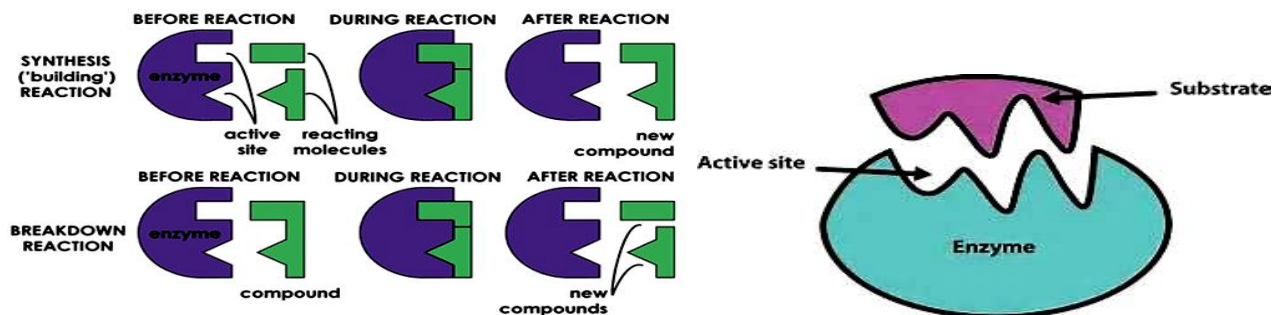


## Industrial Use of Enzymes in Our Daily Life

### Basic knowledge of Enzymes

1. Enzymes can be used as **catalysts**(催化劑) in industrial processes (Enzyme Technology)
2. Enzymes can be isolated from the cells and function outside the cells
3. Enzymes can be obtained from animals and plants (including microorganisms such as bacteria and fungi)
4. Enzymes are specific in action (each enzyme can only bind to a particular substrate)
5. Enzymes are sensitive to temperature and pH changes (unsuitable conditions may cause denaturation)



### Types of Enzymatic Industry

#### ❖ Food processing industries

##### 1. Meat products

**Papain**(木瓜蛋白酶) extracted from papaya is used to break down **proteins**(蛋白質) in the meat as a meat tenderizer. Powdered meat tenderizers use enzymes from papaya and pineapples to break meat down the same way that proteins are digested in our **intestine**(腸道).

##### 2. Starch processing products

**Amylase**(澱粉酵素) and **amylglucosidase**(葡萄糖苷酶) are used to break down starch into simpler form of sugar (usually monosaccharides) in making syrup. In the glucose syrup production processes, starch is usually the major component of reaction mixtures, Enzymes of various types are used in these processes. Although starches from diverse plants may be utilized, corn is the world's most abundant source and provides most of the substrate used in the preparation of starch hydrolysates. One example of the enzymes-involving starch processing is Gelatinization, involving the dissolution of the nanogram-sized starch granules to form a viscous suspension.

##### 3. Dairy products

**Lipase**(脂肪酶) is used for the ripening of cheese while protease is used for coagulating cheese. Rennet is also an enzyme for processing dairy products. Milk contains proteins, specifically caseins, that maintain its liquid form. Proteases are enzymes that are added to milk during

cheese production, to hydrolyze caseins, specifically kappa casein, which stabilizes micelle formation preventing coagulation. Rennet and rennin are general terms for any enzyme used to coagulate milk. Technically, rennet is also the term for the lining of a calf's fourth stomach.

#### 4. Fruit juice

**Pectinase**(果膠酶) is used to break down pectin in fruit juice to make them look clear. Nearly all fruits contain pectin, the presence of soluble pectin in squeezed juice cause cloudiness. The addition of pectin degrading enzymes (pectin methyl esterase, pectinase) at the pressing stage increases the amount of juice produced and can reduce cloudiness. The pectin component is manipulated requiring a balance between pectin methyl esterase, to promote cloudiness by increasing the pectin and **polygalacturonase**(多聚半乳糖). To break cloudiness, **depolymerisation** of pectin is required.



#### ❖ Other industries

##### 1. Leather products

**Trypsin**(胰蛋白酶) is used to remove hair from animals' skin. The main enzymes that are of interest to the leather industry are as followings:

- **Proteases** hydrolyze the protein fraction of dermatan sulfate, making collagen more accessible to water and reducing the attachment of basal layer. They also act in the removal of globular proteins.
- **Lipases** hydrolyze fats, oil and grease present in the hypoderm.
- **Keratinase**(角蛋白酶) hydrolyze the keratin of hair and the epidermis, breaks down the disulfide bonds of the molecule.

##### 2. Medical products

Most genetic diseases are a result of a particular enzyme deficiency. Similarly certain bacteria are more pathogenic because of an enzyme activity they have. **Protease** are used to clean wounds and therefore accelerate the healing process.

##### 3. Use in Biological Washing Powders

Principally **protease** digests organic stains such as grass. Blood, egg and human sweat. **Lipase** are effective on stains resulting from fatty products (lipid molecules). **Amylase** are effective on removing starchy food deposits. Some powders contain **cellulase** to brighten colours and soften fabrics. **Protease, lipase** and **amylase** are also effective in removing food particles as dishwasher detergents, which are environmentally friendly with fewer bleaching agents and phosphates, allowing enzymes to do more work and have beneficial effects on public health.

##### 4. Textile products

Enzymes can be safely used in textile wet processing like desizing, scouring, bleaching, dyeing and finishing, while traditional chemicals can cause a lot of pollution. Advance in enzyme

technology use in textile industry have made it possible to explore potential of single enzymes or enzyme mixtures for specific applications.

Hydrolases (e.g. **amylase**, **cellulase**, **pectinase** and **protease**) and **oxidoreductases**(氧化還原酶) have been employed for fabric preparation and finishing.

## □ Advantages of applying enzymes in production process

### 1. Enzymes are biological catalysts

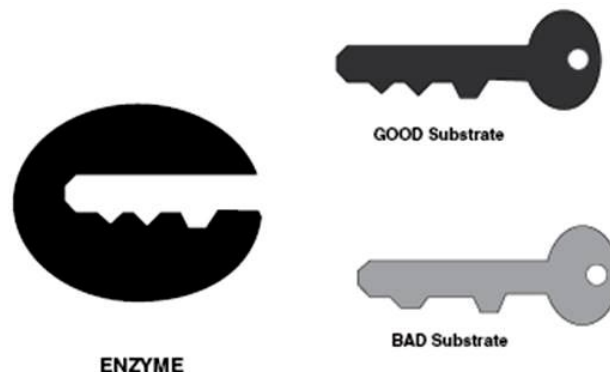
Enzymes are proteins functioning as catalysts that speed up reactions by lowering the activation energy. A simple and succinct definition of an enzyme is that it is a biological catalyst that accelerates a chemical reaction without altering its equilibrium. During the reactions the enzymes themselves undergo transient changes, they speed up the reactions in the cells so that they may occur in fractions of seconds. It can therefore reduce the production cost and allow mass production by speeding the enzymatic reaction in production process.

### 2. Enzymes can be reused

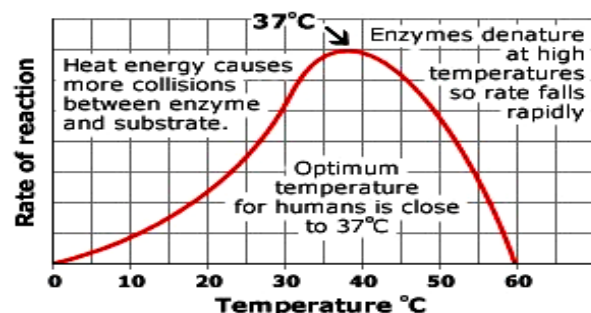
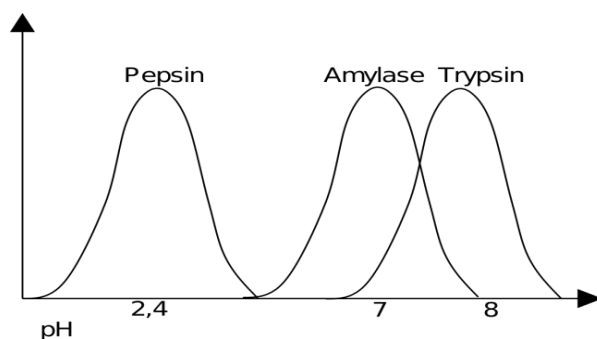
Once the product leaves the active site, enzymes are released in their original form, more substrate can enter. So the enzyme will keep on working until all the substrate is used up. In this case, production cost can be reduced since they are needed in small amount only.

### 3. Enzymes are specific in action

The enzymes are so specific to their action because they have active site which has three dimensional configuration binds to the complementarity three dimensional substrate molecule. In case if the structural configuration of the enzyme changes, the substrate is unable to bind at that site and the reaction does not take place. A specific enzyme only catalyse ONE reaction. (It only acts on one particular substance that happens to be compatible with that enzyme active site). This prevent the production of unwanted materials or **byproducts**(副產品) in the production.



What's More, enzymes are made of proteins which can be easily affected by temperature and pH changes. Each enzyme has its own **optimum temperature and pH value**(conditions that they work best). It's essential that the production conditions must be well-controlled to prevent the **denaturation** of enzymes!



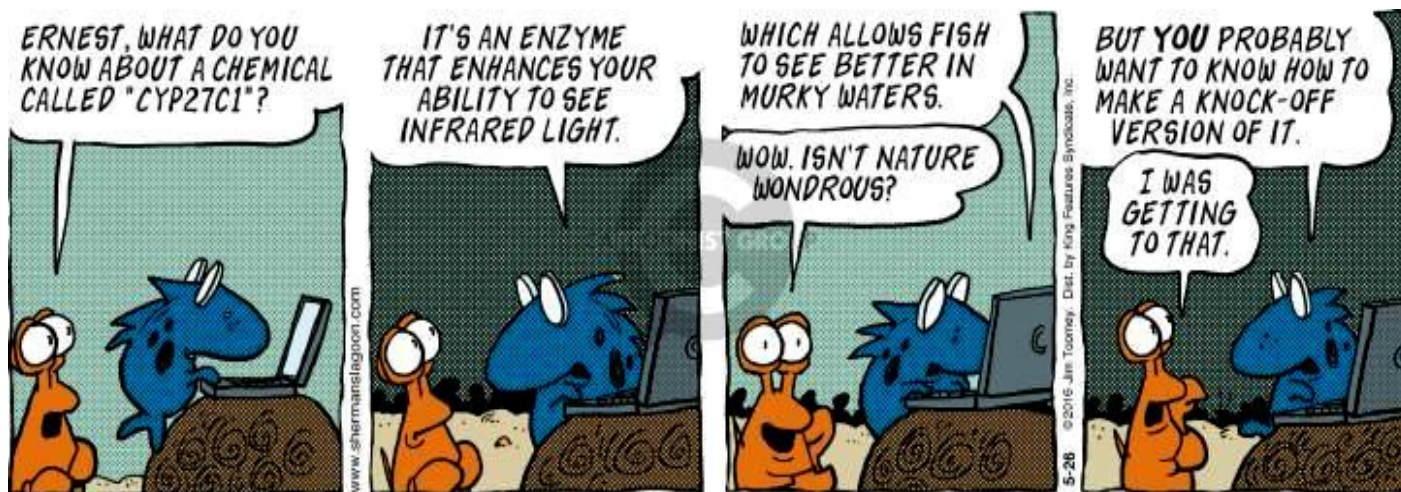


# RELAXING TIME!

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6			1	9	5			
	9	8					6	
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4			8		3			1
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	6					2	8	
			4	1	9			5
				8			7	9

6	7	1	9	8	2	5	4	3
5	3	9	9	1	4	7	8	2
4	8	2	7	3	5	1	9	6
6	5	8	4	2	9	3	1	7
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3	2	4	1	9	7	9	5	8
7	6	5	2	4	3	8	9	1
8	4	3	5	9	1	2	7	9
2	1	9	8	7	9	4	3	5

# COMIC CORNER!



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