T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Science

Occupational specialism assessment (OSA)

Laboratory Sciences

Assignment 1 - Distinction

Guide standard exemplification materials

v1.1: Specimen assessment materials
September 2021
603/6989/9

Internal reference: SCI-GSEM-01

NCFE CACHE

T Level Technical Qualification in Science
Occupational specialism assessment

Guide standard exemplification materials

Laboratory Sciences

Assignment 1

Contents

Introduction

The material within this document relates to the Laboratory Sciences occupational specialism sample assessment. These exemplification materials are designed to give providers and students an indication of what would be expected for the lowest level of attainment required to achieve a pass or distinction grade.

The examiner commentary is provided to detail the judgements examiners will undertake when examining the student work. This is not intended to replace the information within the qualification specification and providers must refer to this for the content.

In assignment 1, the student must perform a literature review, complete a standard operating procedure (SOP) and complete a risk assessment.

After each live assessment series, authentic student evidence will be published with examiner commentary across the range of achievement.

Scenario

A commercial dairy that produces cheese has experienced problems of variable quality of product. This has been linked to the bacteriological quality of the raw milk used in the operation. A new storage routine is being trialled to reduce bacterial contamination.

The company wishes to compare the bacteriological quality of raw milk stored using the old and revised storage methods. Managers have identified total viable count as an appropriate method of measuring the levels of bacteria within the milk.

As a scientist working for this company, you have been asked to produce a standard operating procedure (SOP) for the total viable count technique (also known as aerobic or standard plate count) to determine the number of colony-forming units (CFU) in milk samples. The SOP will be used to compare milk samples from the different storage treatments.

There are 3 tasks in this assessment:

Task 1: Writing a literature review (that includes a literature search)

Task 2: Writing the SOP for the total viable count technique

Task 3: Writing a risk assessment for the SOP

Task 1

Carry out a literature search to determine suitable methods, and how to interpret results.

You will be provided with an online information package of literature sources. Search only these sources to find relevant material and to carry out your review.

Write a literature review which demonstrate how you have evaluated which literature to select for the task, including justifications for the literature selected.

Select key information that will be needed to write the SOP and to interpret the results, for example:

- information that would help to inform the methods, techniques and equipment used
- how results are determined
- the results expected
- safety considerations

Comment on the quality and reliability of the information used.

Reference any sources of information.

(28 marks)

(3 hours)

Student evidence – task 1

Literature review

Following on from issues within the company surrounding the variable quality of the cheese produce, linked to potential issues with the bacteriological quality of the raw milk, a new storage protocol has been proposed to help combat this issue. It has been proposed that the impact of the 2 storage protocols on the bacteriological quality of the raw milk could be measured using the total viable count technique. The aim of this review is therefore to gather and assess literature which would assist in the development of a SOP that will be used to measure the impact of the new storage protocol.

The first piece of literature to be assessed is a document from Public Health England (PHE), as such it contains a method that has been specifically validated by government sciences, and therefore is likely to be robust. The document contains information on preparing milk samples in section 7.2.1, which would be directly relevant to the issue presented to us. A method for producing serial dilutions and then plating them out is presented in sections 7.3 and 7.4, which would be of use to us in testing the bacteriological quality of our samples. However, it contains no information about how to carry out a total cell count of colony forming units which is required for our work.

The next piece of literature is an academic paper from Alexander-Linko et al. (2011), published in Asian Pac J Trop Biomed. This group tested the bacteriological quality of multiple samples of milk bought from supermarkets in Jamaica, using standard plate counts to assess this, among other methods. This piece of literature is a peer reviewed paper published in an academic journal, as such it is likely that the methods were peer reviewed and checked to be valid before publication.

For the standard plate counts they prepared serial dilutions, as described in the PHE document, and then mixed this with the agar before allowing it to set in the plate and be cultured for 48 hours at 37°C before the number of colonies were counted.

Again, this method could potentially be used here to test the bacteriological quality of our samples. This method describes how to perform the cell counts and gives it an advantage over the PHE document.

The third piece of literature appears to be a protocol for standard plate counts produced for an undergraduate course at an online Indian university, Krishi Shiksha. Though this does not seem to be of as high quality as the first 2 pieces of literature, it does contain a full and detailed protocol for standard plate counts, including an equipment list, which would be of use to us here in developing an SOP. This document also contains a detailed description of how to work out the number of CFUs from the plate count which is useful for our purposes.

The final piece of literature is from a veterinary group and concerns the interpretation of bulk milk results. While this contains a lot of information on how to interpret results from standard plate counts, it is mostly focused on how different levels of different bacteria may relate to the health of cattle. While the information about acceptable levels of total cell counts would be useful for us assessing whether the levels in our samples are acceptable or not, the rest of the document does not contain any directly relevant information.

The methods presented in these pieces of literature could potentially therefore be useful for developing the SOP to assess the bacteriological quality of the raw milk product. The methods presented in the PHE source describe procedures for preparing serial dilutions and plating them out onto bacteriological plates which could be used here, while the protocol in the third source gives a full equipment list which will be useful for preparing our own experiment. Thus, I would propose that we follow the procedure outlined in the PHE document.

References:

Alexander-Linko et al., The microbial content of unexpired pasteurized milk from selected supermarkets in a developing country, Asian Pac J Trop Biomed, 2011

Preparation of samples and dilutions, plating and sub-culture, PHE, Document number FNES26 (F2), 2019

www.ecoursesonline.iasri.res.in/mod/resource/view.php?id=101515 – accessed 16/10/2020

www.woodvets.co.uk/wp-content/uploads/2017/02/Bulk-Milk-Explanation.pdf – accessed 16/10/2020

Task 2

Write a standard operating procedure (SOP) for use of the total viable count technique to determine the number of colony-forming units (CFU) in milk samples. The aim of the SOP is to allow comparison of the CFU of milk stored in 2 different ways.

Design and write your SOP.

Your SOP should follow safe working practices. You will be writing a full risk assessment in task 3.

Include a hypothesis in the introduction to your SOP.

Your SOP must include any necessary controls and should indicate how the data from the 2 milk storage methods will be recorded.

(58 marks)

(3 hours)

Student evidence – task 2

Standard operating procedure (SOP)

Procedure: Total viable cell count to determine the bacteriological quality of raw milk samples

Author: D. Student

Date: June 2020

Purpose of this SOP: This SOP lays out a protocol for assessing the quality of raw milk samples through the total viable cell count technique. Samples are dilutes in serial 10 fold dilutions before plating out on agar plates which are then incubated overnight at 37°C. The resulting colonies on each plate are then counted and plotted on a graph, allowing for comparison of the total viable cell count (TVC) of bacteria in each sample, represented in colony-forming units (CFU) per ml.

Equipment and reagents required:

- raw milk samples – control (stored using the old storage procedure) and experimental group (stored using the new storage procedure)
- deionized H2O
- 1ml Pasteur pipettes
- 5ml Pasteur pipettes
- 15ml falcon tubes
- LB agar plates
- bacteriological spreaders
- Bunsen burner
- 37 degrees centigrade incubator

Protocol:

Step	Instructions
1	Identify which of your samples is the control sample and which is the experimental sample, ensure they are both correctly labelled as the original sample.
2	Perform serial dilutions of each sample. Dilute the original samples to a 1:10 dilution (0.5 ml of the original sample diluted in 4.5ml deionized H_2O), then use the 1:10 sample to create a 1:100 dilution and the 1:100 dilution to produce a 1:1000 dilution. Mix the samples well.
3	Near an active Bunsen burner flame, add 0.25ml of each serial dilution sample to a labelled LB agar plate, using a bacteriological spreader spread the liquid evenly and fully across the plate. Dispose of plastic spreaders, or flame between plates to sterilise glass spreaders. Repeat this with each sample on a fresh, correctly labelled LB agar plate. Also prepare a control plate to which 0.25 ml of deionized H_2O is added.
4	Place all plates into the 37°C incubator, upside-down so that the LB agar is on the top side. Incubate plates overnight for 16 to 18 hours.
5	Following the incubation remove all plates from the incubator. Count the number of cells that have grown on each plate and record it in a suitable table.
6	Following completion of the cell counting, the number of colonies should be plotted on a graph, with the Y axis representing the number of colonies grown and the X axis the dilution.
7	The number of CFUs is to be calculated for each of the serial dilutions performed. This can be calculated by using the formula: cfu/ml = (no. of colonies x dilution factor) / volume of culture plate Record the result for each dilution.

Analysis:

The impact of the new storage method in comparison to the old method can then be assessed from the CFU count performed previously. This should be done by comparing the average CFU count for each sample. The sample with the lower CFU would indicate that this storage procedure results in stored raw milk product with a better bacteriological quality.

Task 3

Write a risk assessment for the total viable count procedure described in your SOP (task 2).

Use the template provided.

(16 marks)

(1 hour)

Student evidence – task 3

Risk matrix

Risk matrix – evaluation of risks							**Action level**
Almost certain	**5**	**5**	**10**	**15**	**20**	**25**	**20-25 STOP**
Highly likely	**4**	**4**	**8**	**12**	**16**	**20**	
Likely	**3**	**3**	**6**	**9**	**12**	**15**	**12-16 URGENT**
Unlikely	**2**	**2**	**4**	**6**	**8**	**10**	**8-10 ACTION**
Extremely improbable	**1**	**1**	**2**	**3**	**4**	**5**	**4-6 MONITOR**
	X	**1**	**2**	**3**	**4**	**5**	**1-3 NO ACTION**
		Minimal	Minor injury	7 day + injury	Serious or major injury	Severe	
			Consequence				

Risk assessment form

Person carrying out risk assessment:	D. Student	
Persons responsible on site:	A. Manager	
Venue:	Commercial dairy	
Work activity:	Total viable cell count technique	
Date of assessment:	07/10/20	

Those at risk	Key
Own staff	OWN
Venue staff	VEN
Organisers	ORG
Visitors	VIS
Public	PUB
Contractors	CON
All persons onsite	AOS

Please read the guidelines prior to completing your risk assessment.

Section 1

Hazard	Who might be harmed? (see 'those at risk', above)	Likelihood	Severity	Total risk level	Control measures (add any other control measures you will use)	Likelihood	Severity	Res. risk level
Raw sample – samples contain bacteria that could potentially be harmful to those exposed	OWN	Unlikely	1	2	Clean any spillages up quickly and appropriately.	NA	NA	2
Bunsen burner – open flame that could either burn the operator or cause a fire	OWN	Unlikely	3	6	Remove gloves when using Bunsen burner. Ensure no flammable materials are kept near the Bunsen burner. Use safety flame when not actively flaming material. Wear appropriate personal protective equipment (PPE) (lab coat).	Unlikely	2	4
Spreading can induce the risk of aerosolization of the material if the operator is not properly trained in the flaming and cooling of spreaders	OWN	Likely	1	6	Ensure operator is fully trained in how to flame and then cool the spreader to ensure that a hot spreader is not used, which can increase the risk of aerosolization.	Unlikely	1	2

By signing the declaration below, you have agreed that you will put the appropriate control measures in place to ensure that hazards are reduced and that the risks applicable to your stand are controlled.

Signed	**D. Student**
Print name	D. Student
Review date	07/10/2020

Examiner commentary

The student makes a thorough assessment of multiple pieces of literature making sure precise, logical and informative information is shown, considering many elements that could impact on the reliability and the applicability of the literature to the set task, using their own judgement to select applicable elements of the literature that would inform the brief. The student shows an extensive understanding of the literature principles. The student is able to take select pieces of information from various pieces of literature, selecting the relevant information and combining information from different sources to formulate their own ideas using their own judgement.

The student provides an accurate summation of the presented technique and its purpose, with a full list of equipment and reagents that would be required for the task. The SOP provides a full and detailed protocol for assessing the number of CFUs, using decisive information from the provided literature and their own extensive knowledge to produce a SOP that addresses the set task completely. The method provided is relevant and applicable to the initial brief.

The student is able to accurately identify and explain a range of relevant risks from both the information from the tasks and their own knowledge and judgement. These risks are then appropriately assessed and appropriate control measures put in place to mitigate the risks they have identified.

Grade descriptors

The performance outcomes form the basis of the overall grading descriptors for pass and distinction grades.

These grading descriptors have been developed to reflect the appropriate level of demand for students of other level 3 qualifications, the threshold competence requirements of the role and have been validated with employers within the sector to describe achievement appropriate to the role.

Pass	The evidence is logical but displays minimal relevant knowledge or understanding in response to the demands of the brief.
	The student makes some use of relevant knowledge and understanding of how it informs practices of the sector and demonstrates a limited understanding of skills or approaches associated with the laboratory sciences sector.
	The student makes adequate use of facts/theories/approaches/concepts and attempts to demonstrate breadth and depth of knowledge and understanding of the different aspects of the task.
	The student is able to identify some information from appropriate sources and makes use of appropriate information/appraise relevancy of information and can combine information to make decisions.
	The student makes only select judgements/takes appropriate action/seeks clarification with guidance and is able to make limited progress towards solving non-routine problems in real life situations.
	The student demonstrates skills and knowledge of the relevant concepts and techniques reflected in a laboratory science setting and generally applies this across different contexts.
	The student shows adequate understanding of unstructured problems that have not been seen before, using limited knowledge to find solutions to problems and make justification for strategies for solving problems, explaining their reasoning.
Distinction	The evidence is precise, logical and provides a detailed and informative response to the demands of the brief.
	The student makes extensive use of relevant knowledge and has extensive understanding of the principles and practices of the sector and demonstrates an understanding of the different approaches/skills associated with the laboratory science sector.
	The student makes decisive use of facts/theories/approaches/concepts, demonstrating extensive breadth and depth of knowledge and understanding and selects highly appropriate skills/tasks/techniques/methods.
	The student is able to comprehensively identify information from a range of suitable sources and makes exceptional use of appropriate information/appraises relevancy of information and can combine information to make coherent decisions.

	The student makes well founded judgements/takes appropriate action/seeks clarification and guidance and is able to use that to reflect on real life situations in a laboratory science role.
	The student demonstrates extensive knowledge of relevant concepts and techniques reflected in a laboratory science role and precisely applies this across a variety of contexts and tackles unstructured problems that have not been seen before, using their knowledge to analyse and find suitable solutions to the problems.
	The student can thoroughly examine data/information in context and apply appropriate analysis in confirming or refuting conclusions and carrying out further work to justify strategies for solving problems, giving concise explanations for their reasoning.

Document information

The T Level Technical Qualification is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.

Copyright in this document belongs to, and is used under licence from, the Institute for Apprenticeships and Technical Education, © 2020-2021.

'T-LEVELS' is a registered trade mark of the Department for Education.

'T Level' is a registered trade mark of the Institute for Apprenticeships and Technical Education.

'Institute for Apprenticeships & Technical Education' and logo are registered trade marks of the Institute for Apprenticeships and Technical Education.

Owner: Head of Assessment Design

Change History Record

Version	Description of change	Approval	Date of Issue
v1.0	Published final version.		June 2021
v1.1	NCFE rebrand		September 2021