

Biotechnological Importance of Enzymes



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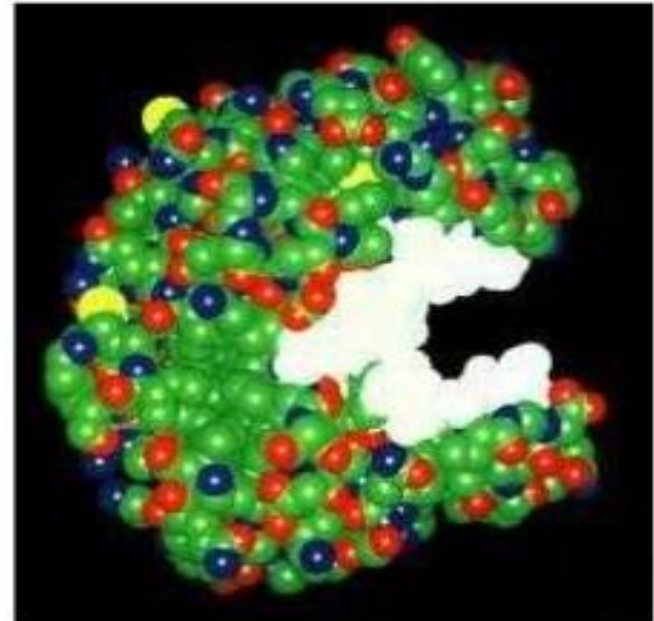
INTRODUCTION



What are enzymes?

Enzymes are large protein molecules which are made up of long chains of amino acids that is folded to produce a molecule with a specific 3D shape.

Enzymes can be used in our bodies as biological catalysts and in industry also.



DEFINITION



- Enzyme are catalytical molecule which alter the rate of reaction.
- Most of the enzyme are proteins but all proteins are not enzyme.

ENZYME**USE**

Protease

used to pre-digest proteins during the manufacture of baby foods

Lipase

used - together with protease - in biological detergents to break down - digest - the substances in stains into smaller, water soluble substances

Carbohydrase

used to convert starch syrup, which is relatively cheap, into sugar syrup, which is more valuable - for example, as an ingredient in sports drinks

Isomerase

used to convert glucose syrup into fructose syrup - fructose is sweeter than glucose, so it can be used in smaller amounts in slimming foods

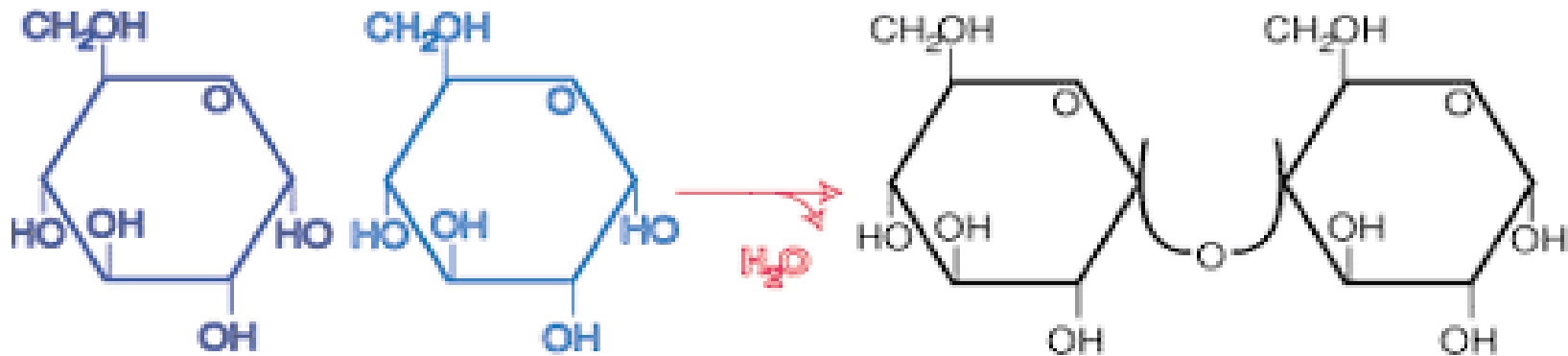
<i>Enzyme</i>	<i>Reaction</i>	<i>Source</i>	<i>Application</i>
Industrial α -Amylase	Starch hydrolysis	<i>Bacillus</i> sp	Conversion of starch to glucose or dextrans in food industry
Amyloglucosidase	Dextrin hydrolysis	<i>Aspergillus</i> sp	Monomeric glucose production
Glucose isomerase	Glucose to fructose conversion	<i>Streptomyces</i> sp	Production of high <i>fructose syrups</i>
β -Galactosidase	Lactose hydrolysis	<i>Aspergillus</i> sp	Hydrolysis of lactose in milk or whey
Proteases	Protein digestion	<i>Bacillus</i> sp	Laundry aid
Penicillin acylase	Benzoyl side cleavage	<i>E. coli</i>	6-APA production for semi-synthetic use
Aminoacylase	Hydrolysis of acylated L-amino acids	<i>Aspergillus</i> sp	Resolution of racemic <i>mixtures</i>

<p>Medical</p> <p>L-Asparaginase</p> <p>Urokinase</p>	<p>Removal of L-asparagine essential for tumour growth</p> <p>Plasminogen activation</p>	<p><i>E. coli</i></p> <p>human urine</p>	<p>Cancer chemotherapy particularly leukaemia</p> <p>Removal of fibrin clots</p>
<p>Analytical</p> <p>Glucose oxidase</p> <p>Luciferase</p> <p>Peroxidase</p> <p>Urease</p>	<p>Glucose oxidation</p> <p>Bioluminescence</p> <p>Dye oxidation using H₂O₂</p> <p>Urea hydrolysis to CO₂ and NH₃</p>	<p><i>Aspergillus niger</i></p> <p>marine bacteria/ firefly</p> <p>Horseradish</p> <p>Jack beans</p>	<p>Detection of glucose in blood</p> <p>Bioluminescent assays for ATP etc.</p> <p>Quantification of hormones or antibodies</p> <p>Measurement of urea in body fluids</p>
<p>Manipulative</p> <p>Lysozyme</p> <p>Nucleases</p>	<p>Hydrolysis of 1-4 glycosidic bonds</p> <p>Hydrolysis of phosphodiester bonds of nucleic acid</p>	<p>Hen egg white</p> <p>Bacteria</p>	<p>Disrupts mucopeptide of bacterial cell walls</p> <p>Genetic manipulation</p>

Glycosidic Bond



- In this bond two monosaccharides join to form a Disaccharide.
- The reaction is similar to condensation.
- The reaction involves the water been given off.



- Above is the structures of a Glycosidic bond.

Starch



- Starch is made up of 2 different homopolysaccharides.
- They are:-
 - ✦ **Amylose**: *linear* polymer of a (**α 1-4 Glycosidic**)linked **glucose** residues.
 - ✦ **Amylopectin**: *branched* polymer of a (**α 1-4 Glycosidic**)linked **glucose** residues with a (**α 1- 6**) linked **branches**.

Enzyme Technology

Enzyme technology is concerned with the application of enzymes as tools of industry, agriculture and medicine

Enzymes are biological catalysts that fulfill their role by binding specific substrates at their active sites

This specificity is one property of enzymes that makes them useful for industrial applications

Enzymes operate at room temperature, atmospheric pressure and within normal pH ranges (around 7) – all of which create energy savings for industry

Enzymes possess specifically shaped active sites for reacting with one specific substrate thereby generating pure products free from unwanted by-products

Enzymes are biodegradable and, unlike many inorganic catalysts, cause less damage to the environment

Products of Enzyme Technology



Micro-organisms have been used for thousands of years for making products such as wine, beer, vinegar, soy sauce, bread and cheese

The micro-organisms (such as yeast) are really used as a source of enzymes during the manufacture of these products of biotechnology

Biotechnological importance of enzymes



Enzymes play very important role in

- Food and beverage industry
- Starch hydrolysis
- Baking industry
- Beverages and wine
- Dairy industry
- Fruit and vegetable industry
- Meat industry
- Leather industry
- Textile processing

Enzymes in Baby Food and Industry

Pure enzymes have many uses in industry.

Proteases are used to make baby foods. They 'predigest' some of the protein in the food because babies when they first start eating solid foods, they are not very good at digesting it. Treating the food with protease. Enzymes makes it easier for a baby's digestive system to cope with.

Carbohydrates are used to convert starch into sugar (glucose) syrup.

Starch is made by plants like corn and it is very cheap. Using enzymes to convert this plant starch into sweet sugar provides a cheap source of sweetness for food manufactures.

It is also important for the process of making fuel (ethanol) from plants.



Food and beverage industry



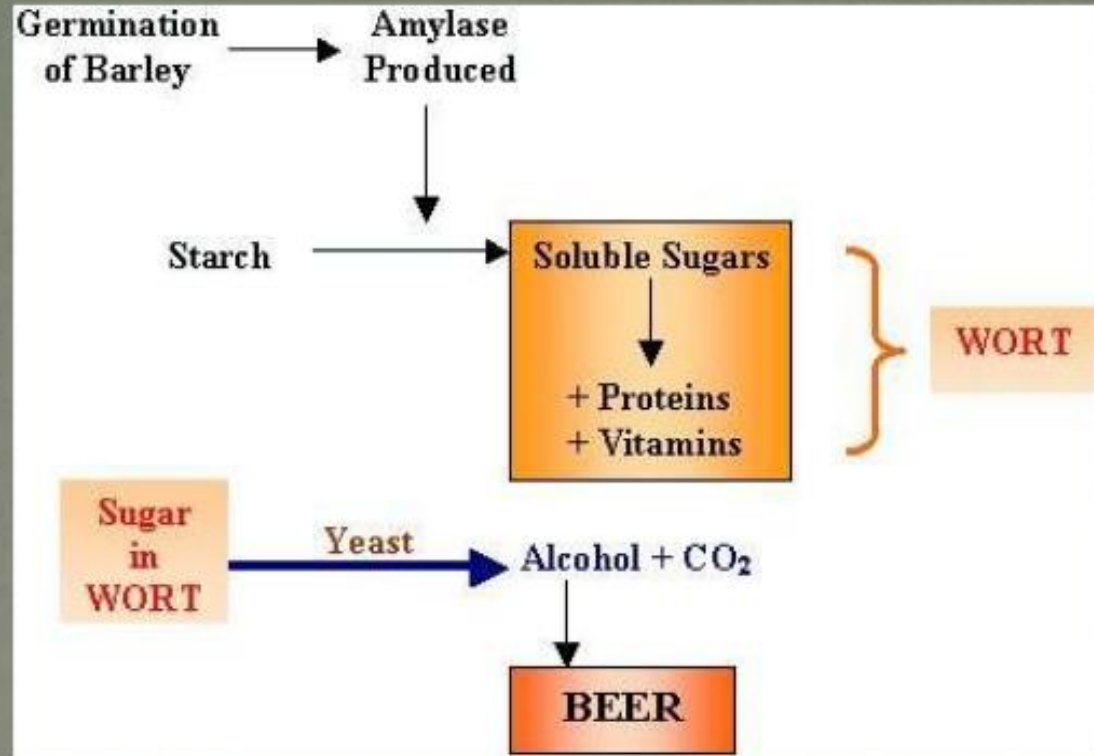
Application of fermentation in production of wine and other alcoholic beverages is also a biotechnological technique



Beverage industry



Germinating barley used for malt



Enzymes & Paper and Pulp Industry

In the paper industry, the enzymes named as amylases, xylanases, cellulases, and ligninases are used to degrade starch to lower viscosity, aiding sizing and coating paper.



A paper mill in South Carolina

Starch Hydrolysis



- Converts starch into glucose and various syrups.
- Converts glucose into fructose in production of high-fructose syrups from starchy materials.

Enzymes used:-

- Amylases, amyloglucosidases and glucoamylases
- Glucose isomerase

Leather Industry



- Leather industry uses proteolytic and lipolytic enzymes in leather processing.
- Enzymes are used to remove animal skin, hair, and any unwanted parts.
- Enzymes used:-
- Protease & Lipases

Enzymes in Medical Diagnosis

If your liver is damaged or diseased, some of your liver enzymes may leak out into your bloodstream. If your symptoms suggest your liver isn't working properly, doctors can test your blood for these enzymes. This will tell them if your liver is really damaged.

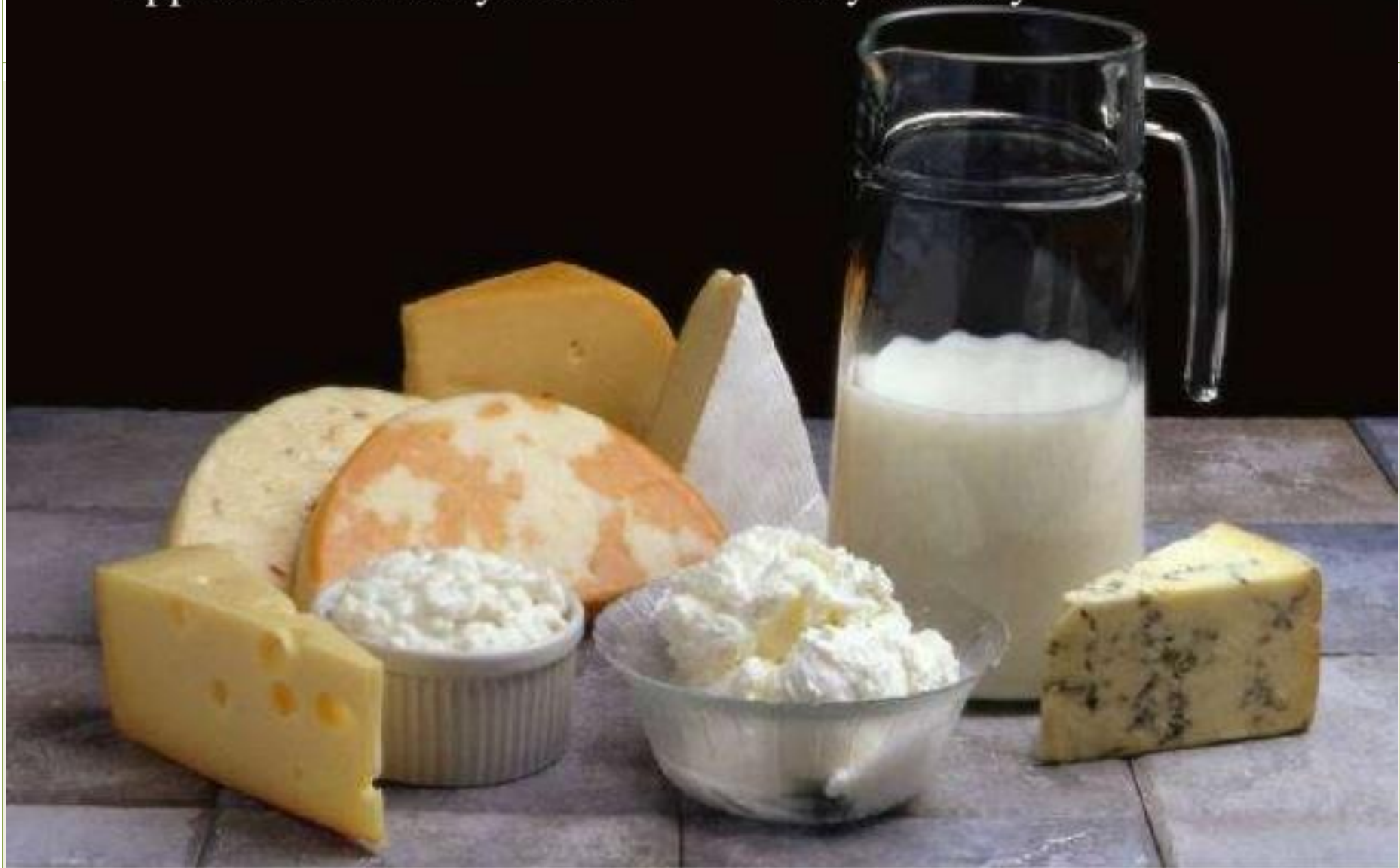


Summary of Liver Function Test Abnormalities

Disease	ALT	AST	GGT	ALP
Viral hepatitis	+++	+++	++	N+
Drug induced hepatitis	++	++	++	N+
Chronic active hepatitis	++	++	++	++
Infectious mononuclear hepatitis	++	++	++	N
Primary biliary cirrhosis	++	++	+++	++
Alcoholic cirrhosis	N	++	+++	N+
Intrahepatic cholestasis	++	++	+++	++
Extrahepatic cholestasis	++	++	+++	+++
Hepatic metastasis	N+	++	++	++

Applications of enzymes In

dairy industry



Dairy industry



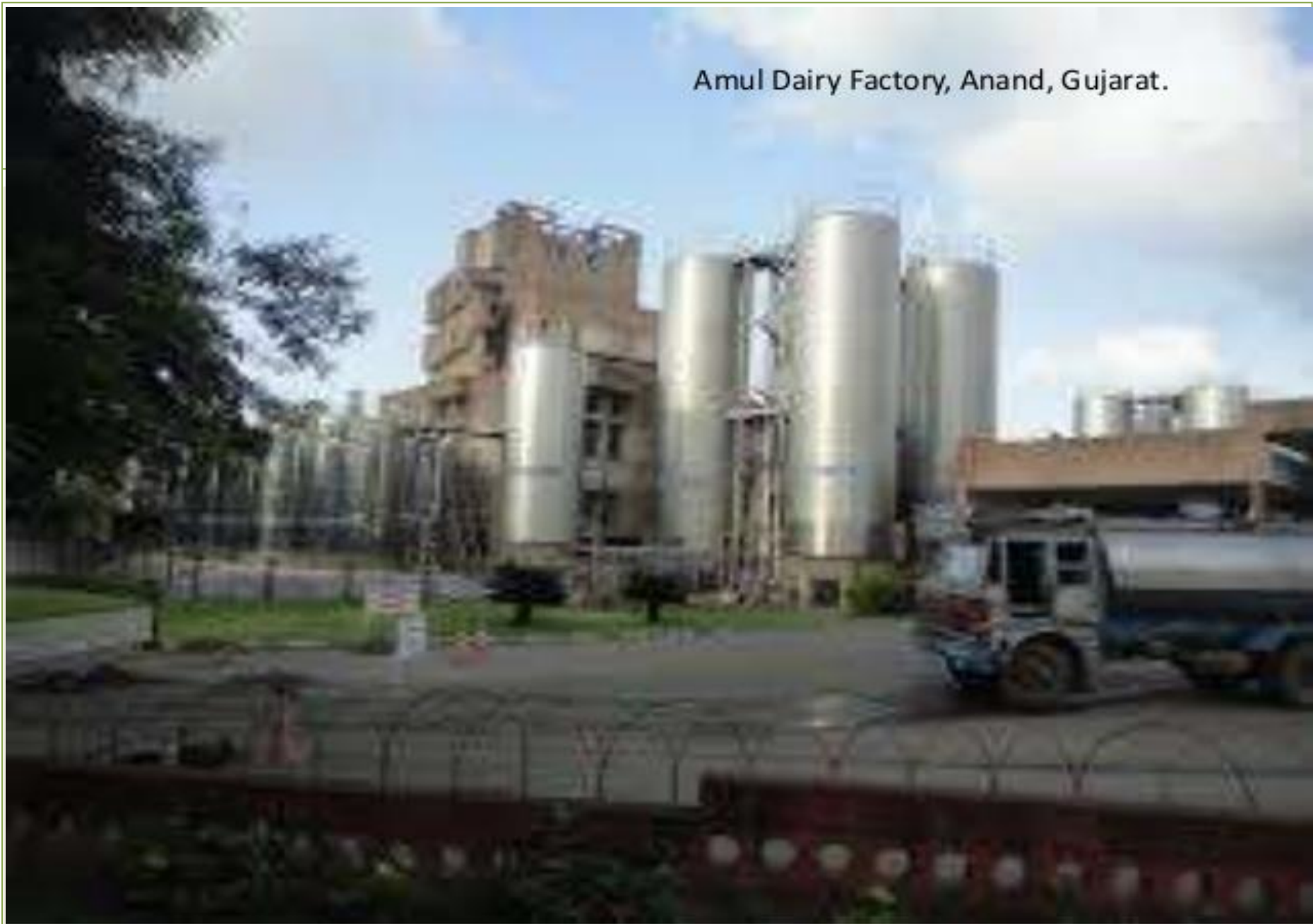
In the dairy industry, some **enzymes** are required for the **production** of cheeses, yogurt and other dairy products, while others are used in a more specialized fashion to **improve texture or flavour**.

Five of the more **common types** of enzymes and their role in the dairy industry are:

- **Coagulant Enzymes**
- **Lactase**
- **Lipases**
- **Bio protective Enzymes**
- **Yield- Enhancing Enzymes**

The function of these enzymes varies widely from **coagulants**, which are used to make cheese, to **bio protective enzymes** to enhance the shelf life and safety of dairy products.

Amul Dairy Factory, Anand, Gujarat.



Enzymes in Clothes and Dishwashing Detergents

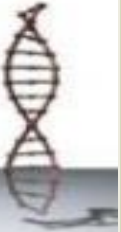
Enzymes can be used as detergents to remove stains such as grass, sweat and food from clothes. These biological washing powders contain proteases and lipases. These enzymes break down the proteins and fats in the stains. They help give cleaner washes and they work better than non-biological detergents at lower temperatures. This is because the enzymes work best at lower temperatures, they denature if the water is too hot. This means you lose less electricity. (Dishwasher detergents contain enzymes that digest cooked-on proteins like eggs, which are often hard to remove.)



Baking Industry

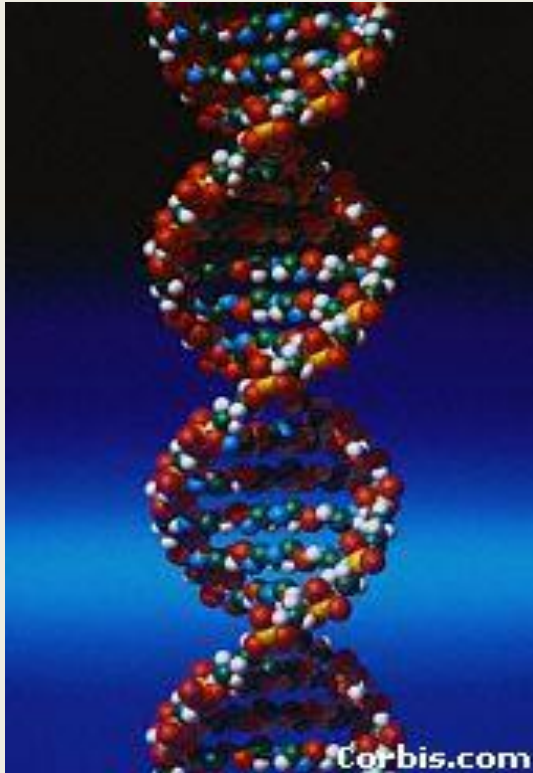


Oldest form of biotechnology



Making breads and curds with the help of micro organisms.

Molecular biology



- Used to manipulate DNA in genetic engineering, important in pharmacology, agriculture and medicine.
- Essential for restriction digestion and the polymerase chain reaction.
- Molecular biology is also important in forensic science.

Part of the DNA double helix ➤ **Enzymes used:-**

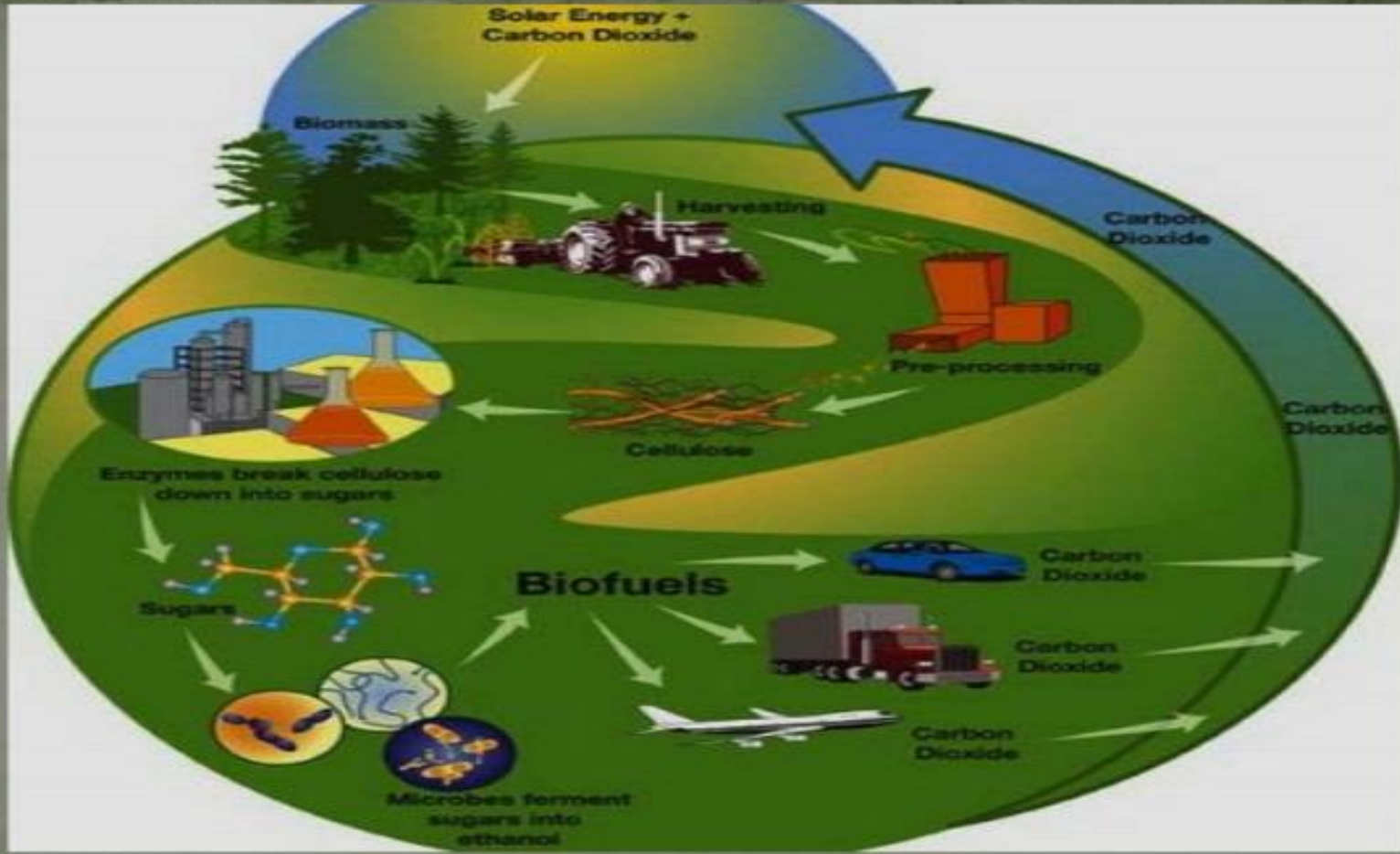
- Restriction enzymes, DNA ligase & polymerases

Biofuel industry



- Any solid liquid or gas fuel that is derived from Biomass is called as Biofuel.
- Types of Bio-fuels
 - Bio- gas
 - Bio -diesel
 - Ethanol
 - Butanol

Biofuel industry



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