BIOLOGY

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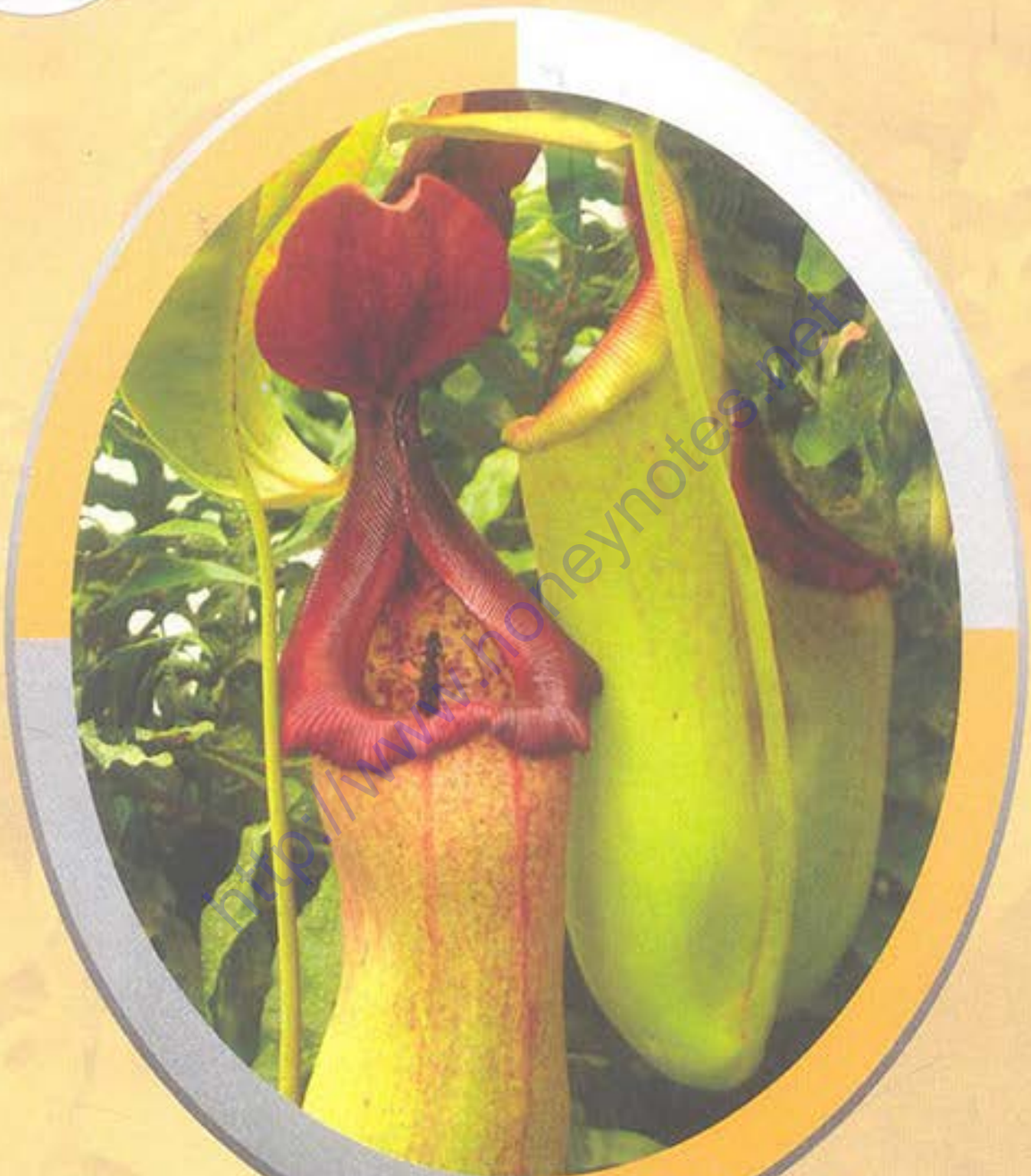

Enzymes

CHAPTER – 3

ENZYMES(BIO-CATALYSTS)

Enzymes are bio-catalyst which speed up the chemical reactions by lowering "Energy of activation".

ENERGY OF ACTIVATION

Amount of energy which is required to start a chemical reaction. OR Energy required to break a (particular covalent) bond present in reactant.

NOMENCLATURE OF ENZYMES

Enzyme is a Greek word means-En(in) and Zyme(yeast).

DISCOVERY OF ENZYME

Term "Enzyme" was coined by F.W Kuhne in 1978.

NATURE OF ENZYME

Almost all enzymes are protein in nature except few which are nitrogenous acids like RNA-DNA(Ribozymes).

Ribozymes catalyze reactions in genetic informations.

CHARACTERISTICS OF ENZYMES

- Protein in nature and are formed by living cells.
- May be intracellular or extra cellular.
- Remains unchanged during and after the reaction.
- Speed up the rate of reaction by decreasing energy of action.
- Specific in their nature.
- Heat sensitive and act on particular (optimum) temp.
- Each has specific substrate pH for its activity.
- Action can be alter by activators and inhibitors.

CLASSIFICATION OF ENZYME (ON THE BASIS OF STRUCTURE)

Pure or Simple Enzyme consist of only protein (e.g.Amylase and Pepsin) Conjugated or Holoenzymes: May contain a

non-protein part "Prosthetic group" as well (e.g. Phosphatase and Peptidase)
Holoenzyme = Apoenzyme + Prosthetic group
……(Protein part)….(Non-protein part)

CLASSIFICATION OF ENZYME (ON THE BASIS OF FUNCTIONS)

(1) OXIDOREDUCTASE

Catalyze reactions in which one substrate is oxidized while other is reduced. Sub classes are:

- Dehydrogenases(convert single bond to double bond)
- Oxidases (use oxygen as oxidant)
- Peroxidases (use H202 as oxidant)
- Hydroxylases (introduce hydroxyl group)
- Oxygenases (introduce mol. Oxygen in place of double bond).

(2) TRANSFERASES

Transfer one carbon group (e.g. methyl) from one substrate to another substrate.

(3) HYDROLASES

Catalyze hydrolytic cleavage of C-O, C-N, C-C and P-O bonds and other single bonds (e.g. Peptidases, Esterases, Glycosidases and Phosphatidases).

(4) LYASES

Catalyze Elimination reactions to form double bond and reversible reaction by adding groups across double bond (e.g. Decarboxlases, Aldolases and Dehydratases).

(5) ISOMERASES

They alter the structure but not the atomic composition by moving a group from one position to another in one molecule (e.g. Epimerases, Mutases).

(6) LIGASES

Catalyze reaction in which two molecules are joined. They are also known as synthtases.

ROLE OF ENZYME

The enzyme react with (energy rich or energy poor) molecules and forms an intermediate complex that breaks into,

(a) Product

(b) Enzyme

(i) Substrate + Enzyme = Complex

(ii) Complex = Product + Enzyme

The equilibrium is achieved if the ratio of conc of reactants (substrate) and product remains same.

Rate of reaction 1/μ Energy of activation

MODE OF ACTION OF ENZYMES

1- The action of enzyme depends on its chemical structure. A typical enzyme molecule, has "3D" structure.

2- Has depression or pit for substrate (to fit in) known as "Active site".

3- Any other site other than active site is called "Allosteric site"

There are two theories in respect of enzyme action, which are as follows.

LOCK AND KEY MODEL

Proposed by Fischer (1898) and modified by Paul Filder and D.D Woods according to this model,

- The active site of enzyme has distinct shape.
- It allows few substrate to fit in (like a particular lock allows particular key to fit in)
- Enzyme breaks substrate to product

FIGURE From Text Book 3.3 page #46 (The cycle of Enzyme – substrate Interaction)

INDUCE FIT MODEL

Proposed by koshland (1959), it states that

- Enzyme binds with a substrate
- This binding induce changes in enzyme structure
- Due to this change enzyme acts and forms product

FACTORS AFFECTING ENZYME ACTIVITY

The activity of enzymes depend on following factors,

1. SUBSTRATE CONCENTRATION

- Increases with increase in substrate concentration (up to a limit)
- At very high concentration, activity again decreases due to saturation of enzyme with substrate and saturation of product i.e. higher concentration of product.

2. TEMPERATURE

- Increases with in temperature(up to limits)
- Maximum activity at optimum temperature.
- Highly active at 37˚C and destroyed at 100˚C
- At 0˚C minimum activity.

3. PH

Enzymes are pH specific i.e. work in specific pH(because of protein can act both in acidic and basic medium.

4. WATER

Enzyme activity is usually maximum (up to limits) but decrease after limits (dilution of enzyme)

5. RADIATIONS

Enzymes become inactive due to radiations (including Alpha, Beta, Gamma rays).

6. CO-ENZYME AND ACTIVATORS

Induce the enzyme activity.

THINGS TO BE REMEMBER

INHIBITORS

Substances which decreases the activity of enzymes.

COMPETITIVE INHIBITORS

Inhibitor molecules which resemble the normal substrate molecule and compete for admission into the active site. They block the substrate from entering active site.

NON-COMPETITIVE INHIBITORS

Inhibitors bind to a part of the enzymes away from the active site (Allosteric site). This binding cause change in the enzyme molecule shape and decrease in enzyme activity.

FEED BACK INHIBITION

Common biological control mechanism of brain in order to regulate enzyme activity.

PROSTHETIC GROUP

Non-protein part of enzyme (Co-enzyme or Co-factor)

CO-ENZYME

When prosthetic group consist of organic molecules (like FAD/NAD)

CO-FACTORS/ACTIVATORS

When prosthetic group consist of inorganic molecules (like Ca++, Na+ etc).

APOENZYME

Protein part of enzyme.