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 : 2008**

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 a slice of yam and a piece of fish. Perform the experiment I and II by following the given procedures.

Experiment I: Place the slice of yam on a hot pan and heat each side at high temperature (above 70° C) for 3–5 minutes. Record changes in colour, texture, and aroma.

(a) The reaction responsible is the Maillard reaction, a chemical reaction between reducing sugars and amino acids producing browning, aroma, and flavour changes.

(b) Three steps involved are: formation of glycosylamine from sugar and amino acid, rearrangement to Amadori products, and decomposition to brown pigments and aromatic compounds.

(c) High temperature provides energy to drive the reaction and evaporates water to concentrate reactants, enhancing browning and aroma.

(d) Two other cooking methods producing similar results are roasting and baking.

Experiment II: Wash the piece of fish and place it directly on a hot pan. Heat each side at high temperature (above 70° C) for 5 minutes. Record changes in texture and aroma.

(a) The fish undergoes protein denaturation and Maillard reaction. The texture firms and the aroma changes. Differences from yam arise because fish proteins coagulate while yam sugars primarily cause browning.

(b) Texture can be improved by marinating in acidic solutions or using moist heat prior to pan heating.

2. You are provided with maltose, sucrose, baking soda, and brewer's yeast. Perform the following experiments:

Experiment I: Dissolve 10 g of maltose in 50 ml of warm water and add 5 g of yeast. Repeat using sucrose instead of maltose. Fill two gas jars with water and invert them on a beehive shelf in a trough. Warm flasks to 30° C and fit each with a delivery tube leading into the gas jars. Observe changes after two intervals of 15 minutes.

(a) Balanced equations: $C_{12}H_{22}O_{11} + H_2O \rightarrow 2\ C_6H_{12}O_6$; then $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$.

(b) Sugar provides substrate; yeast catalyzes fermentation.

(c) Yeast property demonstrated is fermentation.

Experiment II: Mix 2 g of baking soda with 3 ml of water in a test tube. Fit with a delivery tube leading to lime water. Heat gently and observe.

(a) Heating produces CO_2 from $NaHCO_3$ reacting with acids or water: $NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$.

(b) Balanced equation: $2\ NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$.

(c) Importance in baking is leavening the dough.

3. You are provided with samples I, J, K, and L. Perform Experiments I–IV, record observations, and answer questions.

Experiment I: Add 2 ml of sample I to a test tube, add 3 drops of dilute hydrochloric acid, boil gently for a minute, cool, add 3 drops of dilute sodium hydroxide, then Benedict's solution. Shake and boil.

Observed colour change to red indicates reducing sugars hydrolyzed by acid and detected by Benedict's solution.

Experiment II: Add 2 ml of sample J to a test tube, add equal volume of dilute sodium hydroxide, then 2–3 drops of 1% copper (II) sulphate. Mix thoroughly.

Purple colour confirms presence of proteins due to peptide-copper complex formation (Biuret reaction).

Experiment III: Add 2 g of sample K to 5 ml of dilute hydrochloric acid. Filter, neutralize filtrate with ammonium hydroxide, then add 5% ammonium oxalate solution.

Dilute HCl dissolves calcium salts; white precipitate with ammonium oxalate confirms calcium: $Ca^{2+} + C_2O_4^{2-} \rightarrow CaC_2O_4$.

Experiment IV: Dissolve 1 g of sample L in concentrated nitric acid, filter, add a few drops of 10% ammonium molybdate solution, and warm.

Yellow precipitate indicates phosphate; legumes and cereals are good sources; warming accelerates reaction.