THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

155/2 **FOOD AND HUMAN NUTRITION 2**

(For Both School and Private Candidates)

Time : 3 Hours **ANSWERS** **Year : 2010**

Instructions

1. This paper consists of sections **A** and **B**.
2. Answer all questions in section **A** and only **two (2)** question from section **B**.
3. Non-programmable calculators may be used.
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 food sample H, food reagents and a piece of cloth. Perform an experiment by following the given procedures (i)–(iv):

(i) Place the wheat flour in a mixing bowl. Add little water gradually and knead 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 give explanations for the observations.

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

(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.

(iv) Place 2 g 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 3 ml of ammonium hydroxide solution while observing. Record your observations.

Questions

(a) Identify sample H.

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

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

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

(e) What does step (iv) demonstrate? (f) Briefly explain the principle applied in separating the two components of sample H.

(a) Sample H is wheat flour. The kneading process with water followed by washing indicates the separation of starch and gluten proteins, which are major components of wheat flour.

(b) The effect of discarding the top substance obtained in step (ii) is the loss of starch. The milky suspension formed during the first washing is a starch solution, and discarding it reduces the carbohydrate portion of the flour sample.

(c) The substance obtained in step (iii) is gluten. This is the sticky, elastic, and rubbery protein mass left after washing away starch and soluble substances.

(d) The change in the size of the dough observed in step (iii) occurs because most of the starch and soluble components are removed during washing. This leaves only the gluten proteins, which occupy a smaller volume compared to the original dough.

(e) Step (iv) demonstrates the presence of proteins in gluten. When boiled with concentrated nitric acid, gluten proteins undergo nitration, producing a yellow colour that turns orange-brown upon addition of ammonium hydroxide, which is the basis of the xanthoproteic test for proteins.

(f) The principle applied in separating the two components of sample H is solubility. Starch is soluble in water and is washed away, while gluten is insoluble in water and remains as a solid residue.

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.

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

(iii) Spray the third slice with lemon juice.

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

Questions

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

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

(a) The colour change observed is due to enzymatic browning.

First, phenolic compounds present in the food are oxidised by polyphenol oxidase enzymes into quinones.

Second, these quinones polymerise to form brown-coloured melanins that accumulate on the surface.

Third, the process is accelerated by exposure to oxygen in the air when the slices are cut.

(b) The benefit of this reaction in food processing is that enzymatic browning is sometimes desirable.

It contributes to the development of colour and flavour in products such as tea, coffee, dried fruits, and cocoa. This enhances consumer appeal and product identity.

3. You are provided with sample J, K, L, M and N. 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 8 g of sample J in a 200 ml (or 250 ml) conical flask.

(iii) Prepare 50 ml of a mixture of K and L by mixing 25 ml 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 1.0 ml 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.

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

(c) Calculate (i) the acid value of sample J.

(ii) the percentage of free fatty acid (expressed on an oleic acid basis).

(d) Give the importance of; (i) shaking the mixture in steps (iii) and (vi). (ii) heating the mixture in procedure (v).

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

(a) Samples K and L are ethanol and ether, respectively. They are commonly used as solvents to dissolve oil or fat samples before titration.

(b) The function of the mixture of sample K and L is to extract and dissolve the free fatty acids from sample J (oil), providing a suitable medium for the titration process to occur.

(c) (i) The acid value is calculated using the formula:
Acid value = (V × N × 56.1) / W
where V = volume of alkali (NaOH or KOH) used in ml, N = normality of alkali, W = weight of oil

sample in grams.
Assume the average titre volume was 2.0 ml, the normality of alkali was 0.1 N, and W = 8 g.
Acid value = (2.0 × 0.1 × 56.1) / 8 = 1.40 mg KOH/g.

(ii) The percentage of free fatty acid (as oleic acid) is calculated by:
% FFA = (Acid value × 0.503).
% FFA = 1.40 × 0.503 = 0.70 %.

(d) (i) Shaking the mixture in steps (iii) and (vi) ensures thorough mixing of the solvents, oil, and reagents, allowing complete reaction between free fatty acids and the titrant.
(ii) Heating the mixture in procedure (v) reduces viscosity and improves solubility of fats, allowing the titration to proceed more efficiently.

(e) The experimental acid value (1.40) is slightly higher than the literature range (0.9–1.1). This indicates that the oil sample J contains more free fatty acids than expected, suggesting onset of rancidity or partial deterioration. Analytically, this is important in quality control since high values imply reduced shelf life and poor storage conditions.

(f) The significance of cooking oil/fat analysis for Free Fatty Acid (FFA) is that it helps determine the freshness and edibility of oils. Low FFA values indicate good quality oil suitable for consumption, while high FFA values reveal hydrolytic rancidity, which negatively affects flavour, nutritional value, and safety of the product.