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 : 2000**

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 wheat flour, water, and clean bowls. Perform the experiment by following the procedures below:

(i) Weigh 30 g of wheat flour and add about 15 ml of clean water in a bowl. Mix them thoroughly to form a dough.

(ii) Knead the dough for 10 minutes until smooth. Record its texture and explain.

(iii) Place the dough in a muslin cloth, wash under running tap water while squeezing, and collect the first washing in a beaker. Leave it to stand for 15 minutes. Record observations.

(iv) Continue washing until the water runs clear. Collect the residue in a petri dish and observe its elasticity.

(v) Take 2 g of the residue, add concentrated nitric acid, heat gently, cool under running water, then add ammonia solution. Observe the colour changes.

Questions:

(a) Identify the substance obtained in step (iv).

(b) Explain the importance of the substance obtained in step (iv) in bread making.

(c) What does step (v) demonstrate?

(d) Briefly explain the principle behind separation of starch and protein in this experiment.

ANSWERS

(a) Identify the substance obtained in step (iv).

The substance obtained in step (iv) is **gluten**. Gluten is a protein complex that forms when wheat flour is mixed with water and kneaded. It is elastic and sticky, and remains after washing away the starch granules in the dough. For example, if you make a ball of dough and wash it under water, the starch dissolves and drains away, leaving behind a rubber-like mass, which is gluten. This shows that gluten is not soluble in water, unlike starch.

(b) Explain the importance of the substance obtained in step (iv) in bread making.

Gluten is important in bread making because it provides **elasticity** to the dough. This elasticity allows the dough to stretch and trap carbon dioxide produced by yeast during fermentation. Without gluten, the dough would collapse instead of rising. For instance, wheat bread rises more than bread made from maize or rice flour, because wheat flour is rich in gluten.

Another importance of gluten is that it contributes to the chewy texture of bread. When bread is baked, the gluten network becomes firm and gives bread its structure and bite. For example, the difference between soft cakes and chewy bread largely comes from the amount of gluten developed in the dough.

Gluten also helps in moisture retention during baking. This ensures that bread does not dry out too quickly and can stay soft for longer. For example, gluten-rich loaves of bread tend to remain fresher compared to those made from gluten-free flours.

(c) What does step (v) demonstrate?

Step (v) demonstrates the xanthoproteic test for proteins. When concentrated nitric acid is added to a protein and heated, the aromatic amino acids in the protein undergo nitration, producing a yellow colour. On cooling and adding ammonia solution, the colour deepens to orange. This confirms the presence of protein in the gluten.

In the experiment, gluten turns yellow when treated with nitric acid and then orange upon adding ammonia. This is similar to laboratory protein tests where egg albumin or casein gives the same reaction. It shows that gluten contains amino acids such as tyrosine and tryptophan, which react with nitric acid.

(d) Briefly explain the principle behind separation of starch and protein in this experiment.

The principle of separation is based on **differences in solubility**. Starch granules are soluble in water and can be washed out from the dough, while gluten proteins are insoluble in water. By repeatedly washing and kneading, starch and other soluble substances are removed, leaving behind gluten as the insoluble residue.

This principle is widely used in food science. For example, in starch industries, wheat starch is separated from gluten by washing processes. Similarly, gluten-free products are made by removing gluten proteins from flour mixtures. It is also an application of basic separation methods in chemistry, where solubility differences are exploited to isolate components.

Alright, let's continue with **Question 2 and 3 of Paper 1**, same detailed, paragraph-based style.

QUESTION 2 (Paper 1)

You are provided with fresh apple slices, lemon juice, hot water, and plain paper. Perform the experiment as follows:

(i) Place one slice on plain paper at room temperature.

(ii) Dip the second slice in lemon juice.

(iii) Place the third slice in boiling water for 3 minutes.

(iv) Leave all the slices for 15 minutes and record the colour changes.

Questions:

(a) What process causes the colour changes in step (i)?

(b) Explain the effects of lemon juice and boiling water in preventing changes.

(c) State two advantages of this reaction in food processing.

ANSWERS

(a) What process causes the colour changes in step (i)?

The colour change observed in step (i) is caused by enzymatic browning. When an apple slice is exposed to air, enzymes called polyphenol oxidases react with oxygen and phenolic compounds in the apple tissues. This produces brown-coloured melanins on the surface of the cut fruit. For example, when you cut an apple or banana and leave it uncovered, it quickly turns brown due to this enzymatic reaction.

(b) Explain the effects of lemon juice and boiling water in preventing changes.

Lemon juice prevents browning because it is acidic. The low pH denatures the enzyme polyphenol oxidase and slows down the oxidation of phenolic compounds. As a result, the apple slice dipped in lemon juice retains its natural colour for a longer time. For instance, chefs often apply lemon juice to freshly cut fruits such as apples, avocados, or pears to keep them fresh-looking.

Boiling water prevents browning by destroying the enzymes through heat. When the apple slice is placed in boiling water, the enzyme polyphenol oxidase is denatured and becomes inactive. Without enzyme activity, browning cannot occur. This is why blanching is used in the food industry to inactivate enzymes before freezing vegetables and fruits.

(c) State two advantages of this reaction in food processing.

One advantage of enzymatic browning in food processing is that it can be used to develop colour and flavour in products. For example, in the production of tea and coffee, controlled enzymatic browning is essential for the final taste and appearance.

Another advantage is that browning can improve the aroma of some foods during cooking. For instance, browning reactions in dried fruits or roasted nuts create appealing flavours that consumers enjoy. Although enzymatic browning is often seen as undesirable in fresh fruits, it can be useful in processed foods.

3. You are provided with an egg. Separate the white and yolk and perform the following procedures:
(i) Put 2 ml of egg white in a test tube, add 1 ml of 10% sodium hydroxide, then 2 drops of dilute copper sulphate solution. Record observations.
(ii) Heat another 2 ml of egg white in boiling water for 5 minutes. Record observations.
(iii) Place a small portion of egg yolk in a dry porcelain dish and heat strongly. Record colour changes and odour.

Questions:
(a) Identify the test performed in step (i) and state what it confirms.
(b) Explain what happened in step (ii).
(c) What does step (iii) demonstrate about the nature of egg yolk?
(d) State two uses of these properties of egg proteins in food preparation.

ANSWERS

(a) Identify the test performed in step (i) and state what it confirms.

The test performed in step (i) is the **Biuret test for proteins**. When copper sulphate solution is added to a protein solution in the presence of sodium hydroxide, a violet or purple colour appears, confirming the presence of peptide bonds in proteins. In this case, the egg white turned violet, confirming that it is rich in protein, mainly albumin. For example, the Biuret test is commonly used in laboratories to identify proteins in food samples such as milk, meat extracts, and beans.

(b) Explain what happened in step (ii).

In step (ii), heating caused the egg white proteins to **denature and coagulate**. Egg white is mostly water and albumin protein. When exposed to heat, the albumin molecules unfold and form new bonds, creating a solid white mass instead of a transparent liquid. This is why boiled eggs turn white and firm. The process demonstrates that proteins lose their natural structure when heated but still remain as solid nutrients. For example, this same principle applies when frying eggs, where the transparent egg white becomes opaque and solid.

(c) What does step (iii) demonstrate about the nature of egg yolk?

Step (iii) demonstrates that egg yolk contains **fats and proteins** which undergo physical and chemical changes when heated. The colour changes to brown or black due to charring, and a strong odour is produced as proteins decompose and fats break down. This shows that egg yolk is a rich source of lipids, which are sensitive to heat and can produce smoke and odours. For example, when eggs are overcooked, the yolk may develop a dark layer and emit a sulphur-like smell due to breakdown of proteins.

(d) State two uses of these properties of egg proteins in food preparation.

One use is that egg proteins can be used as binding agents. For example, in making meatballs or cakes, eggs help hold the ingredients together because the proteins coagulate during cooking.

Another use is that egg proteins act as thickening agents. When added to custards, puddings, or sauces, egg proteins coagulate upon heating, giving the dish a firm texture. This is why custard thickens when heated and cooled.