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 : 2004**

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 beans, water, and iodine solution. Perform the following:
(i) Soak beans in water for 6 hours.
(ii) Boil the soaked beans for 15 minutes.
(iii) Mash the beans and test a portion with iodine solution. Record observations.

Questions:
(a) What nutrient is being tested in step (iii)?
(b) Explain why boiling changes the test result.
(c) State the significance of boiling beans before eating.

ANSWERS

(a) The nutrient being tested in step (iii) is starch. When iodine solution is added to the mashed beans, the colour changes to blue-black, confirming the presence of starch. Beans, like many legumes, contain starch as their main carbohydrate reserve. For example, in food laboratories, the iodine test is routinely used to confirm starch in foods such as maize, cassava, and potatoes.

(b) Boiling changes the test result because it causes gelatinization of starch granules. During heating, the granules absorb water, swell, and burst, making the starch molecules more accessible to iodine. As a result, the colour reaction may appear stronger or more diffuse compared to raw beans. This shows that cooking alters the physical properties of starch. For example, porridge prepared from flour thickens due to gelatinization, which does not happen with raw flour.

(c) Boiling beans before eating is significant for several reasons. First, it improves digestibility because heat breaks down starch granules and denatures proteins, making the nutrients easier to digest. Second, it destroys anti-nutritional factors such as lectins and protease inhibitors found in raw beans, which can otherwise interfere with digestion. For example, properly boiled beans are safe and nutritious, while undercooked beans may cause stomach discomfort or food poisoning.

2. You are provided with fresh milk, dilute acetic acid, and dilute sodium hydroxide. Perform the following:
(i) Add 5 ml of acetic acid to 20 ml of milk. Record observations.
(ii) Filter the mixture and retain the residue.
(iii) Wash the residue with water and then dissolve it in dilute sodium hydroxide. Record observations.

Questions:

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

(b) What property of protein is demonstrated in step (iii)?

(c) State two food applications of this property.

ANSWERS

(a) The residue obtained in step (ii) is casein, the main milk protein. When acetic acid is added to milk, it lowers the pH and causes casein to coagulate, separating it as curds from the liquid portion (whey). For example, this same principle is used in cheese making, where enzymes or acids are used to curdle milk proteins.

(b) The property of protein demonstrated in step (iii) is amphoteric behaviour. Proteins can react with both acids and bases because of the amino and carboxyl groups in their structure. After coagulating in acid, the casein dissolves again when treated with dilute alkali, showing that proteins can exist in different ionic forms depending on the pH. For example, this property is important in food chemistry when adjusting acidity to control the texture of dairy products.

(c) One application of this property is in the production of cheese, where milk proteins are coagulated by acids or rennet to form curds that can later be processed. Another application is in food preservation and processing, where controlling pH helps maintain protein solubility or cause precipitation for specific products. For instance, yoghurt production relies on acidification to modify the solubility of milk proteins.

3. You are provided with sugar solution, yeast, bicarbonate of soda, and lime water. Perform the following:

(i) Place 10 ml of sugar solution and yeast in a test tube. Stopper and connect to lime water through a delivery tube. Leave for 15 minutes in warm conditions.

(ii) In another test tube, add 2 g of bicarbonate of soda and heat gently. Connect the gas to lime water. Record observations for both setups.

Questions:

(a) Identify the gas produced in both experiments.

(b) Write the chemical equation for the reaction in step (ii).

(c) State the importance of step (i) in bread making.

ANSWERS

(a) The gas produced in both experiments is carbon dioxide (CO_2). In step (i), the yeast ferments the sugar, releasing carbon dioxide, which turns lime water milky. In step (ii), heating bicarbonate of soda produces the same gas, also confirmed by the lime water test. For example, this test is widely used in laboratories to detect the presence of carbon dioxide gas.

(b) The chemical equation for the reaction in step (ii) is:
$2\ NaHCO_3\ (s) \rightarrow Na_2CO_3\ (s) + CO_2\ (g) + H_2O\ (g)$
This shows that heating sodium bicarbonate releases carbon dioxide, along with water vapour, leaving behind sodium carbonate. This reaction is commonly applied in baking powders.

(c) The importance of step (i) in bread making is that the carbon dioxide produced by yeast causes the dough to rise. The gas gets trapped in the gluten network, making bread light, soft, and spongy. Without yeast fermentation, bread would remain flat and dense. For example, in traditional baking, yeast is always used to make breads such as chapati, loaves, and buns fluffy and appealing.