THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

155/3 **FOOD AND HUMAN NUTRITION 3**

(For Both School and Private Candidates)

Time : 3 Hours **ANSWERS** **Year : 2003**

Instructions

1. This paper consists of sections **three (3)** questions
2. Answer all questions
3. Question **one (1)** carries **twenty (20)** marks and question **two (2)** and **three (3)** carries **fifteen (15)** marks each.
4. Communication devices and any unauthorised materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

1. You are provided with potato cubes, hydrogen peroxide solution, and boiling water. Perform the experiment as follows:
(i) Place one cube in boiling water for 5 minutes, then cool.
(ii) Place another raw cube in a test tube and add 10 ml of hydrogen peroxide. Record observations.
(iii) Place the boiled cube in a separate test tube with hydrogen peroxide. Record observations.

Questions:
(a) What reaction is demonstrated by the raw cube in step (ii)?
(b) Why was there a difference between raw and boiled cubes?
(c) State two applications of this reaction in food science.

ANSWERS

(a) The raw potato cube in step (ii) demonstrates the activity of the enzyme catalase. Catalase breaks down hydrogen peroxide into water and oxygen, releasing bubbles or foam. This shows that raw potato tissues contain enzymes that can catalyze the breakdown of toxic substances like hydrogen peroxide. For example, bubbling is clearly visible when hydrogen peroxide is poured onto a fresh potato surface.

(b) The difference between raw and boiled potato cubes is due to the effect of heat on enzymes. In the boiled cube, the catalase enzyme is denatured by the high temperature, so it can no longer break down hydrogen peroxide. As a result, there are no bubbles observed. This illustrates that enzymes are proteins which lose their activity when exposed to heat. For instance, in blanching vegetables before freezing, enzymes are destroyed by boiling to prevent unwanted spoilage reactions.

(c) One application of this reaction in food science is in the removal of hydrogen peroxide residues in milk during processing, where catalase is used to break it down safely. Another application is in demonstrating enzyme activity during teaching experiments in schools, where catalase from potato or liver is used as a simple example of biological catalysis.

2. You are provided with cooking oil, ethanol, and concentrated nitric acid. Perform the following:
(i) Place 5 ml of cooking oil in a test tube, add 5 ml of ethanol, and shake.
(ii) Add 2 ml of concentrated nitric acid and heat gently in a water bath. Record observations.

Questions:
(a) Identify the type of reaction taking place.

(b) State two uses of this reaction in the food industry.
(c) Why is ethanol added in step (i)?

ANSWERS

(a) The reaction taking place is nitration of lipids. Concentrated nitric acid reacts with the oil, causing colour changes and the release of fumes. This indicates chemical modification of the fat molecules. The reaction shows how lipids can undergo structural changes when treated with strong reagents. For example, nitration is one of the tests used to confirm the presence of unsaturated bonds in fatty acids.

(b) One use of this reaction in the food industry is in testing the composition of fats and oils to assess their level of unsaturation and quality. Another use is in research and development of food chemistry, where such reactions are studied to understand stability and reactivity of oils during processing. These tests help in ensuring the quality of edible oils before they are packaged and sold.

(c) Ethanol is added in step (i) to help dissolve the oil and make it mix more effectively with nitric acid. Since oils are hydrophobic and do not dissolve easily in water or acids, ethanol acts as a solvent to form a uniform mixture, ensuring the reaction proceeds smoothly. For example, in many lipid analysis procedures, alcohol is used as a carrier solvent to enable reactions between oils and aqueous reagents.

3. You are provided with maize flour and iodine solution. Carry out the following:
(i) Mix 20 g of maize flour with cold water to form a paste.
(ii) Add boiling water while stirring to form porridge.
(iii) Test a small sample of the porridge with iodine solution. Record observations.

Questions:
(a) Explain the observation in step (iii).
(b) State the significance of this property in porridge preparation.
(c) Give two health benefits of consuming maize porridge.

ANSWERS

(a) In step (iii), the porridge sample turns blue-black when iodine solution is added. This confirms that starch is still present even after heating. However, the reaction may be less intense than with raw flour because part of the starch has undergone gelatinization. Gelatinization occurs when starch granules swell

and burst in boiling water, dispersing into the liquid and thickening the porridge. For example, this is why porridge becomes smooth and viscous when cooked.

(b) The significance of this property in porridge preparation is that gelatinization thickens the mixture, making it more palatable and easier to consume. The swollen starch granules give porridge a smooth, semi-solid texture that is suitable even for infants and elderly people. This property also makes porridge more digestible compared to raw starch, since heating breaks down the structure of starch granules.

(c) One health benefit of consuming maize porridge is that it provides a good source of energy since it contains carbohydrates in the form of starch, which is digested into glucose. Another benefit is that porridge is often enriched with vitamins or proteins, making it a nutritious meal for children and adults. For example, in many households, maize porridge is fortified with milk or groundnuts to improve its nutritional value.