

National Exams May 2013

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. One aid sheet 8.5" X 11" hand-written on both sides containing notes and formulae.
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. Do not provide background information.

I. Food Chemistry

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

1. (a) A 10 min experimental run shows that 75% liquid reactant is converted to a food product by a 0.5 order rate. What would be the amount converted in a half-hour run? (6 marks)

(b) After 8 min in a batch reactor, a reactant (A) (initial concentration, $C_{A0} = 1$ mol/L) is 80% converted; after 18 min, conversion is 90%. Find a rate equation to represent this reaction. (6.5 marks)
2. (a) A potato processor is concerned that her potato flakes are an undesirable golden brown color as soon as they are produced. The potatoes are peeled, steam-cooked, mashed then dried on heated drums. Her proposed solution is to conduct the drying under a nitrogen atmosphere to limit oxidation. (i) What do you think is the most likely mechanism of the browning. (ii) Do you think her solution is likely to be effective? Why? (10 marks)

(b) Why do bubbles rise to the surface of Guinness slower than they rise to the surface of a light beer? (The beers are of very similar viscosity). (2.5 marks)
3. (a) What is the rationale for using saturated salt chambers to control environmental relative humidity for a food storage? (6 marks)

(b) How could one determine the water activity of a food by measurement? (6.5 marks)
4. (a) Cotton candy is made by melting sucrose then spinning the liquid through narrow nozzles into thin strings. What state is the sucrose in cotton candy? How and why does it change when left in a moist environment for even a relatively short period of time? (6.5 marks)

(b) Moisture diffuses from raisins to the wheat flakes in a breakfast cereal. What is the driving force for the diffusion? The solutions proposed to this problem are either to add glycerol to the raisins or coat them with a layer of oil. Why would each method work? (6 marks)
5. (a) The following graph is taken from a paper where the authors measured the effective particle size (d_{32}) of a whey protein isolate stabilized emulsion heated to different temperatures at different salt concentrations (i.e., ionic strength).

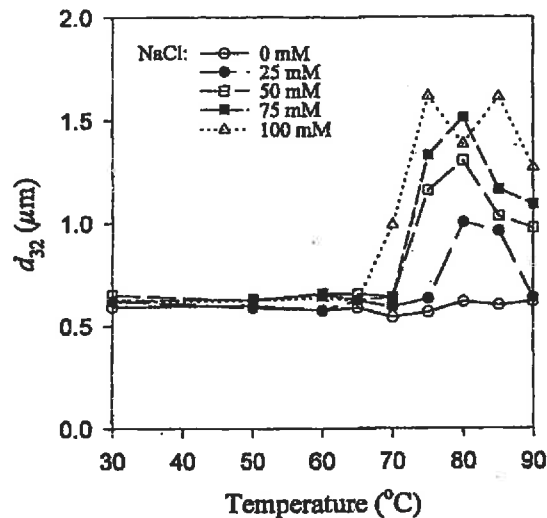


Fig. 2—Dependence of the mean droplet diameter (d_{32}) of 20 wt% corn oil-in-water emulsions on temperature and salt concentration (pH 7, 2 wt% WPI).

Estimate the denaturation temperature of whey protein isolate (6 marks)

(b) How you prevent rancidity in food with high fat content? (6.5 marks)

6. (a) Describe (i) hydrogenation, and (ii) interesterification. (6.5 marks)

(b) The freezing point of a fat is typically lower than its melting point. Why? (6 marks)

7. (a) Briefly define/explain the meaning of the following terms and provide a food example of each: (i) Maillard reaction, (ii) Enzymatic browning, and (iii) Foam (6.5 marks)

(b) Vacuum-packed meat is a dull purple color but when the package is opened and the meat exposed to the air takes on a bright-red color. Why? (6 marks)

II. Food Microbiology

Do any four questions from this section.

8. (a) (i) Explain the F_0 value for thermal processing and, using relevant a microbial example, (ii) discuss why the F_0 value for low acid foods processed at 121°C is at least 3 minutes but lower for high acid foods? (3.5 marks)

(b) Plot the following data on a graph (provided at the end of the question paper) and state the duration of the lag phase and calculate the growth rate of the bacterium? (9 marks)

Time (min)	Colony forming Units per ml
0	49
30	47
60	49
90	50
120	50
150	100
180	200
210	400
240	800
270	1600
300	3200
330	6400
360	12800
390	12750
420	12760
450	12760
480	12760

9. (a) For the following metabolites in foods, describe briefly their beneficial and detrimental effects (i) carbon dioxide, (ii) organic acids (such as lactic, acetic), (iii) alcohols (such as ethanol), (iv) hydrogen peroxide, (v) volatiles (such as sulphur, ammonia), (v) polysaccharides. (8.5 marks)

(b) List the extrinsic and intrinsic factors (2 each) that impact on microbial growth in foods. (4 marks)

10. (a) What is the order in which the following foods would spoil? (i) Green tomato held at 15°C, (ii) Sirloin beef steak held at 4°C on a plate, (iii) Whole fish stored at 4°C on a plate, (iv) Deli meat at 4°C under Modified Atmosphere, (v) Raw milk held at 4°C. (5 marks)

(b) *Listeria monocytogenes* is of particular concern in the ready-to-eat meat processing industry. Describe the characteristics of this organism and how it causes food borne illnesses. Why is *Listeria monocytogenes* especially linked to deli meats, smoked fish and soft cheese? (7.5 marks)

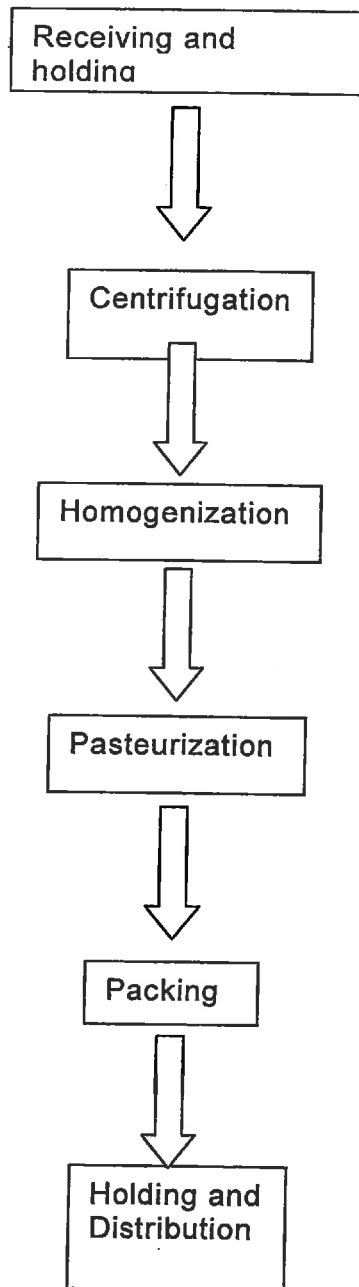
11. Below is a flow diagram for milk pasteurization.

(i) Identify and justify the critical control points (CCP's) in the process.

(ii) How would you monitor each of the identified CCP's

(iii) How would you verify the performance of the HACCP plan?

(12.5 marks)



12. (a) In your opinion, what is the most significant food safety risk that the industry currently faces and what measures could be implemented to reduce the risk? (10 marks)

(b) What is the underlying principle of the hurdle concept? (2.5 marks)

13. (a) Describe the mode-of-action by which irradiation inactivates microbes (5 marks)

(b) What are the advantages and disadvantages of wearing gloves to reduce the microbiological risk of food handlers transferring contamination from hands to product? (3.5 marks)

(c) What are the natural protective structures/constituents found in eggs that protect the developing embryo from becoming infected? (4 marks)

14. **Multiple Choice questions.** Note: For some multiple choice questions there maybe more than one correct answer listed. Example: *Escherichia coli* is which of the following?

- A. Bacterium
- B. Gram negative
- C. Oxidase positive
- D. Virus
- E. All of the above

Full Marks will only be given for a completely correct answer (in this case A, B and C). Half marks will be awarded for partly answered questions. No marks for a wrongly answered question.

Q1: What is the advantage of aseptic processing?

- A) Cheaper than canning
- B) Shorter thermal processing
- C) More acceptable to the consumer
- D) Less impact on sensory quality
- E) Greater lethality against *Clostridium botulinum*

Q2: Irradiation can be applied at different levels to decontaminate foods. Why are low dose (pasteurization) irradiation treatments preferred over levels that ensures commercial sterility?

- A) Cheaper
- B) Reduced risk of generation excessive by-products
- C) Product specific
- D) Accepted by consumers
- E) All of the above

Q3: What are the average bacterial counts of pasteurized milk?

- A) 0 cfu/ml
- B) 100 cfu/ml
- C) 1000 cfu/ml
- D) 100,000 cfu/ml
- E) 10,000,000 cfu/ml

Q4: Why are pre-requisite programs important?

- A) Staged approach to introduce HACCP

- B) Ensure facility is sanitary
- C) Construction of the facility is satisfactory
- D) Ensure GMP are performed
- E) All of the above

Q5: Why is an enrichment step required when screening for pathogens?

- A) Increase numbers of the target cells
- B) Allow for cell repair
- C) Differentiate between live and dead cells
- D) All of the above
- E) Some of the above but not all

Q6: The antimicrobial properties of ozone and chlorine were discovered at the same time. However, chlorine was adopted because?

- A) Easier to apply
- B) Cheaper
- C) Greater antimicrobial action
- D) Less by-product generation
- E) Less corrosive

Q7: Fresh produce can be contaminated by?

- A) Manure run-off
- B) Wash Water
- C) Field workers
- D) Wild animals
- E) All of the above

Q8: Why is food safety training difficult in the industrial setting?

- A) High staff turnover
- B) Limited time
- C) Inadequately trained management
- D) Limited resources
- E) More than one of the above but not all
- F) None of the above

Q 9: Sulphur dioxide is commonly added to wine to?

- A) Suppress the growth or inactivate microbes
- B) Inhibit polyphenol oxidase
- C) Bind to acetaldehyde
- D) All of the above
- E) Some of the above but not all

Q10: Why are direct methods of enumeration used in the dairy and beer/wine industry?

- A) low cost
- B) Rapid
- C) Cell numbers are high
- D) Morphology is important
- E) All of the above

Q11: What should be considered when developing a sanitation plan?

- A) Schedule for sanitation
- B) Verification method
- C) Standard Operating Procedures
- D) End product sampling plan
- E) Some of the above but not all

Q12: What is the first step when investigating a foodborne illness outbreak?

- A) Contact the company
- B) Contact the retailer
- C) Confirm an outbreak has occurred
- D) Perform microbial sampling
- E) Develop a hypothesis

Q13: Which of the following is a non-thermal processing technique?

- A) High pressure processing
- B) Pulsed electric fields
- C) Irradiation
- D) Aseptic processing
- E) All of the above

(1 mark for each and 0.5 mark for the Q13)

