CHAPTER 4: CHEMICAL COMPOSITION OF THE CELL

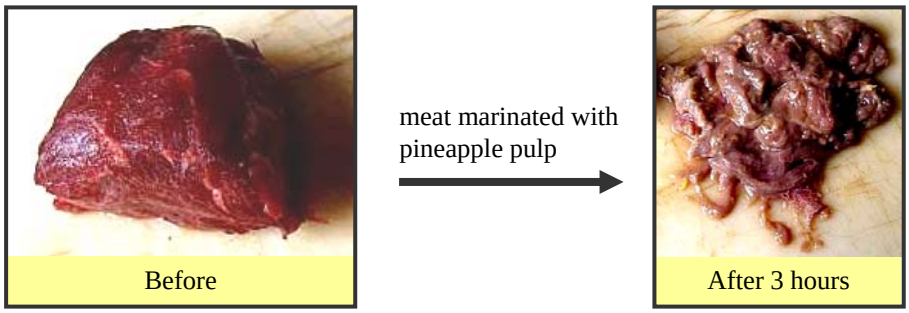
The Uses of Enzymes

1. The table below is a summary of the two general groups of enzymes used in genetic engineering.

Application	Enzyme used	Uses
Genetic engineering (*see Genetic Engineering, unit 14.3.2, page 518, Nexus SPM Biology)*	Restriction enzymes	They recognise specific DNA sequences and are used to cut the DNA chain at specific points. *(see Figure 14.23, page 519, Nexus SPM Biology)*
	DNA-modifying enzymes	They synthesise nucleic acids, degrade them, join the pieces together and remove parts of the DNA. Examples: • **DNA-polymerases** synthesise new DNA chains. • **Ligases** join adjacent nucleotides together. • **Nucleases** hydrolyse the bonds between DNA sugars. • **Kinases** add phosphate groups. • **Phosphatases** remove phosphate groups from the ends of DNA chains. *(see Tables 4.7 and 4.8, page 95, Nexus SPM Biology)*

2. There were questions on the following enzymes in the past years' examination papers.
   (a) **Papain**
      i. **Abstract**
      'Strips of unripe papaya are used to marinate pieces of meat.'
      (Question 2(c), Section A, Paper 2, SPM Biology, 2006)
      ii. **Comments**
      Sap from the unripe papaya contains the enzyme papain, a protease, which helps to **tenderise** the meat.
   (b) **Uses of enzymes**
      i. **Abstract**
      'Explain how enzymes act in helping to cook meat and to extract agar from seaweeds.'*(Question 4(c), Section A, Paper 2, SPM Biology, 2005)*
      ii. **Comments on enzymes in cooking meat**
      • **Proteases** are enzymes that are used in cooking meat.
      • Sources of proteases are papain (from unripe papayas), **bromelain** (from pineapples), **ficin** (from figs), and **rennet** (from calf stomach).
      • Papain, bromelain (see diagram) and ficin can be used to tenderise meat.

- Rennet coagulates milk, causing it to separate into a solid (**curd**) and a liquid (**whey**) and is used to make cheese, whey and junket (a milk-based dessert).



The digestion of meat by bromelain (from pineapple)

iii. **Comments on the abstraction of agar from seaweeds**

- Agar is extracted from agar-producing seaweeds.
- The way to extract agar is to dissolve the agar in the seaweed in hot water, separate the agar from the cell wall residues by filtration and then isolate the agar from the dilute solution.
- **Cellulase** is used to digest the cellulose of the cell walls and extract more agar from the seaweeds.

(c) **Lipase**

i. **Abstract**

'The use of lipase in food industry.' *(Question 1(c), Section A, Paper 2, SPM Biology, 2004)*

ii. **Comments**

- **Lipase** decomposes fat molecules (triglycerides) into more water-soluble compounds by hydrolysing the fat molecules into separate glycerol backbones and fatty acids *(see Figure 4.22, page 92, Nexus SPM Biology*).
- **Uses of lipase:**
  (1) to synthesise cocoa butter
  (2) to improve the whipping quality of dried egg white
  (3) to enhance the flavours of milk chocolate and chocolate ice cream
  (4) to produce different butter flavours
  (5) to produce the essential flavours of certain cheeses such as blue cheese, romano cheese and provolone cheese