PROPERTIES OF ENZYMES

Enzymes possess the following distinctive properties:

- Catalytic power
- Milder reaction conditions
- Specificity
- Regulatory power
- Reversibility
- Colloidal nature
- Denaturation

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GENERAL PROPERTIES OF ENZYMES

1. CATALYTIC POWER OR HIGHER REACTION RATES: 1

The rates of enzymatically catalyzed reactions are typically several orders of magnitude greater than those of the corresponding chemically catalyzed reactions. An enzyme increases the reaction rate by 10^6 to 10^{12} times over an uncatalyzed reaction.

The ratio of the rate of catalyzed reaction to the rate of uncatalyzed reaction is called the catalytic power of an enzyme.

Catalytic power is also called as the *catalytic efficiency* or *power*.

2. MILDER REACTION CONDITIONS:

Enzymatically catalysed reactions occur under relatively mild conditions: temperatures, atmospheric pressure, and nearly neutral pH's. In contrast, efficient chemical catalysis often requires elevated temperatures and pressures as well as extremes of pH.

Exceptions are extremozymes, which are active under extreme conditions

Enzymes	Uncatalyzed rate(*K*uncat /s)	Catalyzed rate (*K*cat/s)	Catalytic power (*K*uncat /s : *K*cat / s)
AMP nucleotidase	1.0×10^{-11}	60	6×10^{-11}
Carboxy peptidase A	3.0×10^{-9}	578	1.9×10^{-11}
Triose phosphate isomerase	4.3×10^{-6}	4300	1×10^{-11}
Carbonic anhydrase	1.3×10^{-1}	1×10^{6}	7.7×10^{-11}
Urease	3×10^{-10}	3×10^{4}	10^{14}

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GENERAL PROPERTIES OF ENZYMES

3. GREATER REACTION SPECIFICITY:

Specificity

Enzymes have a greater degree of specificity with respect to both their **substrates** and their products than do chemical catalysts

Specificity refers to the *extraordinary ability* of the enzyme to recognize a specific substrate to catalyze a specific reaction.

Enzymatic reactions rarely have side products.

4. CAPACITY FOR CONTROL OR REGULATORY POWER:

The catalytic activities of many enzymes vary in response to the concentrations of substances other than their substrates and products.

Catalytic power of an enzyme is *controllable* depending on the metabolic needs of the cell.

Enzymes can be regulated by different mechanism like genetic control, post-translational modification, allosteric regulation, proteolytic cleavage and covalent modification.

GENERAL PROPERTIES OF ENZYMES

5. REVERSIBILITY

Enzymes can catalyze reactions in both directions depending upon the availability of a suitable energy source and suitable solvent conditions.

6. COLLOIDAL NATURE

Enzymes, being high molecular weight proteins, exhibit colloidal properties, due to which they present a large surface area for the reaction to take place.

7. DENATURATION

Enzyme denaturation is commonly defined as *any noncovalent change in its structure*.

This change may alter the secondary, tertiary, or quaternary structure of the enzyme molecules.

Enzymes are thermolabile and pH sensitive. Hence, they are denatured by high temperature, strong acids, and strong alkali.

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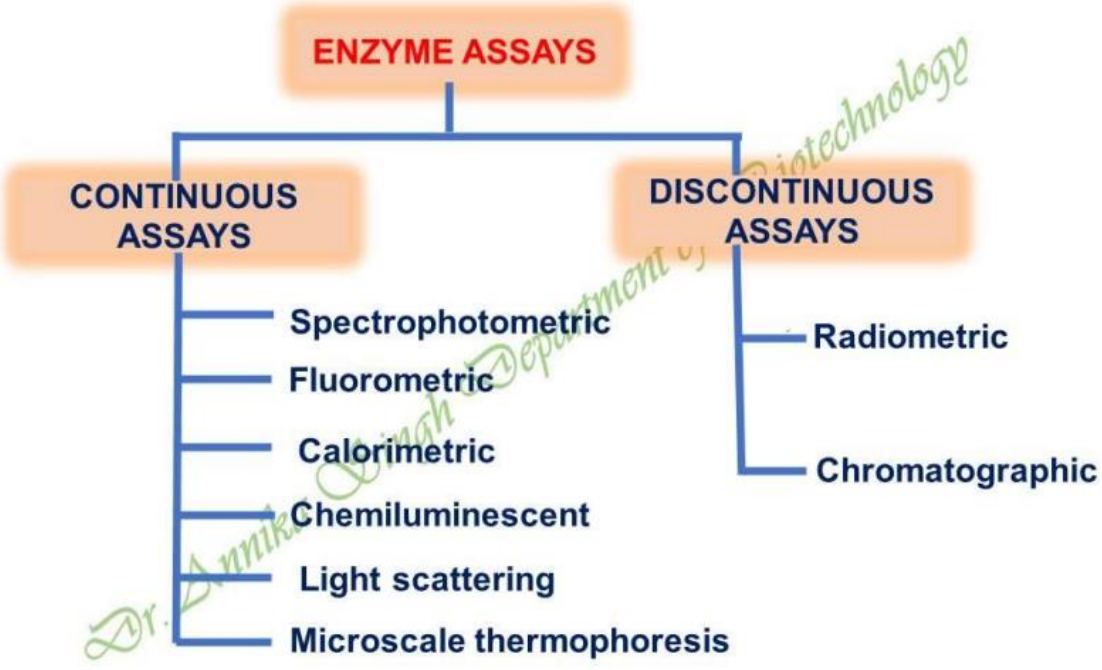
ENZYME ASSAYS



ENZYME ASSAYS

1. DIRECT ENZYME ASSAY :

- For some enzyme assays, it is possible to measure the reactant or product directly based on its absorbance properties Fersht (1999)
- In the reaction catalyzed by glucose-6-phosphate dehydrogenase (EC 1.1.1.49), one product (NADH) absorbs light at 340 nm, making it possible to monitor the reaction by following the increase in absorbance at this wavelength.

Glucose 6-phosphate+ $NAD^+ \rightarrow$ 6-phosphogluconate + NADH + H^+

2. COUPLED ENZYME ASSAYS:

- Difficult detectable enzyme reactions are frequently coupled with easily observable reactions, preferentially NAD(P)H dependent dehydrogenases. An example is the hexokinase reaction connected with the glucose-6-phosphate dehydrogenase :

(1) Glucose+ATP→glucose-5-phosphate+ADP

(2) Glucose-6-phosphate+$NADP^+$→gluconate-6-phosphate+NADPH+H^+

The second, the ***indicator* reaction** can easily be detected by the absorption increase at 340 nm.

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MEASURES OF ENZYME ACTIVITY AND UNITS

- The enzyme unit was adopted by the International Union of Biochemistry in 1964
- The **enzyme unit**, or **international unit** for enzyme (symbol **U**, sometimes also **IU**) is a unit of enzyme's catalytic activity.
- 1 U (µmol/min) is defined as the amount of the enzyme that catalyzes the conversion of one µmol of substrate per minute under the specified conditions of the assay method
- One katal is the enzyme activity that converts one mole of substrate per second under specified assay conditions, so
- 1 U = 1 µmol/min = 1/60 µmol/s ≈ 16.67 nmol/s;
- Therefore, 1 U = 16.67 nkat
- **Specific activity:** This is the activity of an enzyme per milligram of total protein (expressed in µmol min^{-1} mg^{-1}).
- Specific activity gives a measurement of enzyme purity in the mixture.

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THANK YOU