Dairy Products Processing

Level III

Based on May 2019, Version 2 OS and March 2021, V1 Curriculum

Module Title: - Controlling Contaminants and Allergens in the Workplace

LG Code: IND DPP3 M015 LO (1-5) LG (57-61)

TTLM Code: IND DPP3 TTLM 1020v1

March, 2021
Bishoftu, Ethiopia

With the support of
United Nations Educational, Scientific and Cultural Organization
Republic of Korea Funds-in Trust

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LG#57	LO #1- Assess risk of physical contamination

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying types and sources of physical contamination
- Identifying risks in operations, products and consumer
- Identifying control measures to eliminate physical contamination
- Assessing workplace procedures and practices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to identify:

- Types and sources of physical contamination in the workplace
- Risks in operations, product and consumer.
- control measures to eliminate physical contamination
- work place procedures and practices

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

Information Sheet 1	Identifying types and sources of physical contamination

1.1. Introduction

A contaminant is any biological, physical or chemical agent, foreign matter, or other substances not intentionally added to food which may compromise food safety or suitability. Sources of Physical contamination include:

- employees (e.g. hair, band aids, glasses, jeweler and coins or other contaminants, such as dirt, pests, food and raw materials)
- maintenance and cleaning procedures (e.g. metal shavings, grease from equipment, nuts and bolts, dirty equipment from previous products and glass breakages
- packaging materials (e.g. ink, dye, staples, paper, cardboard and plastic)
- pests (e.g. evidence of rodents gnawing on packages, rodent hair, droppings and debris)
- incorrectly labeled or packaged raw materials
- industrial sabotage/damage (e.g. tampering anywhere through the production process)

Accumulation of dusts from unclean environments, dirt particles can get entry in to the milk at the time of milking. The dirt particles from air even, unclean udder or body of the cow, unclean utensils and water supply can contaminate milk. The hair of body of cow or of milk can also fall in the milk.

The habits of the milker can also add some harmful contaminants like chewing tobacco or beetle leaves can make entry of the physical contaminants into the milk. At the barn, all the activities of the milker should be scrutinized / investigated. The cleaning of the milking equipment should be properly done with a reliable and adequate source of water supply. The dairy barns should be maintained regularly and of good condition. The surrounding area of the barn should be kept clean from the waste materials. The milking premises should be free from the cobwebs and accumulation of the dust particles.

Self check-1	Written test

Test item 1: choose the correct answer. (2pts each)

1. Physical contamination is:
   a. Foreign materials intentionally added into dairy products
   b. Ingredients and raw materials added during processing of dairy products
   c. Materials that are un intentionally added during milking, processing and packing
   d. all
2. Examples of physical contamination may include:
   a. Debris of packing materials c. hairs and nails
   b. Glass fragments d. all

Note: **Satisfactory rating 3 and above points** **Unsatisfactory 3 below points**

Information Sheet 2	Identifying risks in operations, products and consumer

2.1 Identifying risks in operations, products and consumer

Risk Factors that cause potential risk to consumers in food products include:

- Size: Health states that anything, product, that is extraneous, and measures two millimeters or more in size can be a health risk.
- Type of consumer: Products that target infants, the elderly, etc. have a higher risk level.
- Type of product: The form the product takes such as infant formulas, milk caisene, etc. can increase risk level.
- Physical characteristics: hardness, shape and sharpness of a product can affect risk level

Risk will occur during operation:

- Maintenance and cleaning process e.g. fragments of metals and glasses as well as residues of cleaning materials.
- Packing and raw material reception e.g. residues of cartoons / glasses and etc.
- quality analysis (test) e.g. broken glass
- Operation and consumption etc.

Products and consumers may suffer risk which comes for foreign materials, requires consideration of, at a minimum, the likelihood that they are present, their physical form (powder, liquid, pieces, etc), as well as the amount of any contaminant present. Risk management must encompass every component of the supply chain, from raw materials supply specifications to the sale of the finished product and including product design and development.

The evaluation should be carried out by personnel appropriately trained in contamination management. Documented procedures for the control and prevention of contamination must be in place and visible or readily available to all employees in the work area. The procedures should contain information about:

- Product development guidelines in terms of contaminant
- Good hygiene, for example, rules regarding clothing, hand-washing and hand contact with foods.
- Cleaning of premises, equipment and tools.
- Handling of rework materials, for example, the conditions under which such products may be used.
- Waste management, for example, how waste should be labelled and kept separate from rework.

Situations where potential cross-contamination can occur between raw materials, products, production lines or equipment, and each employee's responsibility for preventing this. Production scheduling, Labeling of raw materials, semi-finished goods and finished products is also good practice.

Self check-2	Written test

Test I. short answer

1. where can physical contamination in dairy processing identified ?(3pts)
2. write the procedure contained during identification of risk of physical contamination.(3pts)

Note: **Satisfactory rating 3 and above points** **Unsatisfactory 3 below points**

Information Sheet 3	Identifying Control measures to eliminate physical contamination

3.1 Identifying Control measures to eliminate physical contamination

Contamination of dairy produce during milking and manufacturing must be prevented. Product produced for human consumption must be free from foreign matter that would render the product unsafe. Manufacturing equipment, processes and systems must be designed and operated to prevent physical contaminants in product.

Where possible, all products must be filtered or passed through a device that detects foreign matter that would cause harm to the consumer. Product contaminated with foreign matter must be isolated.

Where this is not practicable, equipment must be inspected to detect contamination of the product with foreign matter that would cause the product to be unsafe.

Additionally, the following points are carefully applied:

1. use of personal protective equipment (PPE)

- Must have a cooperative effort between both employer and employee in establishing and maintaining a safe and healthful work environment.

Examples of PPE gloves, safety shoes, safety clothes, helmet etc

2. clothing standards

   Enclosed hair and no jewelry, clothes neatness and personal hygiene must be applied.

3. metal detectors

   There are several methods available to detect foreign bodies on dairy processing and production lines:

   • Magnets can be used to attract and remove metal from products.

   • Metal detectors can detect metal in products and should be set up to reject products if metal is detected. Equipment should be properly maintained to ensure it is always accurate.

   • X-Ray machines can be used to identify hazards such as stones, bones and hard plastics, as well as metal.

   • Food radar systems transmit low-power microwaves through food products to identify foreign bodies such as metals, plastics, bones or kernels in food

4. rulings against glass in production or packaging areas

   Glasses fragments must be disposed regarding to solid waste management system.

5. covering of raw materials and equipment

   Raw materials for dairy products must kept maintain temperature control to avoid contamination.

6. maintenance, cleaning and housekeeping programs

Cleaning and sanitation chemicals must store properly and separate room.

7. inspection schedules

   operation condition such as maintenance, production , quality analysis and allover plant processes perform on schedule.

8. reporting requirements and emergency procedures

Standard operation procedures and environmental guidelines included emergences that may happen. E.g. procedures for fire extinguisher written properly.

Self check -3	Written test

Item I Give short answer(1pt)

1. write ways of controlling and eliminating physical contamination.(5pts)
2. write examples of personal protective equipments. (4pts)

Note: **Satisfactory rating 5 and above points** **Unsatisfactory 5 below points**

Information Sheet 4	Assessing workplace procedures and practices

4.1. Assessing workplace procedures and practices

Physical contaminants are broadly as “hard/sharp” physical contaminants and “choking” contaminants. Both categories can cause injury to the consumer. These injuries may include dental damage, laceration of the mouth or throat, laceration or perforation of the intestine, and choking and may even lead to the death. Because physical contamination cover a broad range of contaminants, such as glass, metal, plastic, wood, and stones, such contamination can occur throughout the processing facility, including the receiving dock for ingredients and supplies.

It is really difficult to determine exact level of physical contaminant in dairy products but can be suggested by calculating composition of milk.

The common physical contaminants – i.e., metal, glass, and hard plastic physical contaminants.

a) Metal

Metal-to-metal contact during processing can introduce metal fragments into products. For example, metal fragments can break off during mechanical cutting and blending operations, and some metal equipment has parts that can break or fall off, such as wire-mesh belts .

b) Glass

Glass fragments can be introduced into milk whenever processing involves the use of glass containers. Normal handling and packaging methods, especially mechanized methods, can result in breakage. Ingesting glass fragments can cause injury to the consumer. Most products packed in glass containers are intended to be a ready-to-eat (RTE) commodity.

In contaminant analysis, consider the potential for glass fragments to originate from sources other than glass containers used in packaging in order to determine the level. For example, some facilities that do not pack in glass prohibit the presence of glass in the production environment to reduce the risk of glass getting into the product.

c). Hard Plastic

Hard plastic can be introduced into food when tools and equipment such as scoops, paddles, buckets or other containers develop fatigue, crack, and break as they wear. Hard plastic also can be introduced into food when plastic sieves and screens deteriorate. examination items to determine whether they are worn and remove worn items before they break, especially if they cannot be effectively cleaned (e.g., because of small cracks).

In general, there is overlap between facility-related physical contaminants and process-related physical contaminants. For example, equipment that has food-contact surfaces that break during food processing and result in physical debris being deposited in the food product can be considered a facility-related physical contaminant (because the equipment is part of the facility) or a process-related physical contaminant (because the equipment broke during processing). In general, in evaluating the potential for physical hazards in food products, it does not matter whether it consider physical contaminants to be facility-related or process-related. However, a few physical contaminants can readily be classified as facility-related or process-related. For example, nuts and bolts used during maintenance procedures would be a facility-related hazard, but production equipment that has nuts and bolts that could fall out during production would be a process related contaminants.

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Guidance on general workplace conditions, including design and maintenance of working to improve or prevent these contaminants is crucial.

Additionally, industry-specific recommendations according to work place procedures considered are presented below.

- Maintain walking and working surfaces clean and dry and provide workers with antislip footwear
- Avoiding wearing of jewellary
- Provide workers with training in the proper use of equipment (including the proper use of machine safety devices) and personal protective equipment (PPE)
- Ensure that the process layout reduces opportunities for process activities to cross paths, thus avoiding collisions and falls
- Demarcate transport corridors and working areas and ensure the proper placement of handrails on platforms, ladders, and stairs
- Ground all electrical equipment and installations in wet rooms
- Separation of contaminated products from normal
- Proper Sanitation
- Good-management practice
- Implementation of integrated pest and vector management programs and maximization of pest and vector control through mechanical means (e.g. traps and use mesh on doors and windows to reduce the need for pest and vector control)
- Segregation of raw materials from finished products
- Reporting any occurrence to the supervisor
- Performing tasks according to standard operation procedures (SOP)

Self chech-4	**Written test**

Test 1 Give short answer

1. Write opportunities identified to improve physical contaminants in dairy processing plant.(5pts)
2. What do SOP stands for ?(2pts)

Test I True/ False item

1. Determining the level of physical contamination is simple task in dairy processing.(2pts)
2. Determining Foreign materials level is important in controlling physical contamination.(2pts)

Note: **Satisfactory rating 6 and above points Unsatisfactory 6 below points**

LG 58#	LO #2- Assess risk of chemical contamination

Instruction sheet 2

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying types and sources of chemical cal contamination.
- Identifying risks in operations, products and consumer
- Identifying control measures to eliminate chemical contamination
- Assessing workplace procedures and practices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to identify:

- Types and sources of chemical contaminants in the workplace
- Risks in operations, product and consumer
- Control measures to eliminate chemical contamination
- Work place procedures and practices

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Information Sheet 1	Identifying types and sources of chemical contamination

1.1 Chemical contamination

Chemical contamination are of concern in two respects first, environmental contaminants and second, adulterants added in milk which may cause illness or adverse health effects. There are several environmental contaminants that can affect the safety and quality of milk.

a) Afla toxins

Afla toxins and other myco toxins are reported to be mutagenic, carcinogenic, tetratogenic and hepatotoxic in most animals and man. Aflatoxins present in the cattle feed are excreted in milk may be found in the milk of animals that are fed with Aflatoxin containing feed. The content of Aflatoxin in milk is entirely dependent on the presence of the precursor Aflatoxin in the ration of dairy cattle and it can numerically express as feed to milk ratio. These toxins can appear in milk within 48 hours of their intake through contaminated feed. It is important to have, regular monitoring for the presence of aflatoxins in milk.

b) Pesticides and insecticides residue

Pesticides are commonly used for control of insects on plants and animals. The common insecticides which may be present in milk are DDT, BHC (Benzene hexachloride), their isomers and other chlorinated compounds such as aldrin, dieldrin, heptachlor etc. The chlorinated hydrocarbons are extremely durable, persistent, endocrine-disrupting activities, bio-accumulating and widely distributed toxic compounds that find their way into the food chain usually through use in controlling environmental or animal pests . As much as 20% of an ingested chlorinated hydrocarbon excretes in milk, Chlorinated hydrocarbons adhere

to milk fat and butter contains a much higher proportion of these insecticides. DDT can accumulate in fatty tissues and can transfer into milk and dairy products. Residues of such compounds may persist in the environment and cause contamination through the food chain presented organochlorine pesticide residues.Chemical fertilizers and growth promoters (Such as Hormones) have been used extensively to boost up agricultural production (USDA,2002).

c) Antimicrobial residue

The most contentious residues that occur in milk are antimicrobial drugs. Much of the veterinary treatment of dairy cattle involves intra mammary infusion of antibiotics to control mastitis. Some drugs apply to control endoparasites, ectoparasites and several illnesses and to increase milk production. The most commonly used antimicrobials in dairy cattle can group into five major classes. These include the beta-lactams (e.g., penicillins and cephalosporins), tetracyclines (e.g., Oxytetracycline, tetracycline and chlortetracycline), amino glycosides (e.g., streptomycine, neomycin and gentamycin), macrolides (e.g., erythromycin) and sulfanomides (e.g., sulfamethazines). Whenever any route with an antibiotic treats a lactating cow, measurable levels of the antibiotic are usually detectable in the milk for a few days after the last.

d) Antibiotic residue

Although antibiotic residues in foods can have a detrimental effect on the processing of cultured products such as cheese and are important in terms of consumer confidence, the public health significance of residue concentrations of some of these compounds in foods from animals appears to be low, based on substantial scientific assessment. Most of the antibiotic drugs currently used in animal agriculture are relatively nontoxic, even at high concentrations, but there are a few antibiotics which pose a small but significant threat to public health when present in sufficiently high concentrations in foods. Among these is chloramphenicol, which has been associated (In a non-dose related manner) with a plastic anaemia due to bone marrow depression in a small proportion of human

patients to whom the drug administered for therapeutic purposes. Some of the patients who survive the bone marrow depression have developed leukemia, which creates concerns about possible carcinogenicity. Other antibiotics have been associated with allergic reactions of varying severity in people. An estimated four to ten allergic reactions occur per 100,000 courses of penicillin treatment administered directly to people, but actual incidents of allergicreaction to penicillin residues in foods are few and poorly documented. Although sulfonamides and tetracycline hydrochloride ministered to people at therapeutic concentrations may have toxic and allergic consequences. Based on experimental evidence, however, there is concern that residue concentrations of antibiotics have the potential to encourage the development of antibiotic resistance in the microbial flora of people eating contaminated foods.

e) Hormone residue in milk Steroid hormones

Milk can also consider as a rich source of steroid hormones. The amounts of lipophilic hormones depend on the fat content of the milk and dairy products. Not only progesterone but also estrogen increases with fat content. Food processing does not seem to influence the amount and ratios of the hormones. In fresh cheese as well as in ripened cheese, testosterone was detected (0.1-0.5 $mgkg^{-1}$). Probably not only propionic acid bacteria but also other fermenting bacteria or clotting enzymes are responsible for the formation of testosterone during the fermentation process.

f) Heavy metals

Heavy Metals for example lead, mercury, cadmium, arsenic, etc. have been reported in milk. Heavy metals enter the human body mainly by the routes of inhalation and ingestion. With increasing environmental pollution, a heavy metal exposure assessment study is necessary heavy metals produce toxic effects byreplacing essential metal ions existing in the chelates present in body. It is well established that lead (Pb) and cadmium (Cd) are toxic for human and children are more sensitive to these metals than adults. Cu and Zn are micronutrient and essential for living organisms, they can be toxic

when taken in excess; both toxicity and necessity vary from element-to-element. Heavy metals can enter to milk and dairy products and affect the health of people who have consumed contaminate milk and dairy products .

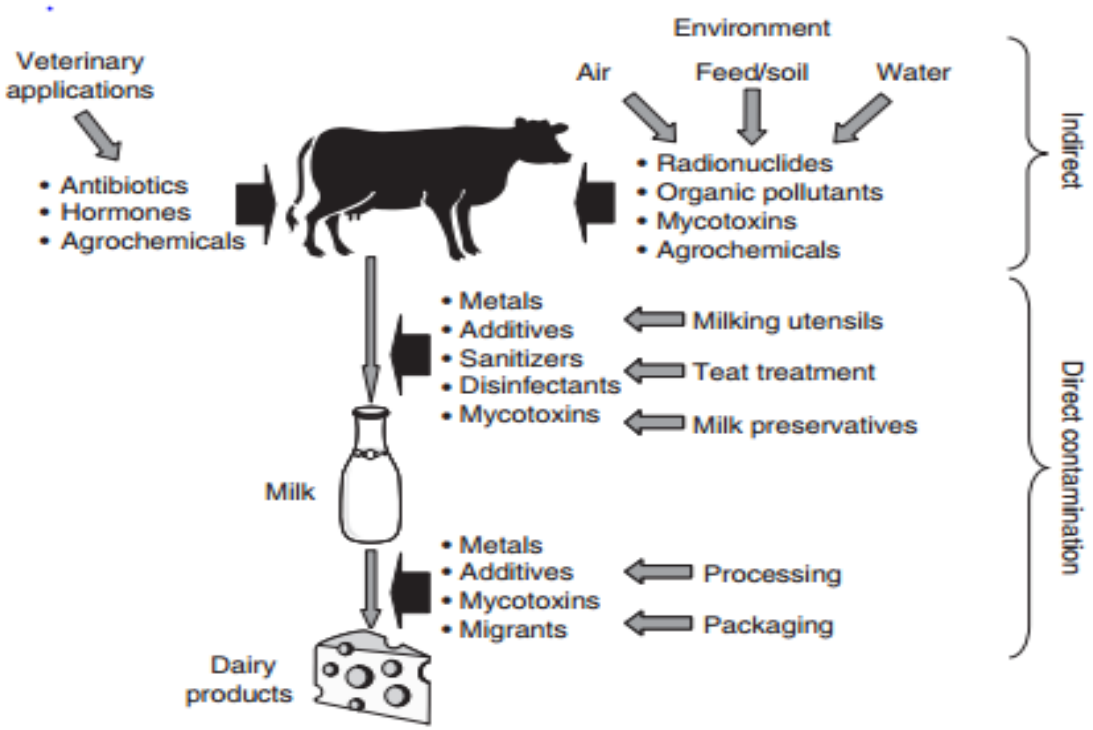

Figure 1: Contaminants of milk and dairy products and their respective sources.

Self check-1	Written test

Test I short answer

1. Write sources of chemical contamination. (5pts)
2. Give examples of direct and indirect sources of chemical contaminants of dairy and dairy products, 3 of each.(5pts)

Note: **Satisfactory rating 5 and above points** **Unsatisfactory 5 below points**

Information Sheet 2	Identifying risks in operation, products and consumer

2.1 Identifying risks in operation, products and consumer

Risks of chemical contamination can be identified in operation, products and consumer by many means.

Operation:

- Machine cleaning and maintenance
- Machine operation
- During lubrication
- From environment
- Mixing ingredients
- Loading etc.

Products:

- Raw material reception
- During dairy product processing
- Quality analysis
- Measuring and weighing
- Storage
- Packing
- Logistics etc

Consumer:

- Processing and consumption

The management of the quality by risk analysis or identification of potential contaminants linked to a product or a process (Hazard Analysis and Critical Control

Points or HACCP-type approach), must be applied along the whole supply chain, from the cow to the consumer. For each identified potential risk, one identifies feasible corrective actions and control plans.

A quantitative risk assessment determines the probability that the exposure to a particular risk can cause a disease for a given individual. It is necessary to take in account the predisposition or the sensibility of certain consumers to pathogenic agents. The risk factors linked to a consumer are age, immune system defenses, sex and stress levels. The measure of quantitative risks allows for the calculation of an “acceptable” risk level and for the establishment of quality norms or criteria adapted to the different situations.

Self check -2	Written exam

Test item I. Short answer

1. write ways how do risks render in operator, product and consumer.(3pts)

Test item II say true or false

2. Operator may be affected by chemical contamination during processing**.(1pts)**

Note: **Satisfactory rating 2 and above points** **Unsatisfactory 2 below points**

Information Sheet 3	Identifying control measures to eliminate chemical contamination

3.1 Identifying control measures to eliminate chemical contamination

Chemical contamination can be eliminated or reduced by:

- Safe handling of chemical contaminants with continuous follow up (preparing formats for follow up).
- storing chemicals away from food production areas
- using correct containers for storing and dispensing chemicals
- correctly labeling chemicals in containers with specific contents
- calculating and applying correct quantities ensuring chemical record sheets are filled correctly

Government also has responsibility for making regulations to protect consumers against harm arising from chemical contaminants in foods. There are many programmes for chemical contaminants prevention and control in milk and dairy products such as HACCP program and total quality management and quality assurance programmes.

3.2 HACCP program

Each producer and processor must have a functioning HACCP system according to the 7 HACCP principles. These are:

PRINCIPLE 1: Conduct a hazard analysis. This includes the identification of potential hazards/contaminants and the need for their control (i.e. prevention or reduction to acceptable levels or elimination).

PRINCIPLE 2: Determine the Critical Control Points (CCPs). Determination is based on the assessment of available control measures as regards their effect against hazards and their ability to be monitored in time for immediate corrective action. CCPs are identified as those steps where control measures essential for achieving the required

level of control (cp principle 1) are located.

PRINCIPLE 3: Establish critical limit(s) Limits are established at each CCP for relevant parameters used for monitoring the correct functioning of the control measures(s). The value of the limit determines whether the control measure is functioning as intended or control has been lost.

PRINCIPLE 4: Establish a system to monitor control of the CCP.

PRINCIPLE 5: Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control. A CCP is not under control when one or more critical limit(s) are exceeded.

PRINCIPLE 6: Establish procedures for verification to confirm that the HACCP system is working effectively. Verification activities also include verification of the system in its entity (prerequisites and HACCP).

PRINCIPLE 7: Establish documentation concerning all procedures and records appropriate to these principles and their application.

3.3 Total quality management and quality assurance programmes

On receipt, raw milk should be subjected to the following controls by analytical laboratories performed according to Good Laboratory Practice for quality assessment:

- Measurement of pH value and of titratable acidity;
- Tests for sediment and antibiotic residues;
- Measurement of temperature, which should not exceed 10°C;
- Determination of its composition;
- Tests to ensure that milk has not been adulterated;
- Somatic cell count In final products, the following quality tests are applied:

a. Physical analysis: example fat, protein, ash, lactose solid not fat total solid and etc.

b. microbiological analysis Total bacteria count, total coliform, E.coli, selemonella, shigella and etc.

Self chek-3	Written test

Instruction 1: choose the best answer for the following questions(2pts)

1. Total quality management and quality assurance programmes include all except:

A . Measurement of pH value and of titratable acidity;

B. tests for sediment and antibiotic residues;

C. measurement of temperature

D. physical appearance of operator

E. Determination of microbiological quality

2. Among seven HACCP principles, one of the followings is used for monitoring the correct functioning and level of the control measures(s).

A. Establishing procedures for verification

B. Establish critical limit(s)

C. Establish the corrective action

D. Establish a system to monitor control of the CCP

Instruction 2: write down short and precise answer.

1. write principles of HACCP.(2pts)
2. Point out good laboratory practice in quality assessment(4pts)
3. Write down control methods of chemical contamination (5pt)

Note: **Satisfactory rating 7 and above points Unsatisfactory 7 below points**

Information Sheet 4	Assessing workplace procedures and practices

4.1 Assessing workplace procedures and practices

Chemical contamination occurs when chemicals are present either where it shouldn't be, or in stronger concentrations than it should be. Preventing chemical contamination plays a large part in ensuring chemical safety in the workplace, along with safe chemical storage facilities and being aware of the dangers of chemical spills and knowing how to respond.

Contamination not only poses the risk of damage to workplace, materials and tools but it also poses a danger to environment and employees health.

There are 6 key ways in which employee can proactively try to prevent chemical contamination from presenting itself as an issue in the workplace.

1. **Clear Labels**

One of the easiest ways people can prevent chemicals from contaminating workplace is by clearly labeling each substance. The labels should ideally include the name of the product, the expiry date and disposal methods, the dangers and clean-up instructions in case of an accident. This prevents the chemicals from being inadvertently used or disposed of incorrectly and encourages safe handling, which largely helps to avoid contamination.

Labeling and signage will always improve the safety of employee workplace. Learn how to choose the correct signage for chemical cabinets .

2. Spill Trays & Decks

Spill trays and decks prevent leaking or spilled chemicals from travelling across workspace. The spill trays can fit neatly on shelves, while spill pallets are ideal for drum storage. It contain any leaks, preventing contamination and ensuring workspace can be easily cleaned. Ideally, chemicals should not share spill trays or decks with substances that may have a reaction with.

3. Clear Protocols

Workers should explain the measures to be taken when handling chemicals and what to do in the case of a spill or leak with all of employees. If possible, have these guidelines posted on the walls as a constant reminder. Ensure every employee is clear on the best protocol and what their own particular actions should be in an incident. If an accident does occur, have the involved employees fill out an incident report. This not only helps to analyze the cause, it allows yto put measures in place to ensure it does not happen again.

4. Drain Seals

Drain seals prevent chemicals from entering, and damaging drainage system. This not only protects workspace from contamination, it also protects local water supply that may be affected by run-off. Furthermore, it allows all chemicals to be removed from work space during clean up, preventing chemical residues from remaining in ones drain where that could potentially mix with other substances or emit fumes.

5. Chemical Storage Cabinets

Chemical storage cabinet's are an important consideration for every workplace using chemicals. it ensure volatile substances are stored securely, without a risk of contamination. It protect chemicals from occurrences that may cause a leak or reaction, as shocks, bumps and temperature changes. Additionally, like a spill deck, bonded

chemical storage cabinets help contains any spreading leaks, again decreasing contamination risks.

6. Cleaning Materials

The correct cleaning materials should be kept in a designated area of the workplace in case a spill or accident occurs. Having it easily accessible ensures clean up is quick and efficient, preventing the chemicals from spreading throughout and contaminating workplace. This should include safety clothing to wear while cleaning and a spill kit for hazardous waste.

Chemical contaminants that end up in milk or other dairy products are primarily caused by ingestion or production of these compounds by the cow. This can occur through the use of contaminated feed, via the uptake of chemical compounds due to grazing on contaminated soil or via the administration of veterinary medicines. Another cause of contamination is through fraud, which may occur at various stages along the dairy production chain. Examples are the presence of dioxins in animal feed due to the illegal use of contaminated technical fats. The following sections present determining levels of the various chemical contaminants of concern that may occur along the dairy chain. Thus, Contaminants from various sources need level to enhance health of producer and consumer.

Animal feed

Cows are fed with roughage, such as grass or maize silage produced at the farm, with by-products from the food industry and from fermentation processes, and with compound feed and by-products that are supplied by feed companies. The main contaminants for silage are the presence of natural toxins such as mycotoxins and plant toxins, whereas compound feed may be contaminated with mycotoxins, pesticides, persistent organic pollutants and heavy metals depending on its origin and production process. Some ingredients have a higher probability of being contaminated with these compounds than others.

Dairy farm

At the dairy farm, milk can become contaminated due to intake of contaminated compound feed or silage, Organic pollutants and heavy metals radionucloides, veterinary drugs, detergents and disinfectants, due to grazing on contaminated land, due to the administration of veterinary drugs or due to the inadequate use of detergents and disinfectants.

Milk processing

Dairy products may be produced either at the factory or at the farm itself Accumulation of contaminants , Food additives and processing aids such as the use of colorants, enzymes, starter cultures or the use of fruit products, Migration from packaging materials may introduce new contaminants during processing. It would be too much to provide a complete list of chemicals associated with the wide range of food additives and processing aids used during processing.

In general, arranging inspection of incoming goods, which is part of a HACCP system, prevents the introduction of the level of chemical contaminants during processing.

Chemical Contaminants in cow's milk and dairy products caused by accidents, carelessness and overzealous/overdose use of antibiotics. Chemical contamination cannot completely prevent, or eliminate from milk and dairy products. Because milk contains the persistent fat and lipophilic contaminants will find for some time.

Further, when the enormous quantity of milk produced is considered, the potential health contaminants posed by the residues is almost non existent. The use of **food safety** and **quality assurance** in farms and plants is very important to reduce chemical contaminants in milk and dairy products. A regulatory law implementation in milk and dairy industries and long term planning is required to do milk safety. In addition, there are other items such as training of personnel or current good manufacturing practices and monitoring. Good manufacturing practices and monitoring can do by regular examination with economic penalties about chemical residues. It is useful to reduce chemical contaminants in milk and dairy products from a regulatory point. Monitoring can accompany by regular re-evaluation of the acceptable levels must continue, but with the realization that some residues will probably always be found in very low quantities and they are considered to be unavoidable contaminants. Generally, improvements of chemical contamination involves continous follow up during raw material reception, processing and final product packaging, there by taking action for unusual occurences in products and personnel.

Self check-4	Written test

Test item 1: true or false

1. Good manufacturing practice play no role in improving chemical contamination.(2pts)
2. Use of food safety and HACCP program are applied to improve level of chemical contaminants.(2pts)

Item II write short answer

1. Write six proactive measures to prevent chemical contamination.
2. Write the points where do the level of chemical contamination would be determined.(4)
3. Some of chemical contaminations' can be determined by visual inspection. (true /false). (1pt)

Note: **Satisfactory rating 5 and above points** **Unsatisfactory 5 below points**

LG#59	LO #3- Assess risk of microbiological contamination

Instruction sheet: 3

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying types and sources of microbiological contamination
- Identifying risks in operations, products and consumer
- Identifying control measures to eliminate microbiological contamination
- Assessing workplace procedures and practices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to identify:

- Types and sources of microbiological contaminants in the workplace
- Risks in operations, product and consumer.
- Control measures to eliminate microbiological contamination
- Work place procedures and practices

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6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, ask your trainer for further instructions or go back to training.

Information Sheet 1	Identifying types and sources of microbiological contamination

1.1 Introduction

Milk when secreted into an uninfected animal's udder is sterile and invariably, it becomes contaminated during milking, cooling and/or storage. It is an excellent medium for the growth of bacteria, viruse, fungi, yeasts and moulds that are the common contaminants of any food material. Their rapid growth, particularly at high ambient temperatures can spoil the milk for liquid consumption and for manufacturing dairy products.

1.2 Sources and types of Microbial Contamination of Milk

Microbial contamination of milk can be from the internal and/ or external sources that are described in the following section.

1.2.1 Interior of udder

Varying numbers of bacteria are found in aseptically drawn milk with the reported counts of <100-10,000 CFU/ml from normal udder, but an anticipated average is 500-1000 CFU/ml in advanced countries. Microorganisms enter the udder through the duct at the teat tip that varies in length (from 5-14 mm) and its surface is heavily keratinized. This keratin layer retains the milk residues and exhibit antimicrobial activity.

During progress of a milking, bacteria are present in the largest numbers at the beginning and then gradually decrease. This is mainly due to the mechanical dislodging of bacteria, particularly in teat canal, where the numbers are probably highest. Because of this discarding of first few streams of milk helps in lowering the counts of microbes in milk. Milk from different quarters also vary in numbers.

Though are slow growing, but if allowed to grow, they cause acid formation and proteolysis. These are mostly non-pathogenic. Streptococci are less frequent than

micrococci. *Streptococcus agalactiae* may be present even in non-clinical mastitis and thus it appears to be a natural inhabitant of udder. Among Gram positive rods, *Corynebacterium bovis* has been found in large numbers. It is non-pathogenic, but if grown causes rancidity. If an animal is infected from mastitis, microbial contamination from within the udder of animal contributes notably to the total numbers of microbes in the bulk milk, when compared with the milk originated from a healthy animal. The influence of mastitis on the total bacterial count of milk depends on the type of the infecting microbe. Most common microbial agents of mastitis in milk animals are given in (Fig 2.) are *Staphylococcus aureus, Streptococcus agalactiae, Streptococcus dysgalactiae, Streptococcus uberis, Escherichia coli* and *Corynebacterium pyogenes*.

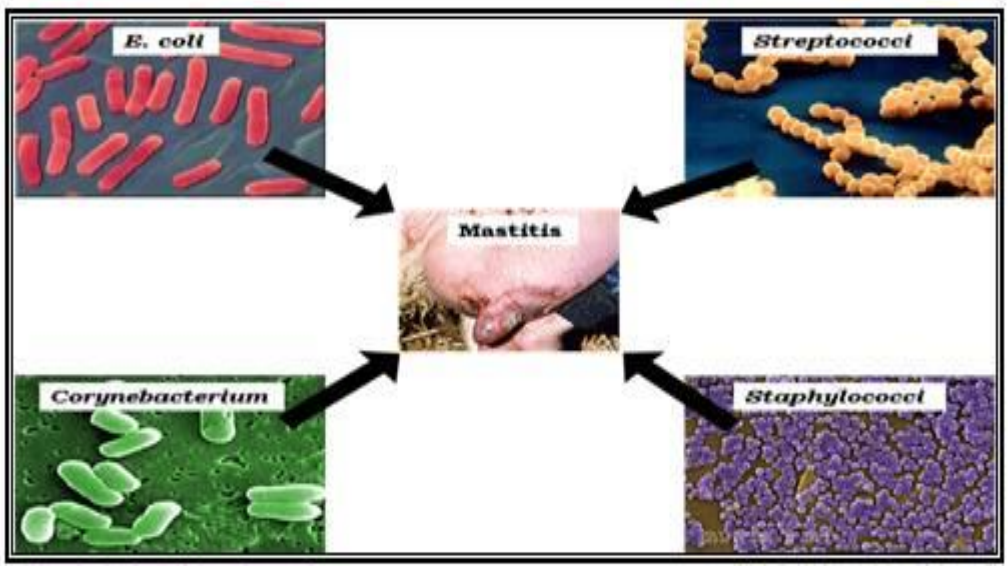

Figure2. Most common microbial agents of mastitis

1.2.2 Exterior of udder

In addition, to the udder infections, unclean udder and teats of animal also contribute significantly to the total bacterial counts of milk. The microbes that are naturally associated with the skin of the animals as well as those derived from the environment, where the cow is housed and milked are predominant in the milk. The environmental conditions such as soil, manure, mud, feed or bedding; determines what kind of microbes will dominate in milk. Udder and teat become soiled with

dung, mud, bedding material such as saw dust, straw etc. With heavily soiled udder teats the counts may be 1, 00,000 cfu/ml. The bedding material in winter has high number of bacteria, mainly psychrotrophs, coliforms and *Bacillus* spp. Udder microflora is not affected much by simple washing. Economy washing with sodium hypochlorite accompanied by drying, helps in reducing the number of microbes. Different category of microbes that occurs in the exterior of udder are :

- Predominantly micrococci and coagulase negative staphylococci exist.
- Next, on the teat surface are faecal streptococci, but Gram negative bacteria including coliforms are less. Coliforms do not survive well on teat surface.
- Aerobic thermoduric organisms are entirely *Bacillus* spp. The more frequent are *B. licheniformis, B. subtilis, B. pumilis* and less frequent ones are *B. cereus, B. circulans* and *B. firmus*.
- Teat surface may also contain clostridial spores that are usually found in cows fodder, bedding and faeces.
- Psychrotrophic and thermoduric bacteria predominate on the teat surfaces.

The psychrotrophs that can grow at 7^0 C and below are mostly Gram negative rods, and the major ones are *Pseudomonas fluorescens,* followed by *Alcaligenes, Flavobacterium* and coliforms.On the other hand, thermodurics on teat surfaces are often bacterial spores (a dormant and non-reproductive structure; highly resistant to radiations, desiccation, lysozymes, high temperature, starvation and disinfectants) that are typically found in the soil . When these spores enter the bulk milk, they may survive during pasteurization and cause a number of post-pasteurization problems.

1.2.3 Coat of cow

The coat serves as a vehicle to contribute bacteria directly to milk. The hairs around udder, flanks and tail contribute to the higher bacterial count in milk. The coat may

indirectly contribute microbes into air, especially *Bacillus* spp. The coat may carry bacteria from the stagnant water pools, especially ropiness causing milk microbes.

1.2.4 Animal shed and surroundings

Milk produced on farms with poor hygiene practices may undergo significant spoilage and have a shorter shelf-life, when compared to milk produced under hygienic conditions. Microbes associated with the bedding materials include:

- Coliforms
- Spore-formers
- Staphylococci
- Streptococci
- Other Gram negative bacteria

1.2.5 Milking staff

The staffs involved at different stages of milk production plays a pivotal role in maintaining hygiene and preventing milk contamination. The hand contacts or dislodging of dust and dirt particles by milker may add varieties of microbes to milk. Risks of contamination from milker are definitely higher, when cows are hand-milked in comparison to when they are machine-milked. Soiled clothes and hands increase the risk of contamination of milk and milking equipments many folds. Milker with infected wounds on hands contributes pathogenic *Streptococcus* spp. and micrococci. If wet hand milking is practiced, the microorganisms present in lubricants like fore-milk, water or saliva of the milker and bacteria from hands and teats will enter the milk.

The common microbial pathogens from humans causing diseases such as typhoid, paratyphoid and dysentery may contaminate the milk. Microbial pathogens causing scarlet fever, septic sore throat, diptheria, cholera etc. contaminate the milk.

1.2.6 Milking equipment (storage containers and transportation systems)

Improperly cleaned milking and cooling equipments are one of the main sources of milk contamination. Milk residues left on the equipment contact surfaces supports the growth of a variety of microbes. Although natural inhabitants of the teat canal, apex and skin; microorganisms associated with contagious mastitis do not grow well on these equipments, it is possible that certain strains associated with environmental mastitis may grow to a significant level. Since, it is very difficult to remove all milk residues and deposits from the milk contact surfaces of milking equipments; hence equipment with smooth surfaces and minimal joints should be used. The tanker and collecting pipes are also the potential sources of contamination, if not adequately cleaned. In addition, biofilms can easily build up on the enclosed, hard to clean surfaces .

Unclean or improperly cleaned milk cans and lids if they are still moist, results in multiplication of thermophilic bacteria like *Bacillus cereus.* Improperly sterilized milking machines contain thermoduric micrococci, *Bacillus* spp. and *Microbacterium* spp. predominantly compared to coliforms and streptococci. Rubber hoses predominantly contribute to pseudomonads rather than thermodurics.

1.2.7 Water supplies

At dairy-farms, the water can be a predominant source of microbial contamination. Water used in production should be of good bacteriological quality. Inadequately or uncleaned, storage tanks, untreated water supplies from natural sources like bore wells, tanks and rivers, may also be contaminated with the faecal microbes (e.g. Coliforms, *Streptococci* and *Clostridia*). In addition, a wide variety of saprophytic bacteria (i.e. *Pseudomonas*, Coliforms, other Gram negative rods, *Bacillus* spores, *Coryneform* bacteria and lactic acid bacteria) may also be present in water and may contaminate the milk potentially. The warm water used for udder washing is potent source of *Pseudomonas* and Coliforms which may even cause mastitis.

1.2.8 Airborne contamination

Aerial contamination of milk by bacteria is insignificant, in comparison to microbes with those that are derived from the teat surfaces. The microbial counts of air in sheds rarely exceed 200 cfu/l. Micrococcus account for >50% of the aerial microflora. Air contains dust, moisture and bacteria; hence its entry should be minimized in milk. Micrococci, Coryneforms, *Bacillus* spores, streptococci, and Gram negative rods are the major genera present in air. In general, more air incorporated into milk leads to the faster growth of bacteria. Following are some of the practices that increase aerial counts in milk:

- Sweeping of floors just before milking process
- Handling hay and feed shortly before milking process
- Brushing of animals prior to milking process
- Having the dusty bedding materials for animals
- Allowing dust and dirt to accumulate on the walls or ceiling of sheds

Self check-1	Written test

Directions: Answer all the questions listed below.

Test I Short Answer Questions

1. Write sources of microbial contamination in dairy and dairy products.(5pts)

2. Write examples of Microbes associated with the bedding materials of animals.(5pts)

Test II Write true if the statement is correct and false if statement is incorrect

1. Gram negative bacteria would affect dairy product as air born contaminant.(1pt)
2. Water supplies can cause *Coryneform* bacteria to contaminate milk.(1pt)

Note: **Satisfactory rating 7 and above points** **Unsatisfactory 7 below points**

You can ask you teacher for the copy of the correct answers.

Score:
Rating:

Information Sheet 2	Identifying risks of microbiological contamination on operations, products and Consumer

1.3 Identifying risks of microbiological contamination on operations, Products and Consumer

From a healthy animal, raw milk is expected to harbour no pathogens at the point of collection. However, this is seldom in the case.

Pathogenic microorganisms can contaminate raw milk in two ways.

First, endogenous contamination occurs when milk is contaminated by a direct transfer of pathogens from the blood (systemic infection) of an infected animal into the milk, or via an infection in the udder.

The second means by which fresh milk can be contaminated, known as exogenous contamination, occurs where milk is contaminated during or after collection by animal faeces, the exterior of the udder and teats, the skin, and other environmental source risk factors identified:

Primary production

- Diseases (mastitis)
- Housing, bedding and husbandry
- Feed and water quality
- Waste management

Milk collection:

- Milking practices
- Equipment cleaning
- Personnel hygiene

Raw milk storage

- Availability and efficiency of cold storage facilities

Packaging

- Packaging Equipment and material

Transportation and distribution

- Transportation mode
- Road network between milk collection centres and market centres
- Maintenance of cold chain

Consumer practices

- Storage temperature at home storage
- Adherence to handling instructions and good personal hygiene
- Poor refrigeration during home storage of both raw and processed milk can accelerate the proliferation of pathogenic microorganisms.
- Lack of proper hygiene and non adherence to handling instructions can lead to contamination and proliferation of pathogenic microorganisms.

These needs action to take and involve the following steps:

a. Risk Identification

The starting point is a milking of the available source and the data collected in the dairies that are processed. In the first stage, the following terms are defined:

• Hazard/contaminant—product features reducing its quality (which consists of health safety, sensory characteristics, nutritional value, and availability)

• Cause—the cause of hazard

• Risk of food loss like milk- the probability of the occurrence of a hazard in the product, which may cause loss of milk for consumption purposes or cause that food that is suitable for human consumption (but of lower quality than expected) to be subjected to reprocessing.

b. Risk Analysis

Subsequently, the identified risks of food losses and contaminants are analysed in order to understand them in detail. For this purpose, a relationship diagram was used to present the causes of hazards. To determine the significance and incidence of the causes of hazards. Determination of the probability of the occurrence of an unfavourable event provides baseline information to determine the level of risk, which depends on the probability and consequences, and these parameters depend on the accuracy of the information inputs.

c. Risk Evaluation

In order to evaluate risk, which has a significant impact on the decision-making process, the risk matrix is used to determine whether the expected risk is within the acceptance limits or whether it is outside these limits. The risk matrix defined the risk depending on the obtained value . The risk levels are divided as: “low”, “medium”, “high”, and “very high”. For each of these risk levels, adequate decisions were indicated. If risk is not acceptable, further treatment is required.

d. Risk Treatment

The results of the risk analysis formed the basis to decide what and to what extent the identified risks require that the organization implement proper risk treatment algorithms and for their application to be prioritized.

options for treating risk may involve, for example, avoiding the risk, removing the risk source, changing the consequences, or retaining the risk by making an informed decision. The following risk treatment options are adopted: tolerance, prevention, and avoidance.

Self check-2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short answer questions

1. Write the source of risk factors of microbial contamination with possible examples. (4pts)
2. Write down risk treatment options.(#3pts)

3. Define risk analysis.(#2pts)

Note: **Satisfactory rating 5 points** **Unsatisfactory -5 below points**

You can ask you teacher for the copy of the correct answers.

Score:-----

Rating: ----------

Information Sheet 3	Identifying control measures to eliminate microbiological contamination

3.1 Control to eliminate microbiological contamination

1. Natural Antimicrobial Systems in Milk

Raw milk contains natural antimicrobial peptides and enzymes including lactoferrin, lactoperoxidase, lysozyme and N-acetyl-β-D-glucosaminidase, which may enhance the microbial safety of raw milk. These natural inhibitory systems in milk may prevent a significant increase in microbial loads within the first 3–4 hr after harvesting milk at ambient temperatures. These natural antimicrobials inhibit post harvest bacterial growth in the raw milk, there by protecting consumers of raw milk against pathogenic microorganisms. Lactoferrin is a glycoprotein with two binding sites for iron, and is found predominantly in colostrum, milk and other mammalian body secretions such as saliva, seminal fluids and tears.

In the colostrum, lactoferrin concentration is higher in both human and cow milk but decreases during the lactation period to insignificant levels. The antimicrobial effects of lactoferrin can be direct through bacteriostatic and bactericidal activity or indirect through activation of a complex series of reactions that lead to a protective immune response following microbial infections . Another mechanism for the antimicrobial property of lactoferrin is the direct interaction of intact or partially hydrolysed lactoferrin with lipopolysaccharide of the microbial cell, which may disrupt the cell wall integrity through dispersion of lipopolysaccharides, resulting in cell lysis.

Generally, the antimicrobial activities of lactoferrins are not significantly affected by commercial pasteurisation. However, treatments above temperatures used for pasteurisation can lead to their inactivation . Thus, lactoferrins may contribute to the safety of raw or pasteurized milk and can complement—but cannot substitute—good hygienic practices in milk production and processing. Lactoperoxidase, also known as milk peroxidase, is one of the heat-stable enzymes which is initially present at low

concentrations in cow colostrum but increases after delivery. Like peroxidase found in tears, saliva, intestinal as well as nasal and bronchial, lactoperoxidase plays a protective role in the mammary gland, preventing microbial invasion . In milk, lactoperoxidase alone has no significant antimicrobial activity. These hypothiocyanite ions are transient but have potent bacteriostatic effect against most mesophilic bacteria present in raw milk when oxidized by free sulphydryl groups. This occurs due to inactivation of important metabolic enzymes in bacteria consequently shutting down the cell metabolism and hence cell growth. This natural system is known as the lactoperoxidase system (LP-system). Lysozyme is another enzyme in milk, which acts synergistically with other antimicrobials to enhance the safety of raw milk. Lysozyme occurs in low concentrations in bovine raw milk but these levels are not reduced during pasteurisation because the enzyme is heat stable . However, cows infected with mastitis have significantly higher concentrations of lysozyme in their raw milk compared to noninfected cows. The antibacterial activity of lysozyme is effective when working together with lactoferrin or immunoglobin A. Lysozyme causes lysis of some Salmonella spp. in association with ascorbate and peroxide, both of which are present in low concentrations in milk. However, lysozyme alone as a biopreservative at concentrations up to 5 mg/mL, was not successful at inhibiting the growth and biofilm formation of S. aureus isolated from raw milk and cheese .

2. Traditional Milk Processing Methods

Raw milk is processed into various traditional products including yoghurts and cheeses . The main risks associated with the consumption of raw milk or its products are mainly of a microbiological nature. It has been shown that consumption of raw unpasteurized milk and its products pose realistic health threats due to possible contamination with human pathogens . Therefore, it is prudent that various precautionary measures are put in place during production, handling and processing of milk to ensure safety of consumers. Traditional processing of milk in Ethiopia employs various unit operations or techniques which may enhance the safety of milk.

3. Heat Treatment

The microbial risks associated with the consumption of raw milk can be significantly reduced or completely eliminated by heat treatment. To prevent over-growth of surviving pathogens that contaminate the milk during harvest or incidental recontaminations during processing, pasteurization and temperature control (rapid cooling, chilled storage) are critical control points for food borne pathogens associated with milk. Depending on the time–temperature combinations applied, heat treatment of milk can be categorized as thermization (57 ◦C –68 ◦C for 15–20 s), pasteurization (60 ◦C–65 ◦C for 30 m or 71–74 ◦C for 15–40 s) or sterilization (110 ◦C –120 ◦C for 10–20 min) which includes ultra-high temperature (UHT; 135–140 ◦C for 6–10 s for indirect and 140–150 ◦C for 2–4 s for direct UHT) and innovative steam injection (ISI; 150–200 ◦C for < 0.1 s) treatments. Each of these heat treatments of milk aim at different microbial targets and result in different shelf-life of the treated milk . For example, thermization generally leads to only a 3–4 log reduction in the counts of the vegetative commensally microorganisms such as Aeromonas spp., coliform bacteria, Enterobacter spp., Micrococcus spp. and Pseudomonas spp., of milk, but does not completely inactivate all vegetative pathogens.

On the other hand, pasteurization can eliminate all vegetative microorganisms, including vegetative human pathogenic cells of E. coli, Salmonella spp., L. monocytogenes, Yersinia enterocolitica, Campylobacter jejuni, enterotoxin producing S. aureus and Clostridium botulinum which may be present in raw milk . However, pasteurization does not destroy preformed heat-resistant enterotoxins of S. aureus and C. botulinum B toxin and the emetic toxins (cereulide) of Bacillus cereus. Similarly, pasteurization neither destroys the heat-resistant spores of C. botulinum nor of B. cereus.

Therefore, in order to destroy vegetative as well as spores of most pathogens, sterilization treatments are ideal. With the exception of spores of some nonpathogenic thermoresistant bacilli, sterilization can destroy spores of most pathogens including those of C. botulinum and B. cereus. Additionally, preformed toxins of S. aureus and C. botulinum in milk and the enterotoxins of B. cereus can be destroyed by sterilization techniques . Therefore, boiling or heating raw milk is commonly practiced to improve the safety of milk before consumption by destroying or reducing the growth of pathogenic

and spoilage microorganisms. Thus, it is common for milk to be heated several times as a means of preservation before consumption or further processing. Although the temperature–time combinations used in heating milk in traditional milk processing are not properly controlled, they can be considered generally as pasteurization, and are therefore capable of completely destroying most spoilage and vegetative human pathogens which may contaminate raw milk . This method however, may be inefficient dependent on the microbial source of contamination or if initial levels of microbial contamination are high, e.g. pasteurization of milk at 72 ◦C for 15 s was found to be inadequate to render the milk safe due to the high initial counts of bacterial contamination.

4. Natural Fermentation

For the majority of smallholder dairy farmers and milk fermentation of milk is the cheapest and most convenient method to prolong the shelf-life of milk. Traditional dairy fermentations are generally spontaneous or completed by back-slopping. Thus, these processes do not involve the use of properly defined starter cultures and the fermentation takes place under poorly controlled conditions such as temperature and time. The fermentation process is initiated and carried out by commensally microorganisms present in collection and fermentation containers, the environment or from the hands of processors. Lactic acid bacteria (LAB) and yeasts are predominantly involved in traditional fermentation of dairy products.

Traditional fermented foods are generally considered to be safe due to the production of antimicrobial compounds by fermenting bacteria and the reduction in pH which contribute to inhibiting the growth of pathogenic microorganisms. The metabolic activities of LAB and yeasts results in a considerable decrease in pH due to production of organic acids (lactic and acetic acids). Additionally, compounds such as diacetyl, hydrogen peroxide and carbon dioxide are produced during LAB and yeasts fermentation. These organic acids, together with the other compounds, act in synergy as antimicrobials, interfering with various metabolic activities of many pathogenic microorganisms by reducing their internal pH, altering their cell membrane potential and inhibiting active transport, destroying membrane integrity by per oxidation of

membranes lipids and denaturing enzymes and DNA . However, depending on the species and strains of fermenting bacteria, varying amounts of these compounds are produced during milk fermentation.

Generally, diacetyl is produced in low concentrations by some LAB as part of their metabolic activities. The antimicrobial activity of diacetyl is enhanced when used synergistically with other antimicrobials such as hydrogen peroxide. Bacteriocins, on the other hand are antimicrobial peptides produced by some bacteria, and typically show activity against closely related species whereas the producer bacteria are unaffected because they possess specific protective mechanisms .

5. Use of Antimicrobial Additives In order to inhibit the growth of pathogenic and spoilage microorganisms

Traditional milk processing employ the use of various medicinal plant parts or their extracts to serve as antimicrobial agents. Microbial counts in plant extract-fermented milk were found to be lower than control, even though pH was higher in the plant extract-fermented milk.

6. Role of Governments and Regulatory Bodies

The role of governments in ensuring the safety of milk and dairy products includes setting the necessary safety standards, performing inspections and putting measures in place to ensure that the standards are met, and having a strong enforcement program. In this context, there is the need for governments in the contamination to set up and legislate laws and regulations on the handling of milk—from farm to cup. Some of the expected standards for milk will include milking under sanitary conditions, cooling milk to refrigeration temperatures (below 4 ◦C) immediately after milking, transporting milk with vehicles equipped with appropriate cooling facilities, etc.

Governments must also incentivise farmers by providing the access to necessary facilities. For example, the provision of centrally placed holding and distribution centres that are equipped with chilling and microbial testing facilities will ensure that milk travels only short distances from time of milking until cooling. This way, milk will not be

subjected to significant temperature abuse that promotes spoilage, thus assuring that the milk fed into the food system is safe. There should also be functioning surveillance measures and systems to track and halt the carrying of contaminated milk into the dairy chain, and these surveillance systems must be accessible by the general public. Governments should also perform outbreak investigations to identity sources of contamination in the dairy chain, new pathogens and their food vehicles, as well as gaps in the dairy chain that compromise on food safety. Such investigations can be done in partnership with various academic and research institutions who can use the findings in the training of the next generation of food safety and control staff in the fields of food science, food technology, agriculture and biology. It is worth noting that governments must upgrade the requirements for food safety to support other important requirements such as economic implications (e.g., economic risks that arise from food spoilage), trade partnerships and agreements.

Finally, to develop lifelong safe food handling habits among the populace, governments would need to implement a wholistic food safety and hygiene as part of the education curricula beginning with junior and senior high schools to improve food safety cognition among students and promote long-term safe food-handling behaviour.

7. Role of Dairy Chain Actors Dairy farmers

Distributors and milk processors play the most important role in ensuring the safety of milk and dairy products. Every actor in dairy chain must get training in preventive approaches such as hazard analysis and critical control points (HACCP) design and implementation, good hygienic practices (GHPs), and good manufacturing practices (GMPs) in the handling of milk. Knowledge on the use of simple equipment such as mastitis detectors to assess the health of cows, and using kits to estimate microbial loads in milk are also important. Dairy farmers must also have knowledge on good agricultural practices (GAPs) that include good milking practices, human treatment of cows to promote animal health, ensuring that cows are only fed safe feed and water etc. Farmers will also need to liaise with the necessary governmental bodies to run surveillance systems and ensure an effective recall program in the event that milk is found to be contaminated.

Agricultural extension officers can assist with the training of farmers in food quality assurance and management programs. Milk distributors and dairy processors also have a role to play in ensuring the safety of milk in the dairy chain. Processing of milk via fermentation into yoghurts, cheeses and other fermented products should be carried out using well defined starter cultures rather than by spontaneous fermentation . Moreover, distribution outlets will need to be equipped with the necessary facilities for rapid cooling, pasteurisation, testing for microbial load, and cold transportation of milk.

Self check -3	Written test

Test item I short answer

1. Write traditional microbiological contamination elimination/reduction methods.(3pt)
2. Discuss the ways how do government envolved in microbiological contamination contron methods.(5pts)

Note: **Satisfactory rating 4 and above points Unsatisfactory 4 below points**

Information Sheet 4	Assessing workplace procedures and practices

4.1 Assessing workplace procedures and practices

Milk and dairy product quality is the consequence of all activities developed during the production process, from the farms to the transformation in the dairy industry. Cow's milk contains the nutritional requirements necessary for the growth of the calf, since it is a source rich in lipids, proteins, amino acids, vitamins, and minerals, which added to its high activity of water (aw) and makes it an excellent matrix for the growth of a large number of spoilage microorganisms.

Not so long ago, it was believed that the milk contained in the mammary gland was sterile and that the microorganisms isolated had their origin from external contamination. Nevertheless, this idea has been questioned due to the development of more sensitive molecular methods which suggests that there is colonization of a wide variety of microorganisms in the healthy mammary gland.

The microbial composition and level of milk is influenced by several different parameters such as, in the case of raw milk, the microorganisms present in the teat canal, on the surface of teat skin, in the surrounding air, and in feed as well as other environ- mental factors including housing conditions, the quality of the water supply, and equipment hygiene . Moreover, the insufficient cold capacity and long storage times can also increase the bacterial count owing to the bacterial growth during milk storage . The most commonly used microbial quality tests for determination of milk and milk products quality and level of microbiological contamination include:

1. Total bacterial count E.coli, coliform count, staphylococcus spp count
2. Estimation of yeast and mould counts - can give an insight of the source and leve of contamination.
3. Somatic cell count

It is therefore, more effective to exclude microorganisms than trying to control their growth once they get access into the milk.

Here are some important points to observe in order to work place, to produce clean milk:

● Milking should be carried out in a well-ventilated barn with adequate lighting.

● The floor of the milk barn must be durable and easy to clean, preferably made of concrete.

● After use, milking vessels and equipment must be cleaned with potable water, sanitised and dried in the sun on a drying rack. Suitable disinfectants, such as hypochlorite solution, should be used at the recommended concentrations.

● Milkers must be healthy and not suffering from contagious diseases or ulcers.

● Only healthy cows should be milked. Cows suffering from mastitis should be milked last and their milk discarded. Milk from cows on antibiotic treatment should not be sold until the specified withdrawal period (usually 72 hours or more) has elapsed.

● Colostrum (the milk produced in the first five days after calving) should not be mixed with normal milk. Calves must be allowed to suckle their dams and excess colostrum may be given to other calves or fed to pets (cats and dogs).

● During milking, the first strips of milk (fore milk) should be milked into a separate, black-coated cup (strip cup) to check for mastitis. The fore milk should then be discarded.

Infection control and workplace cleanliness

Infection control procedures relating to cleanliness in the workplace include:

- regularly washing the floors, bathrooms and surfaces(such as tables and bench tops) with hot water and detergent
- periodically washing the walls and ceilings
- periodic cleaning and sanitizing of dairy products processing machines

- thoroughly washing and drying mops, brushes and cloths after every use – drying mops and cloths is particularly important, since many pathogens rely on moisture to thrive
- using disinfectants to clean up blood and other spills of bodily fluids
- when using disinfectants – always wearing gloves, cleaning the surfaces before using the disinfectant, and always following the manufacturer's instructions exactly
- spot cleaning when necessary

Additionally, the opportunities that are placed on product and process within the milk production industry are interconnected. There is a need for integration of product and process issues, in order to make the best decisions and to balance the different needs of microbial in work place.

These include:

- ✓ approach to designing a production facility, which is addressed primary function of the product
- ✓ installation, operation and maintenance of equipment and machine
- ✓ product quality
- ✓ safety
- ✓ hygienic design
- ✓ cleaning
- ✓ Flexibility and traceability

Means of destruction of microorganisms;

1. Heat pasteurization and sterilization
2. Ionization radiation e.g. uv, gamma rays
3. Electricity by heat generated
4. Chemical acids, alkalis halogens ,H_2O_2

Self check -4	Written test

Test item I choose the correct answer (2pts each)

1. Which of the following is an opportunity used to improve microbiological contamination
   a. Milking healthy cows separately
   b. milking should carried out well ventilated/cold room
   c. Keeping milking equipment hygiene d. all
2. The followings are microbes destruction methods except:

A. Heat pasteurization and sterilization

B . Ionization radiation e.g uv, gamma rays

C . Using pond water for cleaning of dairy and dairy products plant

D .Chemical acids, alkalis halogens and H_2O_2 E. all

Test item I write short answer

1. Write Infection control and workplace cleanliness procedures (4pts)

Note: **Satisfactory rating 4 and above points Unsatisfactory 4 below points**

LG 60#	LO #4- Assess risk of Allergens in the work place

Instruction sheet: 4

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying types and sources of allergens
- Identifying risks in operations, products and consumer
- Identifying control measures to eliminate allergens
- Assessing work place procedures and practices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to identify:

- Types and sources allergens in the workplace
- Risks in to operations, product and consumer.
- Control measures to eliminate allergens
- Work place procedures and practices

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, ask your trainer for further instructions or go back to training.

Information Sheet 1	Identifying types and sources of allergens

1.1 Identifying types and sources of allergens

Allergens are substances that commonly cause allergic reactions or other hypersensitivity reactions. It may include food substances such as nuts, milk product, pollen and grain. There are six major types of milk allergens these are αs1-, αs2-, β-, and κ-casein from casein proteins and α-lact albumin and β-lactog lobulin from whey proteins. The labeling of allergens is the only aid for consumers with allergies or other hypersensitivities, to avoid products which could cause disease.

Food allergy is especially common among small children. Inadequate labeling of allergenic ingredients such as milk, egg, and various nuts poses a serious health risk for these consumers. Symptoms of an allergic reaction can affect several different organs, and common symptoms are stomach pain, vomiting, and asthma. Warning labeling for

contamination with allergens is not yet regulated, but it must not be misleading. This labeling is often described as Precautionary Allergen Labeling (PAL).

Unnecessary PAL might lead otherwise acceptable food products to be unavailable to allergic consumers and might also pose a risk if it leads allergic consumers to ignore the labeling. Labeling with highlighted ingredients also makes it easier for the consumer to find the allergens in the list of ingredients.

It is therefore important that the food business operators follow the legislation and ensure that products placed on the market are in compliance with food safety requirements.

Self check-1	Written test

Test item I write short answer

1. Define allergen.
2. Write sources of allergen
3. Types of allergen
4. Define precautionary allergen label (PAL).

Information Sheet 2	Identifying risks of allergens in operations, products and consume

2.1 Identifying risks of allergens in operations, products and consume

The main points allergens may be identified are:

2.1.1 People/consumer

a) Training

All involved in the commercialization, production, processing and distribution of milk should understand the implications of the presence of food allergens and the need to manage the ensuing risk.

Thus, individuals (e.g. top management, marketing, internal auditors, product developers, design engineers, plant personnel and contractors, operators, employees handling consumer complaints) should receive training specific to their job responsibilities in this area.

They should become aware of measures needed to minimize the risk of allergen cross-contact. All appropriate personnel should be encouraged to take immediate action, if any risk of contamination is suspected.

b) Personal Hygiene

Cross-contact of products with allergenic materials may occur due to poor personal hygiene within a manufacturing facility. The application of existing GMP rules should be sufficient to minimize the risk of such cross-contamination. However, in relation to allergen controls the following aspects should be emphasized:

I) The risk arising from the likelihood of cross-contact happening with people being the vector of the contamination needs to be assessed. For instance, allergens present as dry products (powders) are much more likely transferred by people than non-volatile liquids containing allergens.

II) Provision of dedicated work wears for use in areas handling specific allergens or where a high risk of cross-contact through clothing exists. Such work wear should be restricted to working areas (i.e. not in canteen area, etc.)

III) Employees should not be permitted to bring food or drink into areas where products, ingredients or primary packaging is exposed.

c) Supplier Management

A food operator at any point in the supply chain can only perform his own risk assessment effectively if he is in possession of correct information about the complete allergen status of the raw materials and ingredients used. This requires knowledge of each supplier's understanding and application of allergen management. When it comes to allergens and other risks, a good relationship between raw material suppliers and manufacturers promotes good product safety.

In practice, a food operator will need to: Ascertain that the allergen status is fully described in raw material, packaging, labeling and specifications declarations. For instance, generic terms such as 'favoring, spices' are not appropriate where these substances originate from allergenic sources according to legislation. Assess each supplier and the application of allergen management practices in their operations and document that assessment. For instance, this can be achieved by means of a questionnaire and, where appropriate, an audit.

d) Raw Materials Handling

I. Incoming Raw Materials Handling

The focus at this step should be the clear identification of incoming raw materials and ingredients and minimizing the possibility of cross-contact. Thus: Allergenic raw materials, semi-finished products, etc., should be identified upon receipt and, if possible, kept in sealed packaging or separate from each other and from other foods. Clear labeling reduces the risk of mix-ups and cross-contact. All deliveries should be checked before unloading commences. For all deliveries (including allergenic materials) consideration should be given to the need for a special “allergen spillage” procedure, analogous to glass breakage procedures. Where allergenic materials are sampled on delivery, measures should be in place to make sure that the sample and the sampling tools do not create a cross contact risk, for example, by using color coded and/ or disposable sampling equipment. Bulk delivery points should be locked when not in use to prevent unauthorized off-loading prior to the completion of necessary checks.

II. Handling of Raw Materials and Intermediate Semi-Finished Products

The main risks that arise from raw material storage are cross-contamination of other raw materials and inadvertent selection for a recipe of an allergenic material not present in the product. Thus, the key principles that should be applied are clear identification and segregation of each allergenic material from other materials and each other. As appropriate: Assure/check that allergenic materials are delivered clearly labeled, and securely packed to prevent accidental misuse, cross-contact or damage prior to receipt. Store allergenic raw materials in clearly identified areas, for example, using color-coded boxes and/or demarcation of storage areas using painted lines on the floor. All allergenic materials should be stored in clearly marked packaging until required. Where allergenic raw materials are de-bagged or de-boxed, they should be placed in dedicated closed and clearly labeled containers. Such containers must only be used for storage of other raw materials after appropriate cleaning using validated procedures. Ingredients, in dry powder form, can present a particular danger of cross-contamination during handling. Special care should be taken with these types of ingredients.

d). Equipment and Factory Design

Production includes ingredient dispensing, recipe make-up, mixing the raw materials and ingredients, processing them and then packaging the finished product. Critical allergen risks related to equipment and factory design include incorrect equipment selection, cross-contact between materials as well as between products produced on the same line. Good Manufacturing Practices (GMP) forms the basis for minimizing these risks. Specific considerations to minimize allergen risks include:

I) Equipment and Layout Design:

Avoid the crossover of open production lines (for example, conveyor belts) to prevent cross-contamination through spillage. Allow adequate space between production lines and around equipment to permit effective cleaning and inspection thus helping to minimize the risk of allergen cross-contact.

II) **Dedicated Lines, Areas and Equipment**:

Where practically possible, areas and equipment should be dedicated to a specific allergen profile within a production facility. This includes weighing equipment, scoops and utensils, containers, etc. These tools and aids should be color-coded or appropriately labeled, or a validated cleaning programme should be in a place.

e. Production Process and Manufacturing Controls

I) Recipe Verification

The first requirement to avoid allergen risks is to ensure the correct materials are used in the recipe.

Systems therefore need to be designed to avoid recipe mistakes. These systems will depend on the actual production facility, and can include not only verification of the recipe at the time of addition of materials, but also software and engineering design features to avoid use of the wrong ingredient(s).

An example would be a system which checks barcodes in the recipe against those of the raw materials or ingredients when these are weighed out for a pre-mix and prevents the operator from continuing if they do not match. Rework represents a special case of an “ingredient” which these systems also need to consider.

II). Separation

separation of the products of allergen-containing products from those that do not contain the allergen or contain.

III) Internal Labeling for Handling and Production

There must be control procedures to ensure proper labeling of raw materials, semi finished goods and products.

When finished packing materials are of the same or similar appearance, (e.g. for different flavour variants), it is especially important to ensure that the correct packaging is used.

Co-products, misshapes and broken products, which for quality reasons are not acceptable as finished products but could still be consumed by employees or sold through factory shops, must be subject to the normal risk assessment and risk communication controls.

IV) Packaging and Post-Production Controls

Incorrect packaging and/or labeling is a major cause of allergen-related product recalls. Procedures for checking that the correct labels are applied to products should be implemented and audited regularly, so that accurate information is provided to allergic consumers.

Checks should be in place between processing and packing to ensure the correct packaging is used, for example, with the use of automated label verifcation systems. If packaging materials are stored (even for short periods) in processing areas, there is the potential for cross-contact with allergenic material. Production planning should include the order in which different products are manufactured and packaged. Special attention must be paid when the production of bulk volumes takes place at one location and the packaging of the finished product at another. In such cases, the order of packaging must be designed to reduce the risk of cross-contact by allergens and must include effective cleaning routines.

e. Product Development and Change

1. Reformulating Products

Consumers do not always become aware of product recipe change unless some clear indication is given. This is particularly so for allergic consumers, who will often remain loyal to a product they trust and is particularly important when the allergen profile changes. Therefore, when an existing recipe is changed or one ingredient is substituted for another one containing allergens (or different allergens), the consumer should be clearly informed about the change in product composition. This can be done, for example, by using prominent labeling flashes, preferably on the front of the pack, in addition to the amended ingredients list. Suitable warnings might be, for example, “New Recipe” or “New Contains.”

It may also be possible to use other methods such as websites and patient group updates, to inform consumers of recipe changes. In addition, food operators and retailers are recommended to provide updated information to consumer support/allergic patient organizations as they have systems in place for informing their members about changes and this approach helps to target the information at those who are most at risk.

2. New Product Development

The starting point for all food production is ensuring that complete product specifications are available. In product development, the ingredients and manufacturing procedures should be looked at from an allergy perspective. The people responsible for development of products and recipes must have sound knowledge of the risks to people with food allergies and other food intolerance. By definition, most food allergens are common and valuable components of the diet and it is neither practicable nor even desirable to exclude them from new products. However, in order not to add complexity to existing allergen risk management practices, new product development technologists. new products: Using an allergenic ingredient in a product; and Introducing new allergens into new formulations of existing products/ brands.

Self check -2	Witten test

Test item I say true or false

1. Improper handling of raw material can cause risk of allergen.(1pt)
2. Risk of allergen has no effect in product and consumer.(1pt)
3. The frst requirement to avoid allergen risks is to ensure the correct materials are used in the recipe.(2pts)

Note: **Satisfactory rating 2 and above points** **Unsatisfactory 2 below points**

Information Sheet 3	Identifying control measures to eliminate Allergens

3.1 Identifying control measures to eliminate Allergens

Allergens are hazards /contaminants that must be prevented, eliminated, or reduced to acceptable levels. Food business operators must put in place a permanent procedure based on the HACCP principle, but some of the food business operators had not included allergens in their HACCP. This might correlate with the observation, that the allergenic ingredients were no correctly transcribed in the list of ingredients of the products.

Additionally, it might also explain the presence that undeclared allergens are found in products without Precautionary Allergen Labeling (PAL). Thus, it is of great importance that food and beverage organization (FBO's) are thorough when conducting their risk analysis regarding allergens in the final product. If labeling is not seen as a Good Manufacturing Procedure by the food business operator, there might be mistakes in the labeling of allergenic ingredient.

Accurate assessment of the actual presence of allergens is an important measure in order to avoid misleading PAL. Still, it is the responsibility of the food business operator to find good methods and procedures/routines to decrease allergenic contamination.

Control Measures

At all stages of production, processing, and distribution within the business under their control, food processors, business operators shall ensure that foods satisfy the requirements of food law that are relevant to their activities and shall verify that such requirements are met legal regulations.

The food business operator is responsible for ensuring that products are accurately labeled and that they have functioning internal control for allergen safety.
• Labeling warning for contamination with allergens (Precautionary Allergen Labeling (PAL)) is must be included. The labeling should, however, not be misleading. Milk, peanut, and egg was more commonly detected in products labeled with PAL compared to products without PAL. Certain chocolate products contained milk, egg and peanut in concentrations that more than 50% of the allergic consumers would react to. Allergic consumers might therefore need to avoid chocolate products with PAL for milk, eggt and peanut.

- Allergenic ingredients should be highlighted in the list of ingredients.
- follow hygiene and proper cleaning practices
- follow food and beverage laws

Self check-3	Written test

Test item I short item

1. Write control measures of allergen. (4pts)

Test item II say true or false accordingly

1. Accurate assessment of the actual presence of allergens is an important measure in order to avoid misleading allergen precautionary management.(1pt)

Note: **Satisfactory rating 3 and above points** **Unsatisfactory 3 below points**

Information Sheet 4	Assessing work place procedures and practices

4.1 Assessing work place procedures and practices

Level of allergen depends On dust or aerosols containing allergens:

• Cross-over points in processing lines

• Reuse of cooking oil

• Reuse of cleaning solutions

• effectiveness of cleaning

Effective cleaning is one of the most important strategies for preventing cross-contact

• Food proteins can be difficult to remove from food

contact surfaces- esp. if the protein has been heated/denatured

• Proteins vary in their “stickiness” to food-contact surfaces

• Wet cleaning can be effective at removing allergenic

food soils- but all procedures must be evaluated.

Cleaning in a dry environment is a challenge and it can be difficult to clean all allergens.

• Older food processing equipment- not designed to be cleaned

Factors Affecting level of Allergen Removal

Allergen-related factors

I. Type of food allergen

- Physical form- paste, particulate, powder, liquid
- Chemistry- water- vs. lipid-based ingredients

III.Concentration of food allergen

- High vs. low concentration in food

IV. Equipment-related factors

- Equipment design
- Age of equipment
- Type of food-contact surface
  - o Composition- stainless steel, plastic, cloth
  - o Texture (finish) of surface

IV. Processing-related factors

- Application of heat- hot vs cold soil
- Length of processing run- biofilm/build-up of food material

V. Cleaning method-related factors

- Type of cleaning method (wet vs dry)

Wet

- Plant area and equipment designed to accommodate water
- Employ detergents and sanitizers
- Can be automated (CIP), semi-automated (COP), or manual
- Purging line with ingredient or next food (water-based)

Dry

- Plant area/equipment not designed accommodate water (low water activity foods)
- Water use limited
- Compressed air, vacuum and/or dry steam may be used to “clean” surfaces
- Other methods- blasting with CO_2
- Purging line with ingredient (e.g. salt, sugar, corn starch, oil)

Factors Affecting level of Allergen Removal

Wet Cleaning

- Contact time

- Action (manual or automatic)
- Soil (Containing Proteins)
- Clean Surface
- Temperature
- Chemical(Components & Concentration)

Effectiveness of Cleaning Solutions/Detergents for Removing Protein Soils

- Chlorinated Alkaline Detergents (CAD) – Excellent
- Alkaline/Caustics with $_{H202}$- Excellent
- Enzymes – Excellent
- Alkaline/Caustics -- Fair ⇒ Very Good
- Detergent Builders/Surfactants -- Fair ⇒ Very Good
- Acids – Poor
- Water --- Poor to fair

Tools for Verifying Cleaning Efficacy

- Clean in place (CIP) rinse-water
- Push through materials (salt, sugar next product)
- First product off line, final product
- Food-contact surfaces(visualinspection; swabs)

Notice: Having an adequate sampling plan is important!

Figure. 3 machine with dirty surface (food residue)

Varies methods are used to improve allergen in dairy and dairy products based on work place procedures and practices. Thus the great care is taken to control plan analysis and which includes:

A, Supplier Review/Monitoring

Food manufacturers should obtain copies of product or ingredient formulations, specification sheets or certificates of analysis (COA's) from suppliers of raw ingredients.

B, Plant traffic flow

Review product flow through the production process that will occur operationally in the plant. For example, look for overhead conveyors that cross one another or cross over exposed products.

C, Raw material storage and color-coding systems

Store all allergenic foods or ingredients derived from these foods in an area that is secluded or removed from non-allergenic materials. If this is not possible, require that incoming material pallets are shrink wrapped to contain dust and to prevent other cross-contamination opportunities such as leakage from torn bags.

Allergen identification is also a useful tool for your firm. All raw materials that are allergens should be labeled with a tag that states “ALLERGEN.” This can also help avoid substitution mistakes. A color-coded tag may also be an option. It is a good idea to place color coding charts throughout the plant’s production area for easy identification by plant personnel. Store allergenic compounds on the bottom of racks or nearest to the floor to avoid spilling of allergenic ingredients to items below.

D, Production scheduling and cleaning

There are two main methods used to control allergens in the plant. The first method involves producing all allergen-containing as the last product on a production line. If all products manufactured contain the same allergen, a label declaration is enough to contain the allergen.

However, if only one product produced contains an allergen, run that last product last. If one product does not contain an allergen, but the rest of the products do, run this product first after a complete wet cleaning procedure or perform a wet cleaning procedure between the allergen containing product run and non-allergen-containing product run.

The second method used for controlling allergen cross-contamination is to implement a wet cleaning procedure prior to or following the run of allergen-containing product on a particular line. When opting for the wet cleaning method, first assess the food items that are processed on shared equipment. Each product contains a different allergen, necessitating the implementation of scheduling or cleaning procedures. It is important to note that each tree nut is a distinct and individual allergen.

E, Rework

When using reworked products, always add “like into like.” Reworked products should always be labeled with tags that indicate which products contain allergens.

The reworked products containing allergenic ingredients must be stored in areas separate from those products that do not contain allergens. Utensils should be color-coded for use with allergen-containing products.

If at all possible, rework product back into the same production run.

f, Evaluation of program effectiveness

Changes in raw materials, suppliers and customer demands result in the need for continuous reevaluation of the effectiveness of the Allergen Control Plan. Incorporating routine auditing practices, both for suppliers and own in-plant operations, is a key component in verifying that the plan is working correctly.

G, Label review policies

Develop a system for maintaining labels that are placed on foods containing allergens in easy to identify areas. Discard old label, as they can cause an error in the future. Conduct a thorough review of the current recipes and match them with the labels used. A good idea to manage Allergen Control Plan would be to have a binder that lists raw material specification, formulations and the finished product label. When a raw material ingredient statement changes, processor would then be able to cross-reference with the finished product labels and understand what products and labels would be affected by the change.

H, Frequency of Allergen Plan review

Allergen Plans should be reviewed during l HACCP validation. Items should include specific allergen policies (scheduling, utensil usage, cleaning, raw ingredient segregation and color coding for example) that are in effect in the plant.

I, Documentation and reviewing the documentation

The documents created should state what processor are going to do within own work plant environment.

J, Employee education

Allergen education may be easily incorporated into good manufacturing training periods. As always, trainer should document the employees that attended as well as the materials conveyed, the date of the training and the trainer for firm's records.

Self check-4	Written test

Test item I short answer

1. write allergen control plans to improve allergens in dairy processing.(3pts)

2. Write policies that may included in Allergen Plan review.(2pts)

Test item II: choose the best answer(2pts)

1. Determining level of allergen depends aerosols containing allergens all of the following except.
   A. Cross-over points in processing lines
   B. shifting of employee
   C. Reuse of cleaning solutions
   D. effectiveness of cleaning
2. Factors Affecting level of Allergen Removal include
   A. Contact time
   B. Temperature
   C. Cleanness of surface
   D. all

Test item III short answer

1. write at least four examples of detergents used to clean soils containing protein.(4pts)
2. write factors affecting allergen removal.(4pt)

Note: **Satisfactory rating 3 and above points** **Unsatisfactory 3 below points**

LG 61#	LO #5- Implement control measures to manage contaminants and allergen

Instruction sheet 5

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Implementing control measures of allergens
- Identifying emergency procedures and conditions
- Identifying and reporting documentation associated with allergens
- Conducting work according to environmental guidelines

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to identify:

- Control measures of allergen
- Emergency procedures and conditions of allergen to be implemented
- Report and identify documentation associated with controls of allergen
- Conduct work in accordance with workplace environmental guidelines.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work.
6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, ask your trainer for further instructions

Information Sheet 1	Implementing control measures of allergens

1.1 Implementing control measures of allergens

To implement control measures of allergen, Mapping the location and movement of allergens across a manufacturing site provides a clear and comprehensive picture of areas where there is potential for cross-contact and this assists in identifying control measures to mitigate the risk.

Mapping steps :

1. Walk the manufacturing line with regulation
2. Draft a site floor plan and raw material overview
3. Overlay this with a process flow chart which identifies each step along the processing line, the equipment, the allergens that may be introduced along the line, and key cross contact points.

Mapping should commence from receipt of raw materials and ingredients, and map all on-site manufacturing processes, including labelling of the finished product. Controlling raw materials and ingredients With a growing awareness around the risk of inadvertent contamination of ingredients with allergens, food fraud, or substitution, is essential to ensure the allergen profile of raw materials and ingredients is known and accurate.

Regular testing of ingredients can be used to verify the allergen profile as documented in the supplier's certificate of analysis. Supplier approval Knowing what allergens are present in raw materials and ingredients is a critical first step. All suppliers to a manufacturing site should be identified as approved suppliers and have a regularly audited food safety program in place.

Suppliers should retain records of the way they manage allergens and provide certificates of analysis showing the allergen profile of all supplied raw materials and ingredients. Management and storage of ingredients clearly identify all ingredients containing allergens when they arrive on your site. The product information form provides compositional information related to raw materials and ingredients and information regarding allergen and allergen cross-contact.

The manufacturer should also review the ingredient specification and the certificate of analysis for allergens on receival of ingredients. Store ingredients containing allergens in designated and dedicated bins, bays or holding areas, and labelled with a clear visual identification system (such as colour coding or tagging). Ensure all paperwork or electronic records; work in progress (WIP) and rework; specification sheets and finished product records are retained.

Where designated bays or dedicated storage areas are not available, storage of like-with-like is the best approach. Store non-allergenic material above allergenic material to reduce risks from spills. Where an electronic warehouse management system is in place, check sensors regularly to ensure the system is correctly identifying allergenic ingredients and allocating their storage correctly. Before substituting any ingredients, ensure the allergenic ingredients and cross-contact risks are the same. The same ingredient from different suppliers may have different cross contact risks.

To minimize the risk of cross-contact:

• dispose of ingredients received in damaged or open packaging

• use pallet covers to prevent cross-contact from fine powders in the warehouse areas

• dust or clean down, re-cover, or re-wrap bags or boxes removed from pallets for staging or production preparation before returning to the warehouse

• examine the type of packaging used, as some packaging contains wheat-based release agents or may have allergen derived oiled liners.

It is important that warehouse staff are fully trained in protocols and procedures for handling allergenic ingredients and that an allergen spill procedure is in place with dedicated tools and equipment for clean-up and disposal.

Manufacturing staff should be made aware of alternative names, for example ingredients labelled as sodium caseinate, whey protein concentrate, milk protein hydrolysate, lactoglobulin, or lactalbumin all contain milk protein.

Segregation during manufacture Separate equipment, processing, and packaging lines; staff; and cleaning procedures contribute significantly to allergen control. Where possible, use dedicated lines to segregate allergen and non-allergen containing food products. If your site has an 'allergen-free' area or a controlled production environment where segregated production takes place, you must provide:

• separate storage areas for the ingredients

• separate controlled room entry

• dedicated change rooms

• dedicated equipment and cleaning utensils

• area- or operator-specific personal protective equipment (PPE). The PPE may be as simple as a different coloured uniform or include a full range of protective equipment set aside for a specific production line or product. This colour coding or other visual identification system should be used consistently throughout the site from raw material to finished product.

Always ensure staff have received adequate instructions on the use of PPE so it doesn't contribute to cross-contact and is stored and disposed of separately. Dedicated line-specific tools and monitored maintenance programs also help reduce cross-contact.

The use of separate lines, even if adjacent, or placing physical barriers (such as shield covers or catch pans) will reduce the risk from spillage or cross-contact but it is important to have evidence to demonstrate that separation and control mechanisms are effective.

In-progress work Appropriate management of in-progress products or work in progress blends is critical to ensure the correct products are produced, and ingredients waiting to be staged and/or processed are neither exposed to cross-contact nor made up into incorrect formulations.

Cross-contact risks can be reduced by:

- segregation of ingredients and products
- visual identification systems
- appropriate handling

As part of good manufacturing practice (GMP), any utensils or containers used for allergenic ingredients or product should be emptied, cleaned and dried as soon as possible to reduce the risk of cross-contact. Sites where allergenic ingredients are added Where practical, isolate allergen addition points and dedicate re-feed systems. If allergens are added at the end of a processing line, fewer parts of the process line and equipment will require intensive cleaning to remove residues.

It is important to have control or lock out procedures for access to equipment that uses or supplies allergenic ingredients to ensure that the equipment isn't used in another area of production without appropriate cleaning. The allergen spill protocol should also be applied here with dedicated clean-up equipment and disposal process. Site design and modifications New production facilities should be designed, constructed and equipped with due consideration for the management of allergens, and include barriers or manufacturing zones that physically segregate allergen and non-allergen containing food products. Pre-existing premises may need to be modified to ensure all equipment, regardless of age, is fit for purpose, can be effectively cleaned and maintained, and able to produce safe food.

Equipment designed to be disassembled and/or easily cleaned is also ideal for allergen management. A register of each item of equipment, its maintenance program, and any known issues will help prepare the allergen map and the documentation of cross-contact risks. Where possible, limit or eliminate cross-over of conveyor lines carrying allergenic ingredients or product. Alternatively, use shielding or cover systems to limit spillage or dropping of unsealed product from overhead conveyor lines. Scheduling manufacturing Separating allergen and non-allergenic products using scheduling is a practical allergen control strategy.

This includes:

• processing and packaging non-allergenic products prior to those containing allergenic ingredients

• batch production of allergen containing products to reduce cleaning problems and downtime • beginning with products with less allergenic ingredients or easier to clean allergens through to those with highest allergen levels

• extended runs of allergenic products, if possible, to minimize changeovers. Automated scheduling systems and batch sequencing systems are highly dependent on the correct information being available, so monitoring the system and checking for compliance with the allergen mapping is essential. Similarly, the success of scheduling for allergen control is based on an effective, validated cleaning procedure and evidence it has taken place. Where push through product or purging is used to act as a buffer between allergenic and non-allergenic product or as a cost-effective cleaning process, it is important to accurately determine the amount of push through necessary to remove allergenic product. Any product or ingredient used for this purpose needs to be strictly monitored, labelled appropriately and its use controlled e.g. as rework or discarded. Labelling and packaging to provide appropriate warning to consumers of the presence or possible presence of an allergen in a product, all allergenic ingredients must be listed legibly and prominently on the product label. Incorrect labelling of product is a significant cause of allergen related recalls and has been responsible for a number of allergic consumer reactions to packaged food.

Self check-1	Written test

Instruction I short answer

1. write ways of implementing control methods of allergens.(2pts)
2. mention ways to reduce Cross-contact risks of allergen.(3pts)
3. Write the ways of mapping of allergen plan applied in implementing control of allergen.(2pts)

Note: **Satisfactory rating 4 and above points** **Unsatisfactory 4 below points**

Information Sheet 2	Identifying emergency procedures and conditions

2.1 Identifying emergency procedures and conditions

The allergens shall be indicated in the list of ingredients in accordance with the rules laid with a clear reference to the name of the substance or product. The name of the substance or product shall also be emphasized through a typeset that clearly distinguishes it from the rest of the list of ingredients, for example, by means of the font, style, or background color. For example, these might be written as casein (milk) or casein (milk) and starch(wheat) Allergenic ingredients shall be declared when included as:

- Ingredients: Namely raw materials as well as additives and flavourings.

Compound ingredients: Allergens in a compound ingredient shall be declared. For instance, the list of ingredients for a bun with a vanilla filling could be written as: “Wheat flower, vanilla filling 20% (water, sugar, modified starch, milk powder, vegetable fat (coconut), natural vanilla flavour), skimmed milk, sugar, vegetable oil (rapeseed), egg, water, yeast, salt”.

- Additives: This also includes additives that do not have a function in the final product (carry over) and carriers. wheat and milk proteins can be used as carriers in spices.
- Processing aids: These are intentionally used in the processing of food and might result in unintentional but technically unavoidable presence in the final product. Food business operators at all stages of production, processing, and distribution within the business under their control shall ensure that foods satisfy the requirements of food laws which are relevant to their activities and shall verify that such requirements are met.

Food business operators shall put in place, implement, and maintain a permanent procedure or procedures based on the HACCP principles. This includes identifying any hazards and allergens that must be prevented, eliminated, or reduced to acceptable levels. Allergens should be included as a hazard when relevant. Labeling a product with PAL, without using HACCP principles, is an incorrect measure with regard to preventing, eliminating, or reducing the risk with an allergen.

Precautionary allergen labeling should only be a final option when the risk of contamination with allergens on a specific production line is:

1. Uncontrollable, i.e. it is impossible to control the entire production process. e.g. part of the production equipment is not accessible for cleaning or cannot be cleaned with water.

2. Sporadically occurring, i.e. identified through

Example, a. analysis of an allergen that is homogeneously distributed in the product

b. visible parts/shavings on the production equipment even after cleaning

c. through inspection of the cleaning process

d. verified allergic reaction in consumers

Conditions for importers or introducers of food

The importer must ensure that the producing company can show that the allergens listed on the advisory labelling comply with the conditions presented above for use of the “May contain traces of (allergen)” label. This can be done by example through documentation or by an inspection of the manufacturing premises by the importer.

The controlled companies, the sampling procedures, and the allergens selected for analysis were chosen in a risk-based manner, including:

- Companies producing and importing pre-packed dairy products, bakery products, meat/fish products, and ready-made meals.
- Products that a person allergic to milk or intolerant to dairy products would likely choose based on such products not containing one or more of those allergens according to the list of ingredients.
- Products labeled with warnings for contamination with milk, egg, peanut, or gluten.

Generally, dairy and dairy product processors can identify allergen emergency Following government laws and regulations stated in good manufacturing practices and HACCP principle.

Self chek	**Written test**

Test item I: true false item

1. Emergency procedures and condition of allergen would be determined based on good manufacturing practice and HACCP implementation system. (1pt)
2. Warnings written in dairy products don't include information's about allergen. (1pt)

Note: **Satisfactory rating 2 points** **Unsatisfactory 2 below points**

Information Sheet 3	Identifying and reporting documentations associated with allergens

3.1 Identifying and reporting documentations associated with allergens

Efficient and accurate record keeping is critical to the application of allergen management within a food safety programme. A simple record-keeping system can be effective and easily communicated to employees. It should be integrated into existing operations using existing paperwork, such as delivery invoices and checklists to record allergen status.

A record of the risk management programme should be retained with the risk assessment to demonstrate due diligence. This may be shared, as appropriate, with enforcement agencies and customers to demonstrate how risks have been managed and reduced. This should include details of how the programme is validated, and ongoing verification. Internal compliance with instructions and procedures for control of allergen risks should be verified regularly by trained internal auditors Cleaning considerations should be built into the design of equipment.

For instance, dismantling should be made easy so that hidden areas of the equipment can be adequately accessed and cleaned as failure to clean properly can lead to a build-up of raw material or product residue inside the equipment.

Avoiding the crossover of production lines and allowing adequate space for effective cleaning will also help minimize the risk of allergen cross-contact Line cleaning must be evaluated for its ability to control the hazard; i.e. issues with heterogeneously distributed common allergen traces due to cross-contact and effectiveness of (controlled) wet or dry cleaning need to be assessed.

Line cleaning of heterogeneously distributed allergenic material will be considered as effective only if the whole production line may be visually assessed and complies with the visibly clean Standard (no product residue visible).

Documented and validated cleaning procedures using proper cleaning equipment are essential to ensure that effective cleaning is performed. Adequate time must be allocated for cleaning. Cleaning practices that are satisfactory for microbiological safety may not be adequate for removing some allergens and their validity for such a purpose should be assessed. Equipment may need to be dismantled and manually cleaned to ensure hard to clean areas are free from allergen residues.

Particular food materials (for example, powders, seeds, pastes and particulates) may present significant cleaning and packaging machinery. Where adequate cleaning cannot be assured (e.g. because of inaccessibility), the residual risk from allergen cross-contact should be assessed and advisory labeling used, if deemed appropriate.

The actual cleaning procedure must not contaminate other areas (for example, by use of compressed air), or an area which has already been cleaned (for example, clean dry mix areas from the top down). Any spillage that occurs during production, storage and transportation should be cleaned up immediately to ensure that there is no subsequent allergen cross contact. Where known allergen cross-contact has occurred, the contaminated material should be labeled and physically moved away from the non-contaminated ingredients and work-in-progress.

Self check-	**Written test**

Test type 1 : write true if the statement is correct and false it the statement is incorrect.(2pts each)

1. Reporting document containing allergen is very simple task.
2. Documented and validated cleaning procedures using proper cleaning equipment are essential to ensure that effective cleaning is performed.
3. Any spillage that occurs during production, storage and transportation can cause allergen.

Note: **Satisfactory rating 3 and above points** **Unsatisfactory 3 below points**

Information Sheet 4	Conducting work according to environmental guidelines

4.1 Conducting work according to environmental guidelines

The work environment, facilities and amenities are provided for basic health and welfare of employees, workers, operators and visitors. These include items such as:

- production and processing area
- packing and operation equipments
- toilets
- rest rooms
- shelter sheds
- seating
- dining room
- drinking water
- washing facilities
- change rooms
- lockers
- accommodation
- waste receptacles
- First aid facilities/room and et

4.2. Work Environment

I). Work Layout

The layout of the workplace is required to allow persons to enter and exit the workplace and move within safely, both under normal work conditions and in an emergency.

II). Entry and Exit: Entries and exits are required to be safe to allow impede access and egress for all workers, operators and visitors including those with special needs. In particular:

- entries and exits should be slip resistant under wet and dry conditions
- aisles and walk ways need to be at least 600mm wide and kept free of furniture or other obstructions
- any walkways, boundaries or pathways shall be marked with 50mm wide with a contrasting colour e.g. white or yellow
- open sides of staircases should be guarded with an upper rail at 900mm or higher and a lower rail
- separate entry and exits for mobile equipment
- Power operated doors and gates should have safety features to prevent people from being stuck or trapped.
- Location of exits should be clearly marked and signs posted to show direction of exit doors to aid emergency evacuation.

4.3. Housekeeping

Untidy workplaces may lead to injuries e.g. slips and trips, therefore good housekeeping practices are essential for all workplaces. For example:

- spills on floors should be cleaned up immediately
- walkways should be kept clear of obstructions
- work materials should be neatly stored
- any waste should be regularly removed

- Suitable containers for waste should be conveniently located and regularly emptied.

4.4. Work Areas

The layout of the work area should be designed to provide sufficient clear space between furniture, fixtures and fittings so workers can move freely without strain or injury also evacuate quickly in case of an emergency. In determining how much space is required, the following should be considered:

- the physical actions needed to perform the task
- the need to move around while working
- whether the task is to be performed from a sitting or standing position
- access to workstations
- the equipment to be handled and the personal protective equipment that may be worn to perform the work
- Environmental factors including heat or noise may require an increase to the space, as will work activities that involve manual tasks or the use of equipment.

4.5. Floors and Other Surfaces

Floor surfaces shall be suitable for the work area and be chosen based on the type of work being carried out at the workplace, as well as the materials used during the work process, the likelihood of spills and other contaminants, including dust and the need for cleaning. In general:

- floors shall be free from slip or trip hazards e.g. cables, uneven edges, broken surfaces
- floor surfaces shall have sufficient grip to prevent slipping, especially in areas that may become wet or contaminated
- Floors should be strong enough to support loads placed on them.

4.6. Workstations

Workstations should be designed so workers are comfortable undertaking their task and allow for a combination of sit and standing tasks. For tasks undertaken in a seated position, workers should be provided with seating that:

- provides good body support, especially for the lower back
- Provides foot support, preferable with both feet flat on the floor, otherwise a footrest shall be provided units.

4.7. Lighting

Sufficient lighting is required to allow safe movement around the workplace and to allow workers to perform their job without having to adopt awkward postures or strain their eyes to see. Emergency lighting is to be provided for the safe evacuation of people in the event of an emergency.

The following factors are to be taken into account:

- the nature of the work activity
- the nature of hazards and risks in the workplace
- the work environment
- Illumination levels, including both natural and artificial light.

Self check- 4	Written Test

Directions: Answer all the questions listed below. Extra examples may be necessary to aid some explanations.

Test I Short Answer Questions

1. Write at least four housekeeping rules. (4pts)
2. Write down four factors that affect lightening in dairy industry. (2pts)

Test II say true if the statement correct and wrong if the statement is false

1. Environmetal guidelines are implemented to increase allergen and contamination.(1pt)
2. Separating entry and exits for mobile equipment is used to conduct work properly. (1pt)

Test III choose the best answer (1pt each)

1. One of the following is included in environmental guideline in work place
   a. production and processing area
   b. packing and operation equipments
   c. toilets
   d. All
2. Work environment in dairy industry include
   a. entry and exit
   b. roofs and other surfaces

c. storage rooms

d. quality laboratory e. all

Note: **Satisfactory rating 5 and above points Unsatisfactory 5 below points**

Process dairy products following GMP guidelines and cosume safe products*!!*

Reference Materials

Book:

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AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of regional TVET bureau, TVET College, and Federal Technical and Vocational Education and Training Agency (FTVETA) who made the development of this learning module with required standards and quality possible. We wish thanks and appreciation to the representatives of BEAR II UNESCO PROJECT who covers the financial expenses, scarifying their time and commitments to develop this learning module.

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