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

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

(Actual Practicals)

(For Both School and Private Candidates)

Time: 3 Hours **Year: 2021**

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 food samples J (rice starch), K (cassava starch) and L (white wheat flour). Perform the following experiments:

Experiment I.
(i) Mix sample J and K with distilled water in separate beakers, stir and let them settle for 3 minutes.
(ii) Filter the liquid for each sample to remain with white sediments. Use spatula to take some white sediments from each sample into a slide and examine them under a light or compound microscope in low and high magnification.

Questions:

(a) (i) Draw the structures of each sample observed under microscope:

- Rice starch granules (sample J): Small, polygonal or angular shaped granules with simple or no markings.
- Cassava starch granules (sample K): Large, oval or rounded granules with a distinct hilum (central point) and sometimes showing concentric rings.

(ii) Properties of each structure observed under microscope:

- Rice starch granules: Small, irregular polygonal or angular shapes with smooth surfaces, mostly single granules.
- Cassava starch granules: Large, oval or rounded, having a hilum (central point) and concentric rings under polarised light.

(iii) Plant group from which each sample was obtained:

- Rice starch (sample J): Monocotyledonae
- Cassava starch (sample K): Dicotyledonae

(iv) Identify the samples:

- Sample J is rice starch.
- Sample K is cassava starch.

(v) Common properties of samples J and K:

Both are polysaccharides composed of glucose units. Both are insoluble in cold water but form pastes in hot water. Both form white sediments when mixed with water and can show a blue-black colour with iodine solution. They are stored forms of carbohydrates in plants.

Experiment II.

Place 2 g of sample L in a crucible and heat it by using dry heat (without burning the sample) and record the observation.

Questions:

(b) (i) Name the compound formed after heating the sample:

Dextrin

(ii) Properties of the compound formed after heating sample L:

It is yellowish-brown in colour, water-soluble, has a sweet taste, and gives a red-brown colour when heated with Benedict's solution due to the formation of reducing sugars.

(c) Forms of long chains of glucose units usually present in samples J, K, and L before heating:

All three samples contain starch, made up of two forms:

- Amylose: A linear chain of glucose molecules linked by α-1,4-glycosidic bonds.
- Amylopectin: A branched chain with α-1,4-glycosidic bonds in the chain and α-1,6-glycosidic bonds at the branching points.

2.

You are provided with a fresh egg. You are required to break the egg and separate the contents into two different beakers. Then perform the Experiments I, II, and III by undergoing the given procedures:

Experiment I

(i) Put 2 ml of egg white into a test tube and then add 1 ml of 10% sodium hydroxide solution.
Observation: The mixture remains colourless but turns purple upon adding a few drops of copper sulphate solution.
Explanation: Sodium hydroxide denatures proteins, and when copper (II) ions are added, they form a violet-coloured complex indicating the presence of peptide bonds (Biuret reaction).

(ii) Put 2 ml of egg white into another test tube and then add 2 drops of concentrated nitric acid and leave the mixture to stand for 5 minutes.
Observation: A white precipitate forms.
Explanation: The proteins denature and coagulate due to the strong acidic environment, causing them to lose their solubility.

(iii) Heat the mixture obtained in step (ii) in the boiling water from the water bath.
Observation: The white precipitate turns yellow on heating and then orange upon cooling.
Explanation: The protein undergoes denaturation and forms xanthoproteic reaction due to the nitration of aromatic amino acids like tyrosine and tryptophan.

Questions:

(a) Record the observations and give explanations in each procedure (done above).

(b) Purpose of the experiment:

To test and demonstrate the denaturation and coagulation properties of proteins in egg white under the influence of alkalis, acids, and heat.

Experiment II

(i) Put 3 ml of egg white into a clean and dry test tube and then add equal volume of distilled water.
(ii) Shake the mixture well, place a filter paper on a funnel, wet it with distilled water, and then filter the mixture into another test tube.
(iii) Put 2 ml of the filtrate into a test tube and then perform the Biuret test and record the observation.

Observation:
A violet or purple colour appears after adding Biuret reagent (mixture of sodium hydroxide and copper (II) sulphate solution).

(c) Principle behind the Biuret test:

When proteins (which contain peptide bonds) are treated with dilute copper (II) sulphate in an alkaline medium, a violet-coloured complex is formed due to coordination between the copper ions and the nitrogen atoms of the peptide bonds.

Experiment III

Put a small portion of the egg yolk in an evaporating dish, heat it on dry heat while observing the changes in colour with increase in temperature, then write the observations and give an explanation.

Observation:
The egg yolk changes from yellow to brown and finally black as temperature increases.

Explanation:
The proteins denature and coagulate upon heating. Continuous heating causes further chemical changes including Maillard reaction (reaction between proteins and sugars) and carbonisation, leading to browning and charring.

(d) Justification of the statement:

The ability of egg proteins to coagulate and form solid structures upon heating makes them useful in food preparation. This property helps in binding, thickening, emulsifying, coating, and setting mixtures, essential in recipes such as cakes, custards, sauces, and pastries.

3. You are provided with baker's yeast, white sugar, wheat flour, bicarbonate of soda, and solution A (lime water/calcium hydroxide solution).

Experiment I

(i) Place 2 g of bicarbonate of soda into a clean dry test tube. Fit the test tube with a tight-fitting rubber stopper connected into a delivery tube.
(ii) Put 2 ml of solution A into another test tube and then fit the test tube with a tight-fitting rubber stopper connected into a delivery tube.
(iii) Connect the two delivery tubes from each test tube using a rubber tube. Record the observation on the changes in solution A before heating.

Observation:
Solution A remains clear.

(iv) Heat gently the test tube containing bicarbonate of soda. Record the observed changes and give an explanation.

Observation:
Solution A turns milky.

Explanation:
Heating bicarbonate of soda releases carbon dioxide gas, which passes into lime water (solution A), forming calcium carbonate which makes it turn milky.

Questions:

(a) Identify solution A:

Solution A is lime water (calcium hydroxide solution).

(b) Write balanced chemical equations:

Heating of bicarbonate of soda:
$2NaHCO_3$ (s) -----> Na_2CO_3 (s) + CO_2 (g) + H_2O (g)

Reaction of CO_2 with lime water:
$Ca(OH)_2$ (aq) + CO_2 (g) -----> $CaCO_3$ (s) + H_2O (l)

(c) Application of Experiment I in making bread and buns:

In bread-making, bicarbonate of soda acts as a leavening agent. It decomposes when heated, producing carbon dioxide gas that gets trapped within the dough, causing it to rise and develop a spongy texture.

(d)

In **Experiment II**

> If the environment was maintained at 10°C, the yeast activity would significantly slow down due to low temperature. Fermentation would be delayed, and little or no gas formation would be observed, meaning the flour layer would remain unchanged and the smell would be weak or absent.

(e) What Experiment II demonstrates:

It demonstrates anaerobic respiration (fermentation) by yeast. The yeast ferments the sugar in warm water to produce carbon dioxide and ethanol. The carbon dioxide causes the thin layer of wheat flour to crack and rise, while ethanol and fermentation products produce a characteristic alcoholic smell.

This is a clear demonstration of how yeast works in leavening dough in baking.