**THE UNITED REPUBLIC OF TANZANIA**
**NATIONAL EXAMINATIONS COUNCIL OF TANZANIA**
**ADVANCED CERTIFICATE OF SECONDARY EDUCATTION EXAMINATION**

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

(Actual Practical)

(For Both School and Private Candidates)

**Time: 3 Hours** **ANSWERS** **Year: 2022**

**Instructions**

1. This paper consists of sections three questions.
2. Answer **all** questions.
3. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

1. You are provided with a slice of white bread and a piece of beef.

**Experiment I**

(i) Place the slice of bread on a hot pan and heat each side at high temperature (above 70°C) for 3 to 5 minutes.
(ii) Record the observations:

**Observation:**
The bread changes colour from white to light brown and then dark brown. Its texture becomes harder and crispier. A pleasant, roasted aroma develops.

(a) **Name and define the reaction:**
Maillard reaction — a non-enzymatic browning reaction between amino acids (proteins) and reducing sugars in the presence of heat, producing brown pigments and flavour compounds.

(b) **Three steps involved in the reaction:**

First, reducing sugars react with amino acids to form unstable glycosylamine.

Second, glycosylamine undergoes Amadori rearrangement to form ketosamines.

Third, ketosamines break down into various aromatic compounds, melanoidins (brown pigments), and volatile substances contributing to the aroma and colour.

(c) **Two roles of high temperature in this reaction:**

It accelerates the rate of reaction between proteins and sugars.

It helps in the breakdown of complex intermediates into brown pigments and aromatic compounds.

(d) **Two methods of cooking food resulting in the observed characteristic:**

Toasting

Baking

**Experiment II**

(a) Wash the beef and place it on a hot pan.
(b) Heat each side at high temperature above 70°C for 5 minutes.

**Observation:**
The beef changes from red to brown. The texture becomes firm and harder. A pleasant meaty aroma develops.

(a) **Reasons for changes in texture and aroma differing from Experiment I:**

The beef contains proteins and fats, but little carbohydrate. Heat denatures and coagulates the proteins, making the beef firmer. The fat melts, producing a meaty aroma. Unlike bread, there's no significant Maillard reaction due to lower sugar content.

(b) **How texture of beef is improved during processing:**

By marinating in acidic solutions like vinegar or lemon juice, which tenderises muscle fibres.

By cooking slowly at low temperatures (stewing or braising), breaking down connective tissues (collagen) into soft gelatin.

2. You are provided with table sugar, glucose, baking soda and yeast.

**Experiment I**

(a) Dissolve 10 g of table sugar in 50 ml water in a flask and add 5 g yeast.
(b) Repeat using glucose.
(c) Fill two gas jars with water and place upside-down on a beehive shelf in a trough of water.
(d) Warm the flask to 30°C, fit with delivery tubes, and insert into the beehive shelf.
(e) Observe changes at 15-minute intervals.

**Observation:**
More gas bubbles collect in the jar connected to glucose than sugar after 15 minutes.

(a) **Explain the reaction when heat is applied to baking soda:**

Heating baking soda causes it to decompose, releasing carbon dioxide gas, water vapour and leaving behind sodium carbonate.

(b) **Balanced equation:**
$2NaHCO_3$ (s) -----> $Na_2CO_3$ (s) + $CO_2$ (g) + $H_2O$ (g)

(c) **Importance of this reaction in baking:**

The carbon dioxide gas released forms bubbles that expand within the dough, making it rise and resulting in soft, spongy baked products.

3. You are provided with samples A (fresh sugar cane juice), B (soybean milk), C (cassava leaf powder) and D (sardine powder).

**Experiment I**

(a) Add 3 drops of dilute HCl to 2 ml of sample A, boil gently, then cool.
(b) Add 3 drops of dilute NaOH, then equal volume of Benedict's solution.
(c) Shake and boil again.

**Observation:**
A brick-red precipitate forms.

**Explanation:**

First, dilute HCl hydrolyses non-reducing sugars (like sucrose) into reducing sugars (glucose and fructose).

Then, Benedict's solution reacts with the reducing sugars, forming a brick-red precipitate of copper (I) oxide indicating presence of reducing sugars.

**Experiment II**

(a) Add equal volume of dilute NaOH to 2 ml of sample B, mix well.
(b) Add 2–3 drops of 1% $CuSO_4$ solution and mix.

**Observation:**
A violet colour appears.

**Explanation:**
This is the Biuret test, where copper ions react with peptide bonds in proteins to form a violet-coloured complex, indicating the presence of proteins in soybean milk.

**Experiment III**

(a) Add 5 ml of dilute HCl to 2 g of sample C, mix well.
(b) Filter and neutralise filtrate using ammonium hydroxide (confirmed by red litmus turning purple).
(c) Add equal volume of 5% ammonium oxalate solution.

**Observation:**
A white precipitate forms.

(i) **Reason for adding dilute HCl:**
To extract calcium ions from cassava leaf powder by dissolving them into solution.

(ii) **Balanced equation:**
$Ca^{2+}$ (aq) + $(NH_4)_2C_2O_4$ (aq) -----> $CaC_2O_4$ (s) + $2NH_4^+$ (aq)

**Experiment IV**

(a) Dissolve 1 g of sample D in concentrated nitric acid.
(b) Filter and add few drops of 10% ammonium molybdate solution to filtrate.
(c) Warm gently.

**Observation:**
A yellow precipitate forms.

(i) **Two plant foods rich in the inferred nutrient (phosphorus):**
Groundnuts
Beans

(ii) **Reason for warming the mixture:**
To speed up the reaction between phosphate ions and ammonium molybdate, ensuring the formation of the yellow precipitate of ammonium phosphomolybdate indicating presence of phosphates.