Enzymes and Isoenzymes: Therapeutic and Diagnostic Applications

Enzymes are biological catalysts essential for life. Isoenzymes are their tissue-specific variants.

by Sri Vikram S

Understanding Enzyme Fundamentals

Reaction Speed

Enzymes accelerate reactions up to 10^17 times faster.

Specificity

Operate via lock-and-key or induced fit models.

Cofactors

Non-protein helpers like metal ions and vitamins aid function.

Enzyme Kinetics

Michaelis-Menten model describes reaction rates.

Therapeutic Applications of Enzymes

Replacement Therapy

Corrects enzyme deficiencies in patients.

Thrombolytic Enzymes

Dissolve blood clots: streptokinase, tPA.

Digestive Aids

Amylase, lipase, protease support digestion.

Anti-inflammatory Enzymes

Serrapeptase reduces inflammation effectively.

Asparaginase acts as an anti-cancer agent by depleting nutrients in leukemia cells.

Enzyme Replacement Therapies for Genetic Diseases

Gaucher Disease

Recombinant glucocerebrosidase (Cerezyme) therapy.

Fabry Disease

Treatment with agalsidase alfa or beta enzymes.

Pompe Disease

Uses alglucosidase alfa (Myozyme) replacement therapy.

Mucopolysaccharidoses (MPS)

Various enzyme replacements target MPS subtypes.

Enzymes as Diagnostic Markers in Disease

Tissue Damage

Enzyme release signals damage location and severity.

Heart Attack

CK-MB and Troponin levels indicate myocardial infarction.

Liver Health

ALT and AST enzymes reveal liver disease status.

Pancreatitis

Amylase and lipase enzymes diagnose pancreatic inflammation.

Isoenzymes in Precision Diagnostics

1

CK-MB

Specific to cardiac muscle, key in heart damage detection.

2

Lactate Dehydrogenase (LDH)

LDH-1 and LDH-2 patterns confirm myocardial infarction.

3

Alkaline Phosphatase (ALP)

ALP-1 and ALP-2 identify liver or bone disorders.

4

Prostate-Specific Antigen (PSA)

Different isoforms predict prostate cancer aggressiveness.

Innovative Enzyme Technologies

1

Immobilization

Improves enzyme stability and reusability in treatments.

2

Engineering

Modifying enzymes for tailored medical and industrial uses.

3

Biosensors

Devices using enzymes to detect specific substances quickly.

4

Nanoparticles

Enable targeted delivery of enzymes to precise sites.

Future Trends & Conclusion

Personalized Medicine

Enzyme therapies tailored to individual genetic profiles.

Point-of-Care Tests

Rapid enzyme-based diagnostics for timely care decisions.

Synthetic Enzymes

Artificial enzymes designed for enhanced clinical applications.

Ongoing Impact

Enzymes and isoenzymes remain vital in therapy and diagnostics.