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 : 2006**

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 sweet potato and a piece of chicken. Perform the experiment I and II by following the given procedures.

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

(a) The reaction responsible for the observed characteristics is the Maillard reaction. It is a chemical reaction between reducing sugars and amino acids that occurs when food is heated, resulting in browning and development of flavour and aroma.

(b) Three steps involved in the Maillard reaction are: first, sugar reacts with amino acids forming glycosylamine; second, rearrangement occurs producing Amadori compounds; third, these compounds decompose to form brown pigments (melanoidins) and aromatic compounds.

(c) High temperature accelerates the reaction by providing the energy needed for chemical bonds to break and reform, and it enhances water evaporation, concentrating reactants to intensify browning.

(d) Two other cooking methods that produce similar characteristics in sweet potato are baking in an oven and roasting over charcoal.

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

(a) The chicken undergoes protein denaturation and Maillard reaction. The texture becomes firmer and drier while a roasted aroma develops. Unlike sweet potato, which browns due to sugar-amino acid reactions, chicken changes are mostly due to protein coagulation and partial browning.

(b) The texture of chicken can be improved by marinating with acidic solutions or using moist heat before frying, which helps break down muscle fibers and retain juiciness.

2. You are provided with honey, fructose, baking powder, and yeast. Perform the following experiments:

Experiment I: Dissolve 10 g of honey in 50 ml of warm water in a flask and add 5 g of yeast. Repeat using fructose instead of honey. Fill two gas jars with tap water and place each upside-down on a beehive

shelf in a trough of water. Warm the flasks to 30° C. Fit each flask with one end of a delivery tube and immerse the other end in the respective gas jars. Observe changes after two intervals of 15 minutes.

(a) The balanced chemical equation for fermentation using glucose (from honey) is: $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$. For fructose, it is $C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$.

(b) Sugar provides the substrate for yeast fermentation, while yeast acts as a catalyst and produces enzymes that convert sugar into ethanol and carbon dioxide.

(c) The property of yeast demonstrated is its ability to ferment sugars, producing gas and ethanol as by-products.

Experiment II: Mix 2 g of baking powder with 3 ml of water in a clean, dry test tube. Fit the test tube with one end of a delivery tube and immerse the other end in lime water in another test tube. Gently heat the mixture and observe.

(a) On heating, baking powder releases carbon dioxide gas through an acid-base reaction. The gas bubbles out and turns lime water milky due to calcium carbonate formation.

(b) The balanced equation is: $NaHCO_3 + H^+ \rightarrow Na^+ + CO_2 + H_2O$.

(c) This reaction is important in baking because the carbon dioxide gas leavens dough, creating a soft and porous texture.

3. You are provided with samples E, F, G, and H. Perform Experiments I to IV. Record observations and provide inferences.

Experiment I: In a test tube containing 2 ml of sample E, add 3 drops of dilute hydrochloric acid. Boil under low heat for one minute, allow to cool, then add 3 drops of dilute sodium hydroxide followed by equal volume of Benedict's solution. Shake and boil again.

The observed change, such as a colour change to brick-red, indicates the presence of reducing sugars. Hydrochloric acid hydrolyzes complex carbohydrates into simple sugars, which then react with Benedict's solution.

Experiment II: In a test tube containing 2 ml of sample F, add equal volume of dilute sodium hydroxide and mix thoroughly. Add 2–3 drops of 1% copper (II) sulphate solution and mix.

The formation of a violet or purple colour indicates the presence of proteins. Sodium hydroxide and copper ions form a complex with peptide bonds, known as the Biuret reaction.

Experiment III: In a test tube containing 2 g of sample G, add 5 ml of dilute hydrochloric acid and mix thoroughly. Filter and neutralize the filtrate with ammonium hydroxide. Add equal volume of 5% ammonium oxalate solution to a portion of the filtrate.

Dilute hydrochloric acid dissolves calcium salts in the sample. The addition of ammonium oxalate produces a white precipitate of calcium oxalate: $Ca^{2+} + C_2O_4^{2-} \rightarrow CaC_2O_4$. This confirms the presence of calcium.

Experiment IV: Dissolve 1 g of sample H in concentrated nitric acid. Filter and add a few drops of 10% ammonium molybdate solution to a portion of the filtrate. Warm gently.

Yellow precipitate formation indicates the presence of phosphate ions. Best plant sources of phosphates are legumes and cereals. Warming is necessary to accelerate the reaction between phosphate ions and ammonium molybdate.