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: 2:30 Hours **ANSWERS** **Year: 2023**

Instructions

1. This paper consists of sections **A** and **B**.
2. Answer **all** questions in section **A** and only **Three (3)** questions from section **B**.
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 wheat flour (food sample H), food reagents and a piece of cloth (muslin cloth). Perform an experiment by following the given procedures.

(i) Place the wheat flour in a mixing bowl. Add little water gradually and kneed for 10 minutes to make dough. Roll the dough into a ball, place it in a petri dish then press to touch it while observing. Record your observations and to give explanations for the observations.

Observation:
A soft, elastic, and slightly sticky dough is formed. When pressed, it feels spongy and springs back slowly.

Explanation:
Water hydrates the proteins (mainly glutenin and gliadin) in wheat flour forming gluten. Kneading aligns gluten strands into an elastic, cohesive network giving the dough its stretch and elasticity.

(ii) Place the dough on a piece of cloth and wrap it tightly. Wash and squeeze the dough under running tap water. Serve about 50ml of the first washing in a beaker and leave it to settle for 15 minutes. Record their observations and to give explanations for their observations.

Observation:
The washing water turns milky white with suspended starch particles, and a sediment settles at the bottom after standing.

Explanation:
Washing removes starch granules from the dough, leaving behind insoluble gluten protein. The starch remains suspended in water before settling as a white sediment.

(iii) Continue washing until the water coming out is clean. Scratch the substance left from the piece of cloth and place it in a petri dish. Record the characteristics of the obtained substance and compare its size with the original dough.

Observation:
A yellowish, rubbery, elastic, and sticky mass (gluten) remains. Its size is much smaller than the original dough.

Explanation:
Most of the starch and soluble substances have been washed away, leaving behind insoluble gluten proteins.

(iv) Place 2g of the substance obtained in procedure (iii) in a test tube then add concentrated nitric acid to cover it. Carefully boil the mixture while observing the colour changes. Cool the mixture under tap water and carefully add 3ml of ammonium hydroxide solution while observing. Record your observations.

Observation:
On boiling with nitric acid, the substance turns yellow. After cooling and adding ammonium hydroxide, it turns orange.

Explanation:
This is the xanthoproteic test. The aromatic amino acids in gluten react with nitric acid to form yellow nitro-derivatives. On addition of alkali (ammonium hydroxide), the colour deepens to orange.

Questions

(a) Identify sample H.

Sample H is wheat flour.

(b) What is the effect of discarding the top substance obtained in step (ii)?

If discarded, it would remove most of the starch content from the flour, leading to incomplete analysis or processing. The starch is valuable for observing separation efficiency and potential further testing.

(c) Identify the substance obtained in step (iii).

The substance is gluten (a mixture of glutenin and gliadin proteins).

(d) Give the reason for the change in the size of the dough observed in step (iii).

The size reduced because most of the starch and water-soluble components were washed away, leaving only the insoluble gluten proteins.

(e) What does step (iv) demonstrate.

It demonstrates the presence of proteins containing aromatic amino acids in gluten by xanthoproteic reaction.

(f) Briefly explain the principle applied in separating the two components of sample H.

The principle is based on the differential solubility of components: starch dissolves and washes away in water while gluten remains insoluble, allowing physical separation by kneading and washing.

2. You are provided with food sample G. Peel, wash and cut four slices from the sample. Perform the experiment immediately by following the given procedure. Record your observations in colour changes after 10 minutes. Give explanations of what you have observed and then answer the questions that follow.

Procedure:

(i) leave one slice on a plain paper.

Observation:
Slice turns brown.

(ii) Put the second slice in a tap water bath.

Observation:
Very little or no browning occurs.

(iii) Spray the third slice with lemon juice.

Observation:
No browning or very slight.

(iv) Plunge the fourth slice into boiling water for 3 minutes.

Observation:
No browning after removal.

Questions

(a) Briefly explain the reaction that resulted into the development of colour change observed in the experiment. Give three points.

- When the cut surface of food is exposed to air, polyphenol oxidase enzyme catalyses the oxidation of phenolic compounds to quinones.
- The quinones polymerise to form brown-coloured melanins.
- This reaction is an enzymatic browning process occurring in the presence of oxygen and is accelerated at room temperature.

(b) Briefly explain the benefit of the reaction observed in this experiment in food processing.

The browning reaction can contribute to the flavour, colour, and aroma of processed foods like dried fruits and roasted nuts. However, in fresh-cut produce it is usually undesirable and controlled using acidulation, blanching, or refrigeration.

3. You are provided with sample J (cooking oil), K, L, M (phenolphthalein indicator solution) and N (0.1N potassium hydroxide solution). Perform the experiment by following the given procedure and then answer the questions that follow.

Procedure:

(i) Mix sample J thoroughly before weighing.

(ii) Weigh accurately 8g of sample J in a 200 ml (or 250ml) conical flask.

(iii) Prepare 50ml of a mixture of K and L by mixing 25ml of each sample. Heat the mixture in a water bath to make it hot. Add the mixture to the flask containing sample J, then shake the content.

(iv) Add about 1.0ml of solution M.

(v) Heat the mixture for 10 minutes in the water bath maintained at 75-80°C.

(vi) Titrate the mixture while hot against solution N, shaking vigorously during titration until a permanent colour persisting for at least 10 seconds is formed in the conical flask.

(vii) Record the titre volume and repeat the titration to obtain three readings.

Questions

(a) Identify samples K and L.

K is ethanol, and L is ether.

(b) What was the function of the mixture of sample K and L in this experiment?

The mixture acts as a solvent system to dissolve the fat or oil sample, ensuring efficient reaction of free fatty acids with potassium hydroxide during titration.

(c) Calculate

(i) the acid value of sample J.

Formula:
Acid value = (V × N × 56.1) / W
Where
V = average titre (ml), N = normality of KOH (0.1N), W = weight of oil (g)

Assume average titre V = 2.0 ml

Acid value = (2.0 × 0.1 × 56.1) / 8
= 1.40

(ii) the percentage of free fatty acid (as oleic acid basis).

Formula:
%FFA = (V × N × 28.2) / W

%FFA = (2.0 × 0.1 × 28.2) / 8
= 0.705%

(d) Give the importance of;

(i) shaking the mixture in steps (iii) and (vi).

To ensure uniform mixing of oil and solvent, and to properly mix KOH with free fatty acids for complete neutralisation.

(ii) heating the mixture in procedure (v).

To improve the solubility of oil in the solvent mixture and increase the reaction rate between KOH and free fatty acids.

(e) From the literature, the acid value of the cooking oil ranges from 0.9 - 1.1. Compare the experimental value with the literature value and give the analytical importance of this value.

Comparison:
The experimental acid value of 1.40 is slightly higher than the literature range.

Analytical importance:
Higher acid value indicates increased free fatty acid content, suggesting possible oil degradation, poor storage, or ageing, affecting shelf-life and quality.

(f) Briefly explain the significance of cooking oil/fat analysis for Free Fatty Acid (FFA).

Monitoring FFA content is crucial because high levels indicate hydrolytic rancidity, reducing oil quality, affecting flavour, nutritional value, and safety. It ensures product freshness and stability in food processing industries.