

National Exams December 2011

**04-Agric-A7, Chemistry and Microbiology of Foods**

3 hours duration

**NOTES:**

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. Candidates may use one of the two calculators, the Casio or Sharp approved models. This is a closed book exam.
3. Any four (4) questions from section I and any four (4) questions from section II constitute a complete paper.
4. Marks for each question are given on the question paper. All questions in each section are of equal value.
5. Most questions require an answer in essay format. Clarity and organization of the answer are important. Be brief and to the point.

**Marking Scheme**

1. (a) 7.5 marks (b) 5 marks
2. (a) 6 marks (b) 6.5 marks
3. (a) 6 marks (b) 6.5 marks
4. (a) 10 marks (b) 2.5 marks
5. (a) 8 marks (b) 4.5 marks
6. (a) 8 marks (b) 4.5 marks
7. (i) 3.5 marks (ii) 3 marks, (iii) 2 marks, (iv) 2 marks, (v) 2 marks
8. (a) 3.5 marks (b) 9 marks
9. (a) 7 marks (b) 5.5 marks
10. (a) 6.5 marks (b) 6 marks
11. (a) 7.5 marks, (ii) 5 marks
12. (a) 6 marks (b) 6.5 marks
13. (a) 8 marks (b) 4.5 marks
14. (a) 7.5 marks (b) 5 mark

## I. Food Chemistry

Do any **four** questions from this section.

1(a) Discuss three ways of controlling water activity in a product environment stored in a (i) sealed package, and (ii) in a storage room. (7.5 marks)

(b) Where do the various meat products ((i) fresh ground meat, (ii) canned cured meat, (iii) lightly cured meat (such as pork or beef cuts), (iv) fully cured meat (such as bacon or ham), (v) fermented and dried meat (such as dry sausages), (vi) sausages (such as hot dog)) fit in the categories given in the Table 1 below. (5 marks)

Table 1. Storage categories of meat products based on water activity ( $a_w$ ) and pH of the products with recommended storage temperatures

Category	Criteria	Temperature
Early perishable	pH > 5.2 and $a_w > 0.95$	$\leq 5^\circ\text{C}$
Perishable	pH 5.2-5.0 or $a_w 0.95 - 0.91$	$\leq 10^\circ\text{C}$
Shelf stable	pH $\leq 5.2$ and $a_w \leq 0.95$ or only pH < 5 or only $a_w < 0.91$	No refrigeration

2 (a) Derive a rate equation for the reaction of 0.5<sup>th</sup> order. Also derive an expression for the half life of such a reaction. (6 marks)

(b). Oxidative reactions occurring during food storage result in the depletion of dissolved oxygen. The first order rate constant for the kinetics of oxygen depletion was measured to be 0.142 per hour. The initial dissolved oxygen concentration in the liquid food is 8.7 mg/L. Calculate the dissolved oxygen concentration after 24 h. (6.5 marks)

3 (a) What are the substrates for the following enzymes: (i) Amylase, (ii) Protease, (iii) Lipoxygenase, and (iv) Polyphenoloxidase (6 marks)

(b) Why the enzymatic browning unimportant during roasting of cocoa beans? (6.5 marks)

4(a) Define the following terms: (i) Hydrophobic effect, (ii) shear thinning, (iii) protein hydrolysis, (iv) protein denaturation, (v) protein primary structure (10 marks)

(b) What is polymorphism in fats? (2.5 marks)

5 (a) Define briefly the following terms and provide a food example of each term: (i) oil in water emulsion, (ii) colloid, (iii) super-saturation, (iv) a plasticizer (8 marks)

(b) Provide two reasons why is the Maillard reaction faster in French fries rather than in boiled potatoes. (4.5 marks)

6 (a) What are the biological sources of gelatin, carageenan gum, pectin, and xanthan gum. (8 marks)

(b) Briefly describe how pregelatinized starch is manufactured. (4.5 marks)

7 (i) Why is the freezing point of a fat typically lower than its melting point? (3.5 marks)

(ii) List two defects common in poorly tempered chocolate. (3 marks)

(iii) What are the two glucose polymers in starches? (2 marks)

(iv) Are most polyunsaturated fatty acids cis or trans? (2 marks)

(v) Give an example of a radical scavenging antioxidant. (2 marks)

## II. Food Microbiology

Do any **four** questions from this section.

8. (a) What uses do bacteria make of carbon source? (3.5 marks)

(b) What other nutrients might bacteria require and why? How do selective, differential, and enrichment media differ? (9 marks)

9 (a) Define sterilization, disinfection, disinfectant, sanitizer, bacteriostatic agent, germicide, and bactericide. (7 marks)

(b) What three principles apply to the processes of sterilization and disinfection? (5.5 marks)

10. (a) What is the effect of temperature on microbial growth rates? What is the difference between optimal and maximal growth temperatures? (6.5 marks)

(b) What effect does a high salt concentration have on bacteria? What is the difference between a halophile and a salt tolerant organism? (6 marks)

11. (a) Describe the typical bacterial growth curve. What is occurring during each of the growth phases? (7.5 marks)

(b) Compare batch and continuous culture methods for growing bacteria. (5 marks)

12. (a) Compare the processes of wine and beer production. Why most grains, but not fruits, be hydrolyzed prior to fermentation? (6 marks)

(b) How does the production of red wine differ from the production of white wine? How is the alcoholic content of wine controlled? How are the higher alcohol contents of whiskey and brandy attained? (6.5 marks)

13. (a) Describe how microbes participate in the production of (i) Swiss cheese, (ii) soy sauce, (iii) butter, and (iv) sauerkraut. (8 marks)

(b) What is the difference between fermentation and respiration? (4.5 marks)

14. (a) What are the similarities and differences between animal, plant, and bacterial viruses? (7.5 marks)

(b) How does viral replication differ from cell division? (5 marks)