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 : 2001**

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 maize flour, tap water, iodine solution, and clean bowls. Carry out the experiment as follows:
(i) Place 20 g of maize flour into a beaker, add 40 ml of boiling water, stir to form a paste, and cool.
(ii) Divide the paste into two portions. Add a few drops of iodine to one portion. Record observations.
(iii) Take the other portion, add 10 ml of dilute hydrochloric acid, and heat gently for 5 minutes. Cool, then neutralize with dilute sodium hydroxide. Add Benedict's solution and heat. Record observations.

Questions:
(a) What is demonstrated in step (ii)?
(b) Explain the chemical changes taking place in step (iii).
(c) State the importance of the reaction in step (iii) in human digestion.

ANSWERS

(a) What is demonstrated in step (ii)?

Step (ii) demonstrates the **iodine test for starch**. When iodine solution is added to the maize flour paste, it reacts with starch molecules and produces a characteristic blue-black colour. This confirms that maize flour is rich in starch. For example, in laboratories, the iodine test is widely used to test the presence of starch in foods like cassava, potatoes, or bread.

(b) Explain the chemical changes taking place in step (iii).

In step (iii), starch is hydrolyzed by dilute hydrochloric acid into simpler sugars. The acid acts as a catalyst and breaks down the long chains of glucose molecules in starch into smaller units such as maltose and glucose. When Benedict's solution is added and the mixture heated, a red, orange, or green precipitate appears, showing the presence of reducing sugars. For example, this process is similar to industrial hydrolysis where starch is converted into glucose syrup.

(c) State the importance of the reaction in step (iii) in human digestion.

The reaction is important because it represents how starch is digested in the human body. In the mouth, salivary amylase starts the breakdown of starch into maltose, and in the small intestine pancreatic amylase continues the process. The final breakdown produces glucose, which can be absorbed into the bloodstream.

For example, when someone eats maize porridge, the starch is digested into glucose, providing energy for the body.

2. You are provided with milk, vinegar (acetic acid), and lime water. Perform the following:
(i) Put 20 ml of milk into a beaker and add 5 ml of vinegar. Allow it to stand for 10 minutes. Record observations.
(ii) Filter the mixture and collect both the residue and filtrate.
(iii) Heat the residue gently on a porcelain dish. Record odour and colour changes.
(iv) To the filtrate, add 5 ml of lime water and shake. Record observations.

Questions:
(a) Identify the residue obtained in step (ii).
(b) What does step (iii) demonstrate?
(c) Explain the observation in step (iv).
(d) State two practical applications of this experiment in food processing.

ANSWERS

(a) Identify the residue obtained in step (ii).

The residue obtained is **casein**, which is the main protein in milk. When vinegar, an acid, is added to milk, casein proteins coagulate and separate from the liquid part. The coagulated lumps collected on the filter paper represent casein curd. For example, this same principle is applied when preparing cheese, where milk proteins are separated by acid or enzymes.

(b) What does step (iii) demonstrate?

Step (iii) demonstrates that casein is a protein which undergoes **denaturation and decomposition** when heated. The casein residue changes colour and produces a strong odour, indicating that proteins decompose under high heat. This odour is caused by the release of nitrogen-containing compounds such as ammonia. For example, this is the reason why burnt milk or overcooked cheese develops an unpleasant smell.

(c) Explain the observation in step (iv).

In step (iv), lime water turns milky when mixed with the filtrate, which contains lactic acid and other soluble components from milk. This shows the presence of carbon dioxide or acid reacting with calcium hydroxide in the lime water. The milkiness is due to the formation of insoluble calcium carbonate. For example, this principle is commonly used in chemistry to test for the presence of carbon dioxide gas.

(d) State two practical applications of this experiment in food processing.

One application is in the **production of cheese and yoghurt**, where casein is coagulated by acids or enzymes to form curds. These curds are processed into different cheese varieties.

Another application is in **milk testing**, where adding acid helps in determining whether milk proteins are stable or spoiled. This ensures quality control in the dairy industry.

3. You are provided with cooking oil, sodium hydroxide solution, phenolphthalein, and ethanol. Perform the following:
(i) Place 5 ml of cooking oil in a test tube and add 5 ml of ethanol. Shake thoroughly.
(ii) Add 10 ml of sodium hydroxide solution and boil gently for 5 minutes. Allow to cool.
(iii) Add a few drops of phenolphthalein to the cooled mixture. Record observations.

Questions:
(a) What process is demonstrated in this experiment?
(b) Explain the importance of the process in food and non-food industries.
(c) State one other method used to test the quality of fats and oils.

ANSWERS

(a) What process is demonstrated in this experiment?

This experiment demonstrates **saponification**, which is the reaction of fats or oils with an alkali to produce soap and glycerol. The presence of phenolphthalein indicates the alkalinity of the solution, which is necessary for the reaction. For example, when cooking oil reacts with sodium hydroxide, soap is formed, which can later be used for cleaning purposes.

(b) Explain the importance of the process in food and non-food industries.

In the **food industry**, saponification is important in fat analysis. It is used to measure the saponification value of oils, which helps to determine their purity and quality. For example, edible oils are tested to ensure they are safe for human consumption.

In the **non-food industry**, saponification is used in the manufacture of soaps and detergents. Large-scale soap industries rely on this reaction to produce soaps of different grades. For example, household bathing soap and laundry detergents are all made from fats treated with alkali.

(c) State one other method used to test the quality of fats and oils.

Another method is the **iodine value test**, which measures the degree of unsaturation in fats and oils. A high iodine value indicates a higher proportion of unsaturated fatty acids, while a low value shows more saturated fats. For example, sunflower oil has a higher iodine value than coconut oil, reflecting its higher unsaturation level.