Lecithin) → cell membrane

** Neural tissue → Lipids with more complex Str.

(5) Unit : Nucleotide ← DNA & RNA → Genetic material

N-bases → Heterocyclic (C) (N) rings

Purines (9 Atoms)

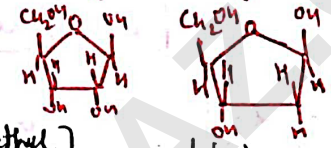


→ Adenine
→ Guanine
(N → 1, 3, 7, 9)

Pyrimidines (6 atoms)

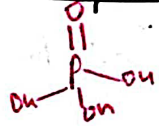
→ Thymine [5-methyl uracil]
→ Uracil
→ Cytosine.
(N → 1, 3)

Sugar → β-form furanose → oxy / deoxyribose



β'-2'-deoxyribose sugar

Phosphate $(PO_4)^{3-}$



* N-base + Sugar → Nucleoside → Adenosine, Guanosine, Cytidine, Uridine, Thymidine

* N-base + Sugar + PO_4^{3-} → Nucleotide → Adenylic ā, cytidylic ā, Thymidylic ā. etc

(6) * Metabolites → Compounds taking part in metabolism in body.

1° metabolites
→ Have identifiable funct^n & play known role in normal physiological processes.

2° metabolites → gums, spices, scents, resins, essential oils, coloured pigments, antibiotics
→ Don't understand funct^n of all 2° metabolites
→ Present in plant, fungal & microbial cells.
→ Useful to Human, Have Ecological Importance

- Pigments → Carotenoids, Anthocyanins
- ** Alkaloids → Morphine, Codein etc.
- Essential oils → Lemon grass oil
- Toxins → Abrin / Ricin (Abrahim toxin)
- ** Lectins → Concanavalin A.
- Drugs → Vinblastin, Curcumin etc..
- Polymeric Subs → Rubber, Gums, cellulose.

③

⑦ Biomacromolecules

* Biomicromolecules → Mol. wt < 1000 Da → In acid soluble fract^n.
* Biomacromolecules → Acid insoluble fract^n molecules tht in..

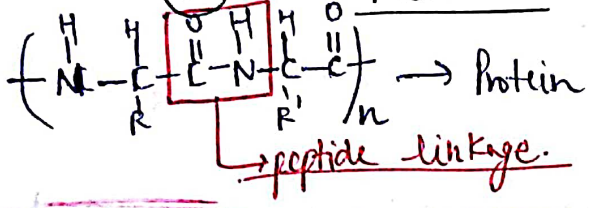
** Lipids → Not polymeric [Mole. wt. < 1000 Da] → Not a macromolecule
↳ forms vesicle → not water/acid soluble

* Acid soluble pool → Roughly cytoplasmic composition.

Abundance :

Avg Composit^n of Cell →	H_2O	Proteins	Nucleic a	Carbohy.	Lipids	Ions
	70–90%	10–15%	5–7%	3%	2%	1%

⑧ Proteins → polypeptide → polymer of AA.

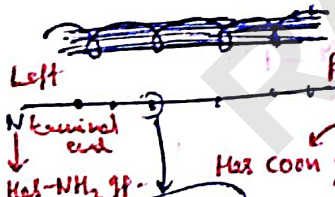


→ Protein → Heteropolymer
↳ peptide linkage.

* Collagen → Most abundant protein of "Animal World".
* RUBISCO → " " " " Biosphere.
* Cellulose → " " Organic comp. of world.

Structure of Proteins

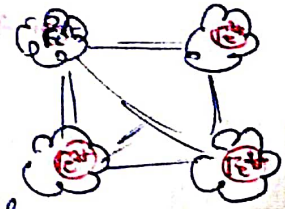
1° Str.
→ Seq. of AA i.e., positional infomat^n in a protein of aa.



2° Str. → H-bond
→ Protein thread folded to form helixes or sheets (α-Helixes) (β-pleated)
Helixes → only right handed

3° Str.
→ Hollow wooden ball like str.. (3-D view of protein)
↳ Necessary of Biol. function of proteins

Quaternary str.
→ proteins assembled in >1 polypeptide/subunits.
→ arr^n. of these subunits is called 'Quaternary Str.'



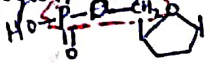
GLUT-4 → Enable Glucose transport into cells
↳ carrier protein

⑨ Linkages

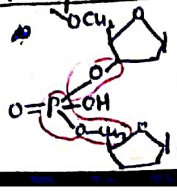
① Peptide :→ blw two AA (–N–C–) → by Dehydrat^n

② Glycosidic :→ blw C-atoms of two adjacent monosaccharides. (–C–O–C–) → by dehydrat^n

③ Ester bond → blw Phosphate & Hydroxyl gp of sugar



④ Phosphodiester :→ In DNA/RNA → two ester bonds 1st with 3' OH of one nucleotide & 2nd with 5' OH of other Nucleotide



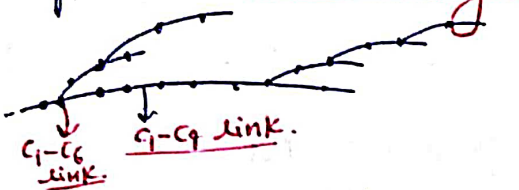
3'→5' direct^n.

(10) * Polysaccharides → cotton thread like

1. Cellulose :→ (β-glucose) → Homopolymer (C_1–C_4) link.
→ Unbranched

variants

a) Glycogen → (α-glucose)
→ Highly branched
→ Animal Storage polysaccharide
→ Right end → Reducing
Left end → Non-reducing



b) Starch → (α-glucose)
→ Helical 2° Str.
→ Can hold I_2 molecules → Dark Blue colour (Starch–I_2)

2. Inulin → polymer of Fructose. (dahlia).

* plant cell wall, paper pulp, cotton fibre → Cellulose.

* Complex polysaccharides → → Building units :→ amino-sugar & chemically modified sugar [N-acetyl galactosamine, glucosamine, etc.]. → Heteropolymers

* Exoskeleton of arthropods :→ Chitin [NAG] → ka homopolymer

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(11) Concept of Metabolism – Dynamic State of Body Constituents

* Comp./Biomolecules concentⁿ terms → mols/cell or mols/l.

* Turn over of Biomolecules :→ Biomolecules are constantly being changed into one-another.

* Metabolism :→ All the chemical rxns involving breaking/making of ~~chemical~~ Biomolecules.
→ All metabolic Rxns are catalysed by proteins called enzymes.

Metabolite flow. → c/a Dynamic State of body constituents

Properties → i) Metabolic pathway :→ Series of linked metabolic rxns converting metabolites into one another → like automobile traffic.
→ Metabolite flow → Has definite direct & rate
→ Pathway → 1) linear/circular 2) Criss-cross eachother (traffic junct^n).

(11) Metabolic Basis of Living :

Rxns → Catabolic :→ Complex → Simple → Energy Released **

Rxns → Anabolic :→ Simple → Complex → Require energy **

ATP → Energy currency
↳ Energy stored in pyro-P bonds.
(A)–P~P~P

** Bioenergetics → Branch dealing with energy considerat^{n} of in living org.

(12) The living State :

* Each Metabolite or Biomolecule → Has characteristic conc. → In a ** Metabolic flux

* All living org. → Exist in ** Steady – State [Characterise by conc. of each Biomolecule]

** Non – eq^{m} state

For proper falling in eq^{m} state → Energy required → comes from metabolism

∴ Living State ← Synonyms → Metabolism

** Blood Glucose Conc. → 4.2 mmol/L – 6.1 mmol/L

Hormones → nanograms/ml

Enzymes :→ Biocatalyst

→ Almost all protein. * Ribozyme → RNA (23S rRNA) ~~Peptidyl transferase~~

→ Backbone of protein → folds upon itself → Chain criss-crosses eachother

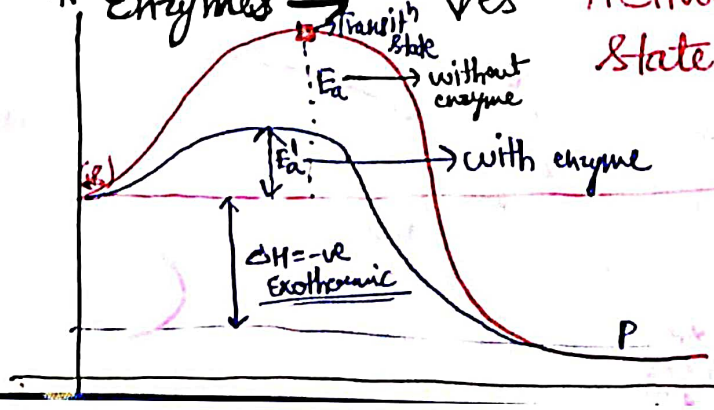
c/as Active sites ← pockets/crevices formed

Catalyse rxn at higher rate. ← Substrate fits into it.

Enzymes → damaged at high temp.

Enzymes of Thermophilic org. → Work at high temp. (80–90°C).

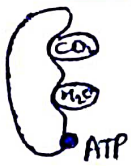
* Enzymes ↓es Activat^{n} energy required to form transit^{n} state structure.



Enzyme Actⁿ :→ **Induced-fit Hypothesis**

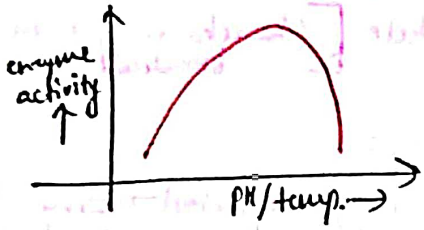
$E + S \longleftrightarrow ES \longrightarrow EP \longrightarrow E + P$

- $E + S$: ↳ fits into active site & alter E shape to tightly fit
- ES: Breaking of S-bond to form EP
- EP: release of P & E → goes for new cycle of catalysis

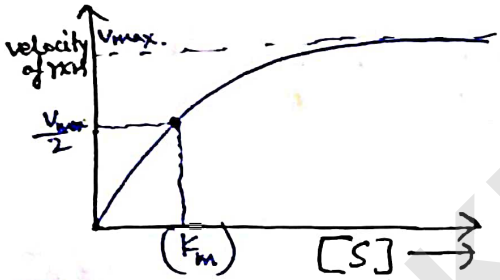


Factors Affecting Enzyme Activity :→ Due to change in 3° str. of protein [Enz.]

1. **Temp. & pH** :→ Optimum pH & temp. → Highest activity of E.
   Low temp → temporary inactive E. High temp → Destroy enzyme activity ∵ protein denatured by heat.



2. **Conc. of Substrate** :→ As substr. conc. ↑es, rate of rxn ↑
   But after some time rate = const as enzymes gets saturated.
   K_m → Michelas Constant. → [S] at $\frac{V_{max}}{2}$



$K_m \propto \frac{1}{\text{Enzyme efficiency}}$ → $K_m' < K_m$

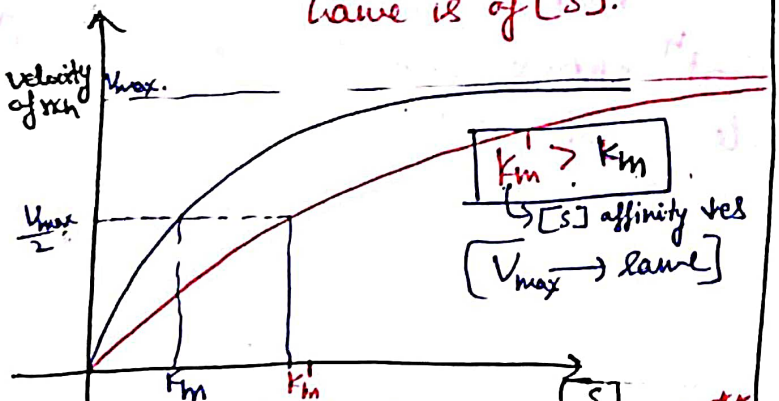
K_m ↑es, affinity for [S] ↓es

K_m': more efficient enzyme; K_m: less efficient enzymes.

Enzyme Inhibitors

Competetive

→ Binds active site & inhibit S to bind E.
→ As [S] ↑es effect ↓es & ultimately V_{max} is reached
Curve is of [S].

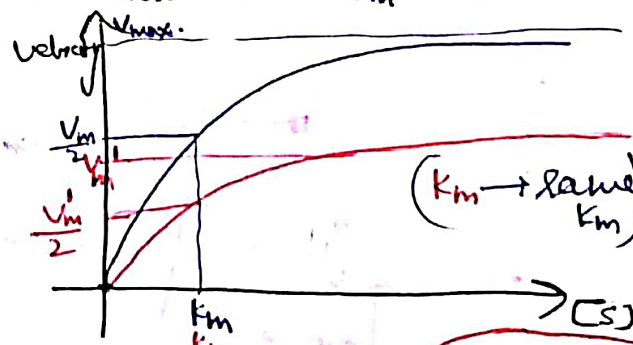


$K_m' > K_m$
↳ [S] affinity ↓es
[V_{max} → same]

eg. → Inhibit° of Succinate dehydrogenase by Malonate
→ Sulpha drugs → For Controlling Bacterial pathogens

Non-competitive Inhibitors

→ Binds to allosteric sites & alter E shape as well as of its active site.
→ V_{max} ↓es. K_m → same.



eg. CN^- ions.

K → Michealis–Menten constant

Cofactors उपसहायक: protein parts

Haloenzymes (whole) → Protein द्विक Non Protein

Apoenzyme — Cofactors.

Prosthetic gp
→ Organic
→ tightly & permanently bound
→ eg. Haem gp (part of active site)
- Catalase ↘ for foll Rxn $2H_2O_2 \rightarrow 2H_2O + O_2$
- Peroxidase

Co-enzymes (vitamins as essential chemical components)
→ Organic
→ loosely bound to apoenzyme
→ NAD & NADP → Has vitamin niacin

Metal ions
→ Zn^{2+}

Carboxypeptidase (proteolytic)

forms coordinate bond with side-chains at active site & one/more coordinate bond with substrate.

* Classificat^{n} & Nomenclature of Enzymes :→

→ There are 6 classes of enzyme.

S.No.	Name	Work	Note
I.	Oxidoreductases/ dehydrogenases.	$S + S' \longrightarrow S_{\text{oxidised}} + S'_{\text{reduced}}$ (S reduced, S' oxidise)	
II	Transferases	$A-X + B \longrightarrow A + B-X$	X can't be Hydrogen
III	Hydrolases	Hydrolysis of ester, ether, glycosidic, peptide bonds etc.	$A \overset{H_2O}{-} B \longrightarrow A-H + B-OH$
IV	Lyases	$>C-C< \longrightarrow >C=C< + X-Y$	
V	Isomerases	Interconversion of optical, geometric/ position isomers	
VI	Ligases	$A + B \longrightarrow A-B$	