

Enzyme Production

- Obtained from several fungi, yeast, bacteria and actinomycetes.
- Fungal and bacterial sources has dominated applications in industrial sectors.
- Bacterial sources *Bacillus subtilis*, *B. staerothermophilus*, *B. amyloliquefaciens*, *B. licheniformis*, *B. acidocaldarius*, *Bifidobacterium bifidum* and *Bifidobacterium acerans* are important species.
- Fungus *Aspergillus niger*

Bulk enzymes

Enzyme	Source	Uses
Protease	<i>Bacillus, Lactococcus, Aspergillus, Rhizomucor</i>	Biological detergents, dough preparation, beer manufacture, cheese production, leather baiting and tendering, tenderization of meat, recovery of silver from photographic films
Lipases	<i>Bacillus, Aspergillus, Rhizopus, Rhodotorulla</i>	Biological detergents, removal of fat during leather processing, cheese ripening and flavour enhancer
α -amylase	<i>Bacillus, Aspergillus</i>	Biological detergents, starch hydrolysis during brewing and baking, textile manufacture
β -amylase	<i>Bacillus, Streptomyces, Rhizopus</i>	Starch hydrolysis during brewing and baking, production of maltose syrup

Glucoamylase	<i>Aspergillus, Rhizopus</i>	starch hydrolysis during brewing and baking, production of glucose syrup, wine and fruit juices
Lactase (β -D-galactosidase)	<i>Bacillus, Kluyveromyces, Candida</i>	Whey syrup preparation, milk and dairy product processing and manufacture of ice creams
Glucose isomerase	<i>Actinoplanes, Arthrobacter, Streptomyces</i>	Manufacture of high fructose syrup
Invertase	<i>Kluyveromyces, Saccharomyces</i>	Production of sweets and confectionary products like soft centered chocolates.
Pectinase	<i>Aspergillus, Penicillium</i>	Preparation of fruit juices, extraction of oils and juices from plants, coffee fermentation
Cellulases	<i>Trichoderma, Penicillium, Bacillus</i>	Wood pulp processing, fruit juice preparations, malting of grains

Hemicellulases	Cryptococcus, Trichosporon	Wood pulp processing, baking, brewing, animal feedstuff, nutraceuticals
Catalase	Aspergillus, Corynebacterium, Micrococcus	Bleaching of textiles , cheese processing
Phytase	Pichia	Animal feed supplement
Urease	Lactobacillus	Wine production, manufacture of ceramics
Penicillin G acylase	<i>E.coli</i> , Bacillus	Biotransformation of penicillin G into 6-amino penicillanic acid

Analytical and diagnostic enzymes

Alcohol dehydrogenase	<i>Saccharomyces cerevisiae</i>	Ethanol estimation
Cholesterol esterase	<i>Pseudomonas fluorescens</i>	Cholesterol estimation
Glucose oxidase	<i>Aspergillus niger</i>	Glucose estimation
Uricase	<i>Arthrobacter globiformis</i>	Gout diagnosis
Creatinase	<i>Pseudomonas putida</i>	Creatinine estimation

Therapeutic enzymes

Urease	<i>Lactobacillus fermentum</i>	Removal of urea from blood
α -amylase	<i>Aspergillus niger</i> , <i>Bacillus subtilis</i>	Aids in food digestion
Asparaginase	<i>E.coli</i> , <i>Serratia marcescens</i>	Cancer treatment
β -lactamase	<i>Bacillus cereus</i> , <i>E.coli</i>	Treatment of penicillin allergy
Rhodanase	<i>Tricoderma sp.</i>	Treatment of cyanide poisoning
Streptokinase	<i>Streptococcus equisimilis</i>	Blood clot buster

Molecular biology enzymes

Restriction enzymes like BamH1	<i>Bacillus amyloliquefaciens</i>	Cut DNA at specific site
Taq polymerase	<i>Thermus aquaticus</i>	DNA synthesis
DNA ligase	<i>E.coli</i>	Joining DNA fragments
RNA Polymerase	<i>Salmonella typhimurium</i>	RNA synthesis

- Amylases are enzymes that break down starch or glycogen.
- The amylases can be derived from several sources such as plants, animals and microbes.
- The major advantage of using microorganisms for production of amylases is in **economical bulk production** capacity and microbes are also easy to manipulate to obtain enzymes of desired characteristics.

- *Bacillus* spp was isolated from environment and maintained on nutrient agar slants and sub cultured for every 10 days.
- **Inoculum and Fermentation Medium:** Addition of sterile distilled water in to the freshly grown nutrient agar slants, from this 0.5 ml of cell suspension was inoculated in to 100 ml of sterilized fermentation medium and incubated at 35°C for 10 hrs.
- **The composition of the fermentation medium was [g/l]:** 6.0 g Bacteriological peptone; 0.5 g MgSO₄, 7H₂O; 0.5 g KCl; 1.0 g Starch, pH 7.

- **Extraction of Amylase from the Fermentation Medium:** After incubation the fermentation medium was harvested by centrifugation at 5000 rpm for 20 minutes at 4°C. The supernatant was collected and isolated the enzyme.