National Exams May 2017

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. This is a CLOSED BOOK EXAM. One aid sheet allowed written on both sides. Approved calculator is permitted.

3. Any three (3) questions from section I and any three (3) 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. Many 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.

6. Some questions can be answered on the question paper and then attach the question paper with the answer books.

I. Food Chemistry
Do any **three** questions from this section.

1. (a) What is the apparent reaction order at S >> k_m in the Michaelis Menten equation? Why? S is solute concentration and k_m is Michaelis Menten reaction rate constant. (6.7 marks)

(b) Experiment shows that the primary reaction in the homogeneous decomposition of A proceeds with the rate:

$$-r_A = \frac{k_1 C_A^2}{1 + k_2 C_A}$$

Where

$$k_1 = 10^{19.39} \exp\frac{-81.6}{RT}$$

$$k_2 = 10^{8.69} \exp\frac{-28.4}{RT}$$

What is the possible minimum and maximum activation energy for this reaction? C is concentration, T is temperature in K, R is gas constant, k_1 and k_2 are rate constants.

Or

(b) An enzyme with a k_m (Michaelis Menten reaction rate constant) of 10^{-3} M was assayed using an initial substrate concentration of $3(10^{-5})$ M. After 2 min, 5% of the substrate was converted. How much substrate will be converted after 10 min? M = mol/L. (10 marks)

2. The following data were collected for the sensory change in beef stored while exposed directly to air at -23°C. Sensory scores were 8.4, 6.2, 5.5 and 5.1 at 0, 3, 6 and 9 months in storage, respectively. Plot the data on an appropriate graph paper (3 types of graph papers are attached), and determine a rate equation to which the data can be fitted and obtain the reaction rate constant. (16.7 marks)

3. (a) Discuss the three ways of controlling the water activity (a_w) in a product environment stored in a (i) sealed package, and (ii) storage room. (6.7 marks)

(b) Conceptually, why does an increase in temperature at constant relative humidity decrease the equilibrium moisture content? (5 marks)

(c) Describe how to adjust the water activity (a_w) of a food product with solute. Briefly discuss the limitations of this procedure. (5 marks)

4. (a) Dry corn is a hard brittle material (about 14% moisture) but it will pop when heated above a critical temperature. What phase transitions are important in the formation of popcorn? (6.7 marks)

(b) A flour improver is added to bread dough to increase the number of inter-protein disulphide bonds present. The effect of the additive is tested in a creep test where a force is applied to a dough sample, held then released and the deformation measured as a function of time. (i) Sketch the creep curve (deformation as a function of time after the applied force is removed) for the original recipe and for the modified dough. (5 marks) (ii) Briefly explain which dough you will prefer for stamping out intricately detailed cookies. (5 marks)

5. (a) Chocolate is tempered by heating to about 50°C, cooling to about 25°C and holding, reheating to about 32°C then pouring into a mold and allowed to set. In the following table describe how the total amount of fat crystals changes with each temperature change and also how the balance of polymorphic forms alters.

	Change in total amount of solid fat	Change in distribution of crystal polymorphs
Heat to 50°C		
Cool to 25°C and hold		
Reheat to 32°C		
Pour into a mold and cool to room temperature		

(10 marks)

(b) Milk fat can be separated into high melting fractions by cooling so the high melting crystallizes then centrifuging it out to separate. The goal is to make large crystals. Why is the fat typically cooled fast, and why are the large crystals more easily centrifuged out? (6.7 marks)

6. (a) Explain showing partial structures, how calcium ions cause soy protein to gel. (6.7 marks)

(b) Why do proteins form precipitates under some conditions and gels under others? (5 marks)

(c) Suggest approaches that would be effective in reducing the dairy industry's problem with rancid milk. (5 marks)

II. Food Microbiology

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

7. (i) Draw and label a bacterial growth curve using the following data (3 types of graph papers are attached, choose the appropriate one for plotting) (6.7 marks):

Time, h	0	1	2	4	8	12	16	20	24	28
Bacteria/ml	1E6	1E6	2E6	8E6	1E8	1.2E9	2E9	4E9	2E8	1E7

1E6 means $1(10^6)$

(ii) What are the major events in each phase of microbial growth? (3 marks)
(iii) During which phase in the growth cycle are organisms most susceptible to destruction by metabolic inhibitors? (4 marks)
(iv) What two factors contribute to the termination of the log phase? (3 marks)

8. (a) For the following metabolites in foods, describe briefly their beneficial and detrimental effects (i) Antibiotics, (ii) Bacteriocins, (iii) toxins, (iv) Amylases, (v) Lipase, and (v) Pectinase. (10 marks)

(b) Mark the appropriate box to identify which foods represent a risk of being contaminated by *Salmonella*. (6.7 marks)

	High risk	Low risk
Bean sprouts		
Lettuce		
Eggs		
Poultry		
Bread		
French fries		
Yogurt		
Orange juice		

9. (a) The number of bacteria in a food doubles every 10 min. What is the order of the growth reaction? (6.7 marks)

(b) With the help of diagrams, explain the mode by which *Salmonella* causes illness. What are the sources of *Salmonella* and how is it disseminated throughout the food chain? (10 marks)

10. (a) What seven steps are performed when establishing a HACCP plan? (must be in order) (6.7 marks)

(b) What is Quorum Sensing in Gram positive and Gram negative bacteria? (use diagrams to describe the general principle of Quorum Sensing circuit). (10 marks)

11. (a) Which human pathogens are typically associated with shellfish? (3 marks)

(b) What are prions and what is the mode by which they cause disease? (3 marks)

(c) List 4 techniques that are classed as "rapid methods" for microbiological analysis. (4.7 marks)

(d) What is the underlying principle of the Most Probable Number technique used to enumerate microbial levels? (3 marks)

(e) Draw and label the structure of i) enveloped and ii) non-enveloped virus. (3 marks)

12. (a) Which foods commonly contain the following preservatives? (4.7 marks)

Sorbic acid .....

Acetic acid.....

Benzoic acid .....

Nitrites .....

Bacterocins .....

12 (b) **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.

Q 1: What would be an example when within batch sampling would be appropriate?
A) Counts in raw milk
B) Sanitation testing
C) End product screening for *Listeria* in deli meats
D) Airborne contamination in a bakery
E) All of the above

Q 2: The probability of acceptance is?
A) Probability of processor accepting a bad batch.

B) Probability of customer accepting a batch
C) Probability of a processor rejecting a batch
D) Defect levels in a batch
E) All of the above

Q 3: Decreasing the number of samples of a batch would?
A) Increase producers risk
B) Decrease producers risk
C) Decrease AQL
D) Increase RQL
E) None of the above

Q4: What is the advantage of chromagenic media?
A) Cheaper
B) Reduces time of analysis
C) Negates the need to perform confirmation analysis
D) All of the above
E) More than one of the above but not all of the above

Q5: The dye reduction test cannot be used to detect P*seudomonads*. This is not significant in UHT milk because?
A) *Pseudomonas* cannot grow in milk
B) UHT products are packed under vacuum
C) *Pseudomonas* is an obligate anaerobe
D) All of the above
E) More than one of the above but not all

Q6: Enveloped viruses are rarely implicated in foodborne illness outbreaks because?
A) Rarely encountered
B) Poor stability
C) Natural immunity
D) Highly resistant to chlorine
E) All of the above

Q7: Why is seafood linked to enteric viruses?
A) Lightly cooked
B) Can multiply if shellfish
C) Accumulate contamination from water
D) Excessive handling
E) Stored under MAP

Q 8: CJD differs from vCJD with regards to?
A) Destroyed by heat
B) Primarily affects young

C) Primarily affects the old
D) Foodborne
E) No difference

Q9: Acetobacter and *Gluconobacter* are important in vinegar production. What is their common characteristic(s)?

- Obligate aerobe
- Alkaline resistant
- Poor biofilm producers
- Gram positive
- More than one of the above

Q10: Actinomycetes are mainly used in industrial microbiology for the production of?

A) Wine
B) Citric acid
C) Amino acids
D) Enzymes
E) Antibiotics

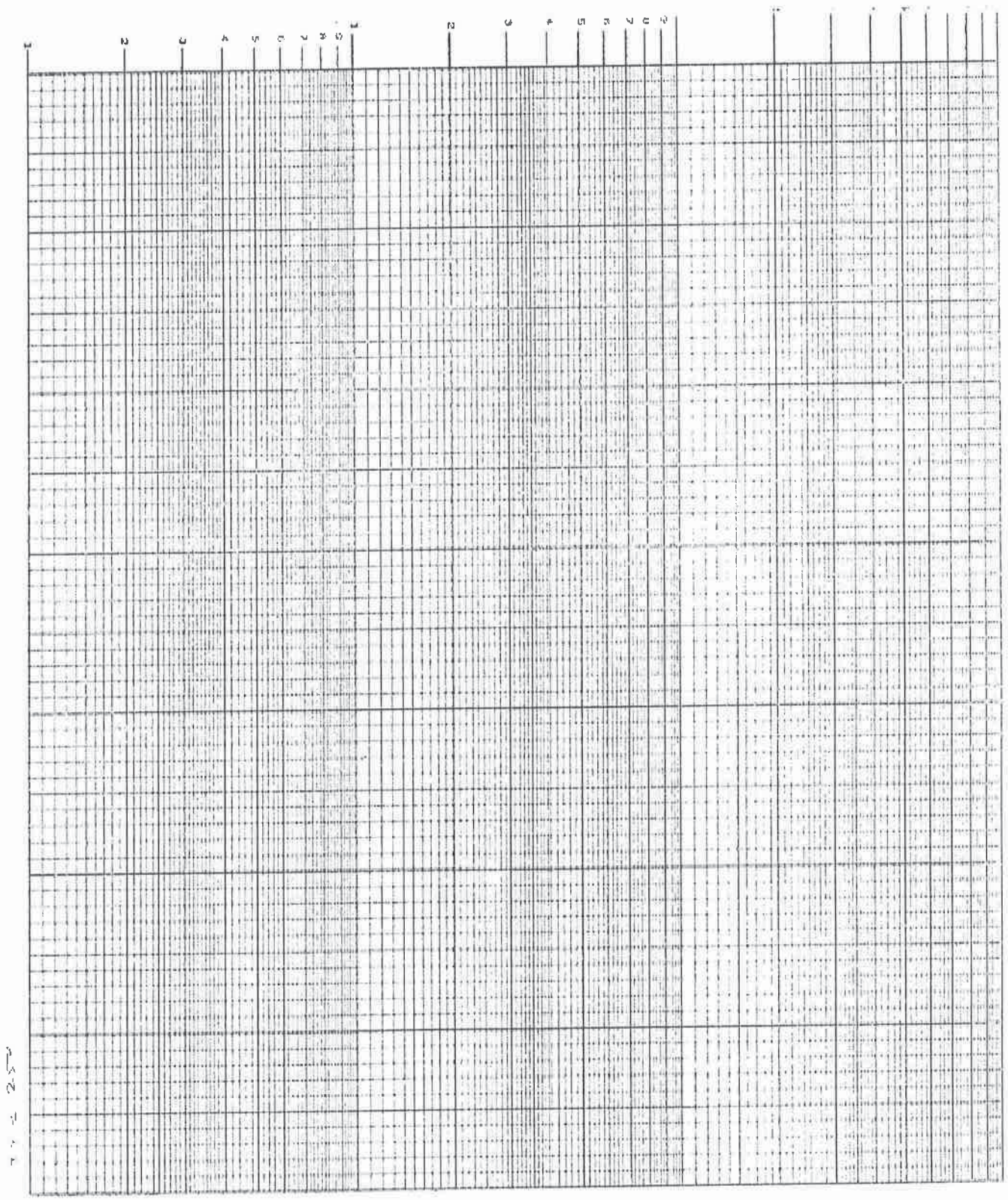
Q11. What conditions would lead to **low** growth yields of yeast cells?

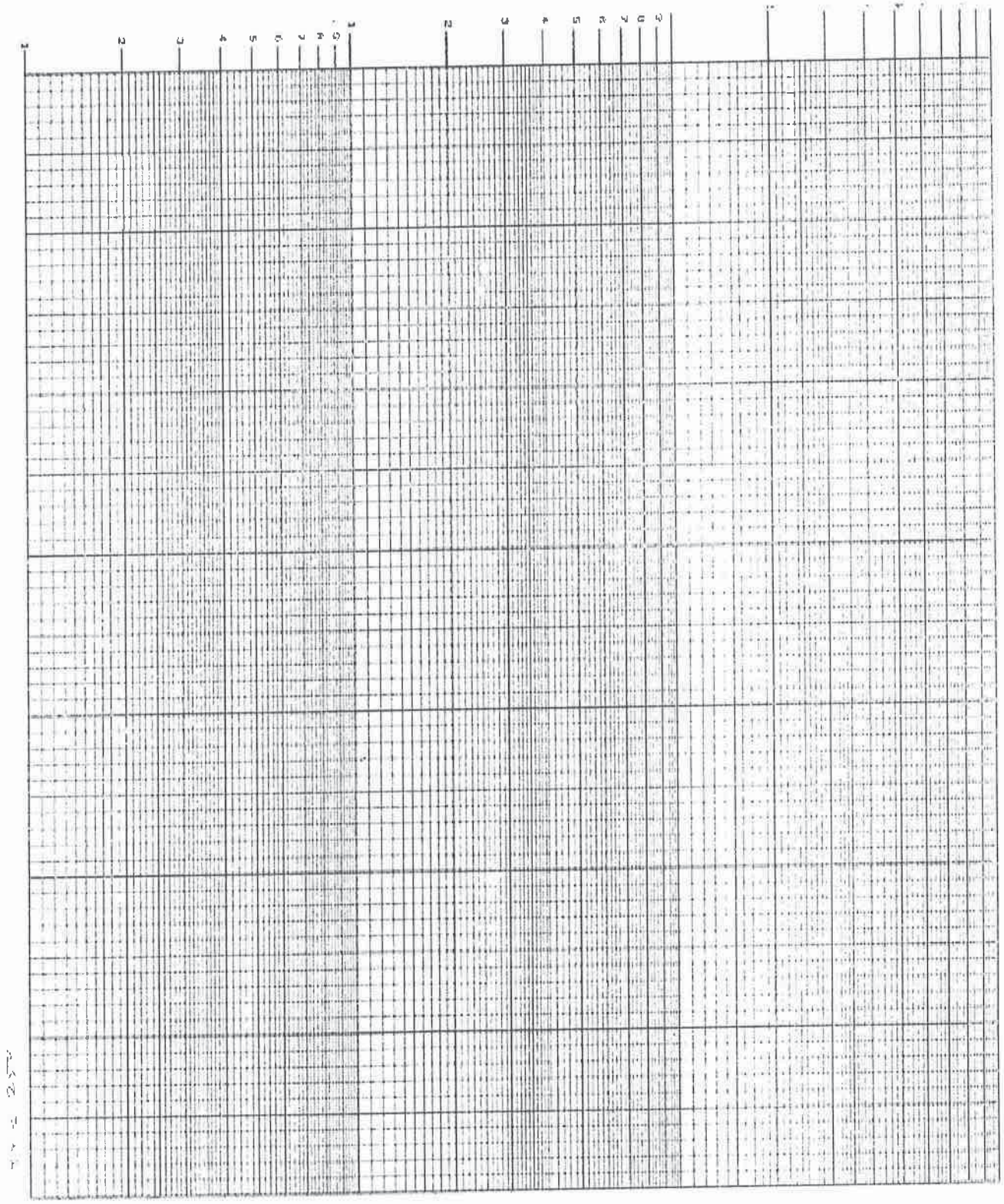
A) High maintenance energy
B) Growth in complex media
C) Aerobic growth
D) High growth rate
E) Some of the above but not all

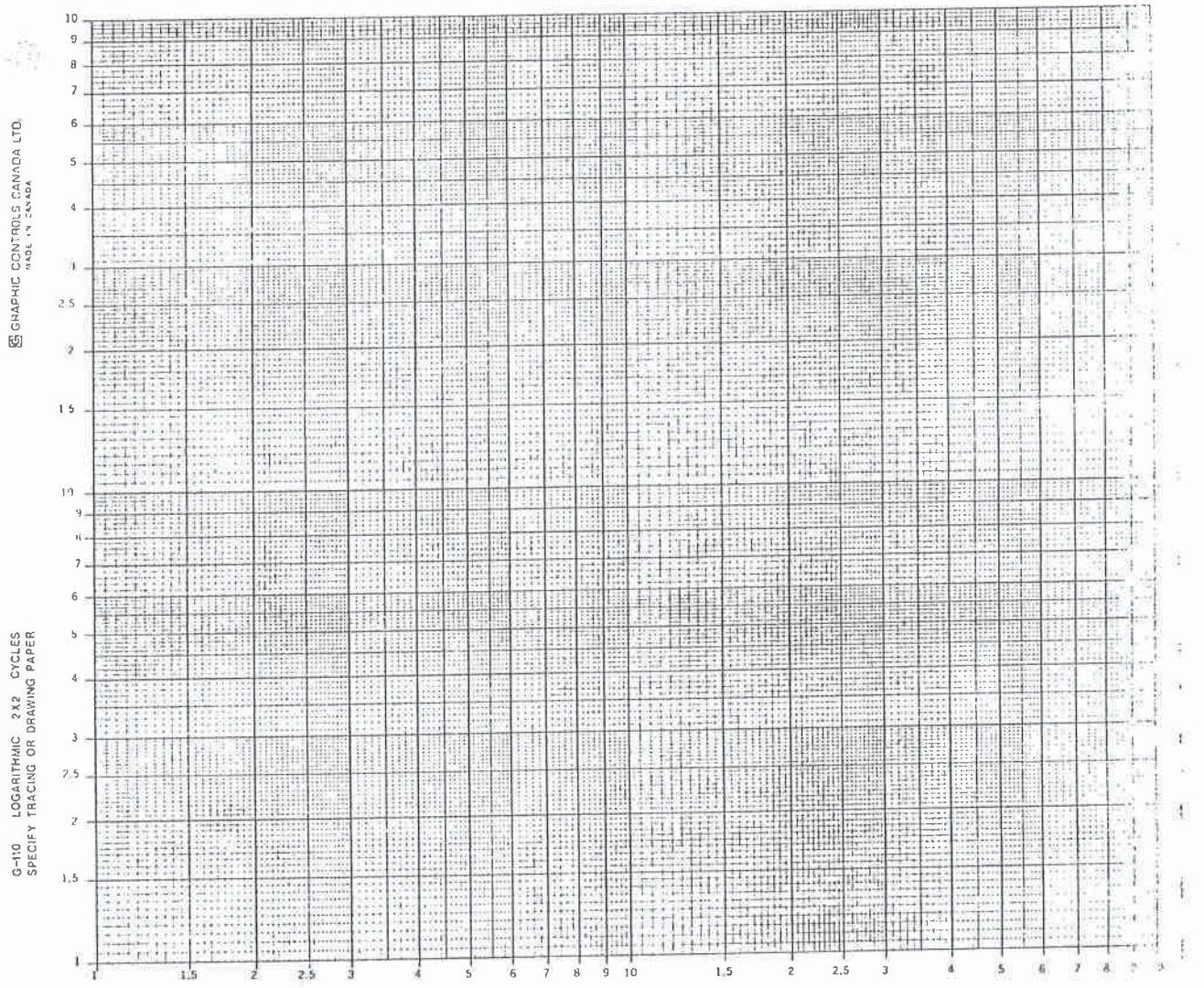
Q12: A high *Staphylococcus* count indicates (there maybe more than one answer)?.

A. Potential contamination by *S. aurues*.
B. Indicates possible temperature abuse
C. Poor handling by food workers
D. Presence of mycotoxins
E. None of the above

(1 marks for each, total 12 marks)



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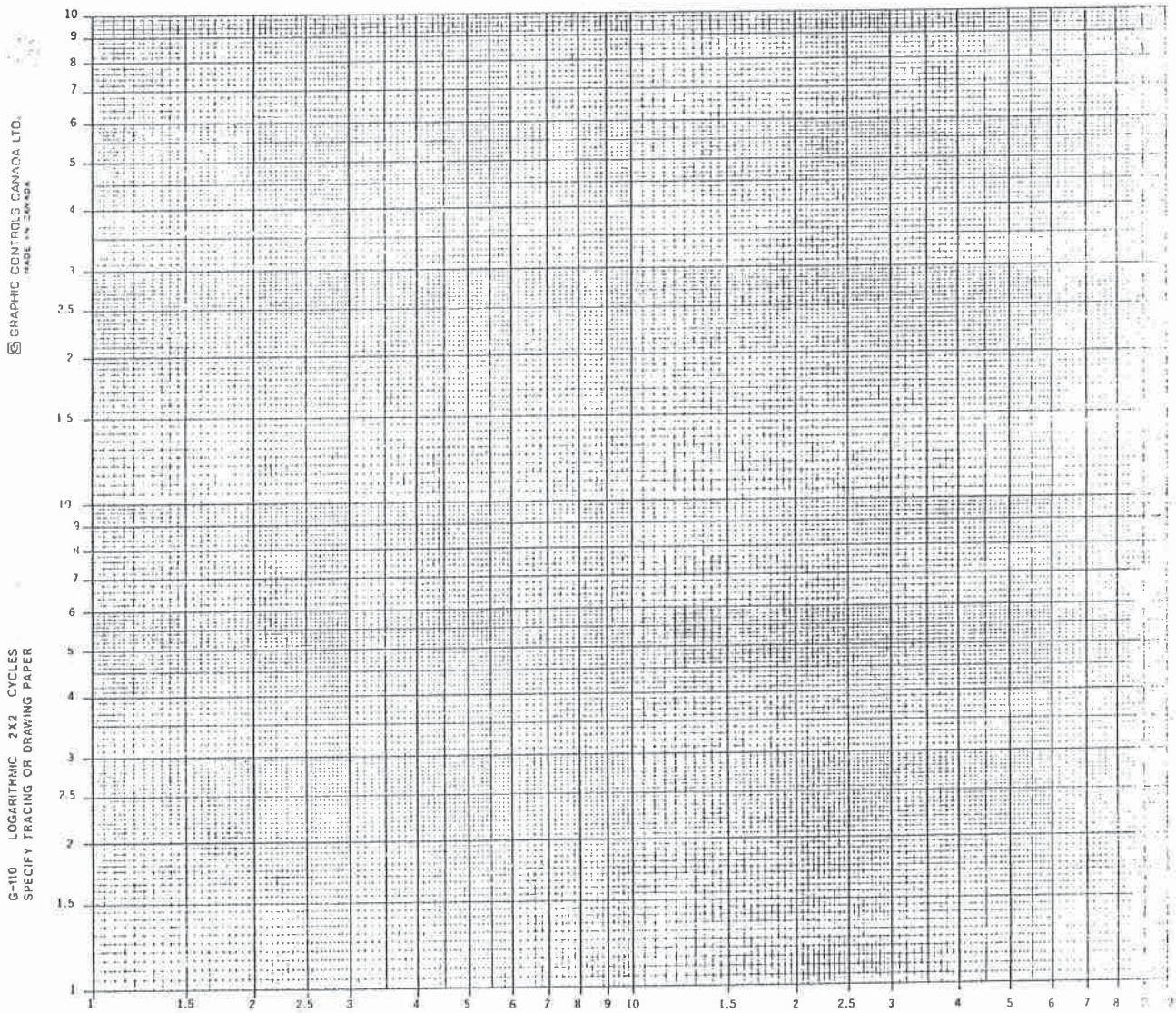
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