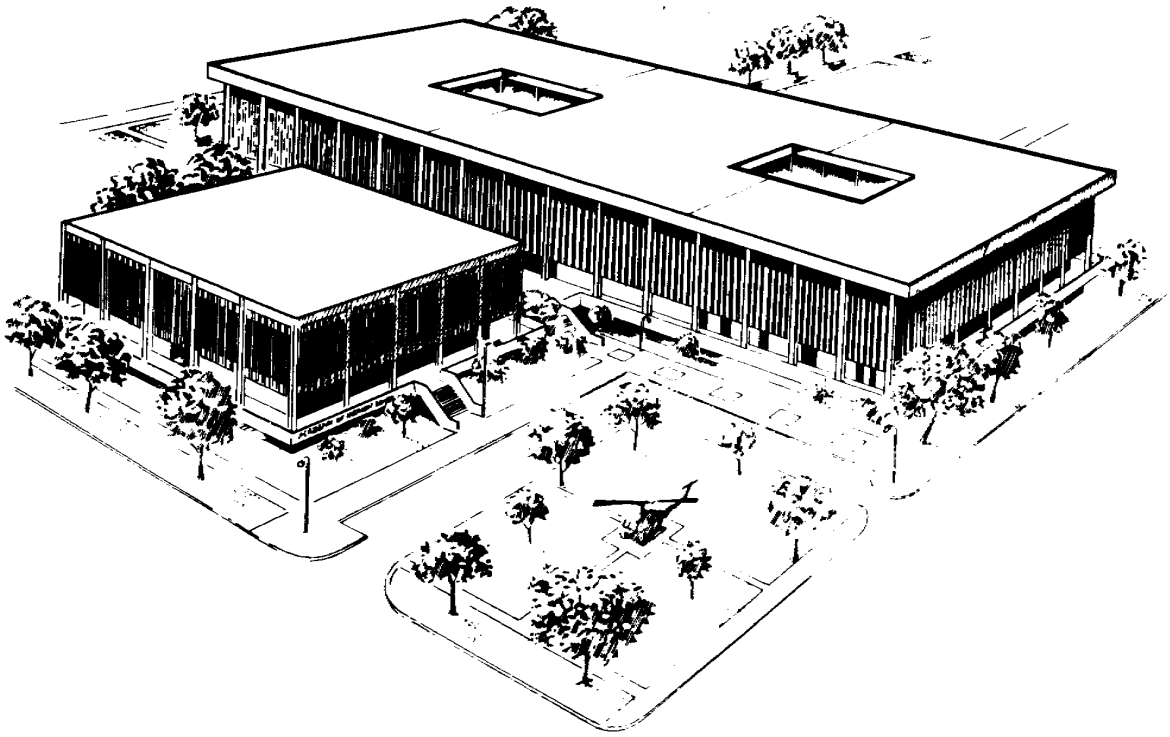
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL
FORT SAM HOUSTON, TEXAS 78234-6100



DAIRY

SUBCOURSE MD0715 **EDITION 100**

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

Proprietary names, that is, brand names or trademarks, have been used in this text solely to make it a more effective learning aid. The use of any name, proprietary or otherwise, should not be interpreted as endorsement, deprecation, or criticism of a product. Nor should such use be considered to interpret the validity of the proprietary rights in a name, whether it be registered or not.

The subject matter experts responsible for the revision of this edition were from the Department of Veterinary Science: DSN 471-6357 or area code 210-221-6357; Commander, U.S. Army Medical Department Center and School, ATTN: MCCS-HV, Fort Sam Houston, Texas 78234-6100.

ADMINISTRATION

Students who desire credit hours for this correspondence subcourse must meet eligibility requirements and must enroll through the Nonresident Instruction Branch of the U.S. Army Medical Department Center and School (AMEDDC&S).

Application for enrollment should be made at the Internet website: http://www.atrrs.army.mil. You can access the course catalog in the upper right corner. Enter School Code 555 for medical correspondence courses. Copy down the course number and title. To apply for enrollment, return to the main ATRRS screen and scroll down the right side for ATRRS Channels. Click on SELF DEVELOPMENT to open the application and then follow the on screen instructions.

In general, eligible personnel include enlisted personnel of all components of the U.S. Army who hold an AMEDD MOS or MOS 18D. Officer personnel, members of other branches of the Armed Forces, and civilian employees will be considered eligible based upon their AOC, NEC, AFSC or Job Series which will verify job relevance. Applicants who wish to be considered for a waiver should submit justification to the Nonresident Instruction Branch at e-mail address: accp@amedd.army.mil.

For comments or questions regarding enrollment, student records, or shipments, contact the Nonresident Instruction Branch at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

NONRESIDENT INSTRUCTION BRANCH
AMEDDC&S
ATTN: MCCS-HSN
2105 11TH STREET SUITE 4191
FORT SAM HOUSTON TX 78234-5064

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

LISTS OF TASKS TAUGHT

Task Number	Task Title	Lesson
081-892-1047	Inspect Dairy Products for Obvious Defects……	1 & 2

CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0715

DAIRY

INTRODUCTION

In Biblical times, the ideal home was in a "land flowing in milk and honey." Today, a common expression used in reference to nutrition is that "milk is nature's most nearly perfect food." Milk and honey are the only articles in the diet whose sole function in nature is to serve as food. Practically everything else we eat fulfills some other function in the animal and vegetable world. Fruits and vegetables are either roots, leaves, or seeds, and meat comes from the bodies of animals. Milk is the one food item that all nutritionists agree on, concerning its value for growth and development of children and young animals. No other single substance can serve as a complete substitute for milk in the diet. Dairy products are also very susceptible to quality and wholesomeness deficiencies. For this reason, it is very important that you, as a veterinary food inspection specialist, be familiar with the composition of dairy products and how improper handling or processing of dairy products affect this composition. This will enable you to assure that only high-quality, wholesome dairy products are utilized by the Military Services.

Subcourse Components:

This subcourse consists of two lessons and an examination. The lessons are:

Lesson 1, Introduction to Dairy Products.

Lesson 2, Inspection of Dairy Products.

Credit Awarded:

Upon successful completion of this subcourse, you will be awarded 15 credit hours.

Materials Furnished:

Materials provided include this booklet, an examination answer sheet, and an envelope. Answer sheets are not provided for individual lessons in this subcourse because you are to grade your own lessons. Exercises and solutions for all lessons are contained in this booklet. *You must furnish a #2 pencil*.

Procedures for Subcourse Completion:

You are encouraged to complete the subcourse lesson by lesson. When you have completed all of the lessons to your satisfaction, fill out the examination answer sheet and mail it to the U.S. Army Medical Department Center and School along with the Student Comment Sheet in the envelope provided. *Be sure that your name, rank, social security number, and return address are on all correspondence sent to the U.S Army Medical Department Center and School*. You will be notified by return mail of the examination results. Your grade on the exam will be your rating for the subcourse.

Study Suggestions:

Here are suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet, which follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

--As you successfully complete each lesson, go on to the next. When you have completed all of the lessons, complete the examination. Mark your answers in this booklet; then transfer your responses to the examination answer sheet using a #2 pencil.

Student Comment Sheet:

Be sure to provide us with your suggestions and criticisms by filling out the Student Comment Sheet (found at the back of this booklet) and returning it to us with your examination answer sheet. Please review this comment sheet before studying this subcourse. In this way, you will help us to improve the quality of this subcourse.

LESSON ASSIGNMENT

LESSON 1	Introduction to Dairy Products
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-47.
LESSON OBJECTIVES:	After completing this lesson, you should be able to:

1-1. Identify the composition and properties of milk.

1-2. Identify fresh dairy products.

1-3. Identify the types of pasteurizers, their characteristics, and steps in the pasteurization of milk.

1-4. Identify types of packaging and standards for milk and milk products.

1-5. Identify tests for wholesomeness of milk.

1-6. Identify fresh cultured dairy products.

1-7. Identify frozen desserts.

1-8. Identify ice cream ingredients, their function, and steps in the manufacture of ice cream.

1-9. Identify manufactured dairy products.

1-10. Identify steps in the manufacture of butter and the grading factors for butter.

1-11. Identify the classification of cheeses and characteristics of specific cheeses.

1-12. Identify steps in the manufacture of Cheddar cheese.

1-13. Identify classes and styles of Cheddar cheese and the quality factors for grading.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

INTRODUCTION TO DAIRY PRODUCTS

Section I. GENERAL INTRODUCTION

1-1. OVERVIEW

a. **The Importance of Milk.** Milk is considered to be nature's most perfect food from a nutritional standpoint. It is an excellent source of calcium and phosphorus, which are necessary for bone growth. It also provides an adequate supply of protein. Milk contains many of the vitamins and trace minerals essential for proper growth and maintenance of the body.

b. **The Importance of Proper Handling.** When handled in a sanitary manner, milk is one of our most important foods. When improperly handled, it represents a potential source of disease-producing organisms. The role of the veterinary food inspection specialist includes the inspection of milk to determine that it has been properly processed and handled from the point of origin to the point where it will be consumed.

c. **The Dairy Industry.** The dairy industry has undergone an astonishing evolution during the past one hundred years. Specialized dairy machinery has been developed and improved. Examples are the milking machine, the pasteurizer, the cream separator, the mechanical bottle washer, the mechanical refrigerator, and the homogenizer. The population and the national economy have both grown, thereby increasing the consumption of milk and milk products. The population has shifted to urban areas, resulting in an improvement of the dairy product distribution system to our cities. Due to the improvement in our transportation facilities, large quantities of milk and milk products can easily be shipped long distances under refrigeration. Recent improvements in processing and pasteurization methods have increased the shelf life of milk products while preserving the fresh milk flavor.

1-2. COMPOSITION OF MILK

a. **Chemical Properties of Milk.** Milk is defined as the lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows. Colostrum is the lacteal secretion produced immediately before and after calving. Whole milk contains not less than 3.25 percent milkfat and not less than 8.25 percent solids-not-fat. The approximate composition ("chemical properties") of milk is as follows:

Water	87.20 percent average.
Milkfat	3.70 percent average.
Solids-not-fat	9.10 percent average.

Solids-not-fat include:

Protein	3.50 percent average.
Lactose	4.90 percent average.
Minerals	.70 percent average.

b. **Water (Liquid).** The 87.20 percent of milk that is liquid serves to hold the other constituents of milk in solution, suspension, or emulsion.

c. **Milkfat.** There are two general types of milkfat or butterfat: true milkfat and fat-associated substances.

(1) True milkfat. True milkfat is composed of fatty acids and glycerols. It is present in milk as an oil-in-water emulsion. The process whereby milkfat forms a cream line is threefold. It is caused by the attraction of the fat globules to each other, agglutination, and gravity.

(2) Fat-associated substances. The fat-associated substances are phospholipids, cholesterol, carotene, vitamin A, and vitamin D.

d. **Solids-Not-Fat.** The solids-not-fat include the following constituents:

(1) Lactose. Lactose is a sugar found only in milk, and it provides the characteristic flavor in milk. It is only one-fourth as sweet as sucrose (table sugar).

(2) Protein. Proteins in milk can be separated into casein protein and whey protein. The casein protein is found only in milk. It is considered a complete protein because it contains all the known, essential amino acids that are necessary for growth and proper maintenance of the body.

(3) Minerals. Milk contains a great variety of minerals. The two most important are calcium and phosphorus, which are present in the proper ratio (3 to 1) for bone growth. Milk is deficient in iron, copper, and manganese, so one may develop anemia if milk is the only food item in the diet.

e. **The Effects of the Separation Process.**

(1) Cream and skim milk. When unhomogenized milk stands for a few hours, it separates into cream and skim milk.

(a) Cream contains most of the milkfat or butterfat and a small amount of the solids-not-fat.

(b) Skim milk contains a very small amount of milkfat and most of the solids-not-fat.

(2) Curds and whey. If milk sours, it will eventually separate into curds and whey.

(a) Curd contains most of the milkfat, casein, and fat-soluble vitamins.

(b) Whey contains most of the water, lactose, whey protein, and the water-soluble vitamins.

1-3. VITAMINS

The water-soluble vitamins are vitamin B complex and vitamin C.

a. **Vitamin B Complex.** The vitamin B complex includes the following:

(1) Thiamine, whose absence from the diet causes nervousness and eventual paralysis in humans.

(2) Riboflavin (vitamin B_2 or G), which is necessary for body growth.

(3) Pyridoxine (vitamin B_6), which prevents cracking of the lips and corners of the mouth.

(4) Niacin, which is necessary for body growth and is normally one of the vitamins recommended in certain cases of pellagra (dermatitis).

(5) Biotin, necessary for normal skin and intestinal development.

(6) Folic acids, which prevent anemia.

(7) Vitamin B_{12}, which is essential for normal fat metabolism.

b. **Vitamin C.** This vitamin, which is also called ascorbic acid, prevents certain diseases and skin disorders, such as scurvy.

1-4. ENZYMES

Enzymes are protein-like substances that have the ability to speed or retard chemical changes without themselves being altered in the reaction. There are seven important enzymes in milk: phosphatase and lipase (the two most important), catalase, peroxidase, lactase, amylase, and galactase.

a. **Phosphatase.** This enzyme is important because it is destroyed by the same time and temperature required to pasteurize milk. The efficiency of pasteurization is determined by testing for a byproduct of this enzyme.

b. **Lipase.** Lipase, which is present in raw milk, has the ability to split fat to produce free fatty acids and a resulting rancid flavor. If milk is homogenized but not heat treated, the lipase enzyme will more readily cause the milk to become rancid. For this reason, homogenized milk is usually heated to temperatures above pasteurization, whereas non-homogenized (cream line) milk is not. Heating will destroy the lipase.

1-5. PROPERTIES OF MILK

a. **Color.** The color of normal milk varies from light cream color to light bluish-white depending in part upon the composition. Generally, the higher the carotene (a pro-vitamin A) and milkfat content, the deeper the creamy color. The color of milk also varies with the age of the cow, the type feed, and the stage of lactation.

b. **Flavor and Odor.** The characteristic flavor and odor of normal whole milk is familiar to most people. The normal flavor is slightly sweet and the normal odor is not pronounced.

c. **Freezing Point.** The freezing point of milk is 31.01°F (-0.55°C) that is slightly lower than for pure water. The freezing point of milk is constant and therefore can be used to detect the presence of added water (the freeze test). The instrument used to determine the freezing point of milk is the cryoscope.

d. **Stickiness.** Milk is sticky to the touch because of the presence of lactose (milk sugar) and casein. This property complicates the cleaning procedures in dairy plants.

e. **Viscosity.** Milk is more viscous than water. This is due to the presence of the fat emulsion and the colloidal particles. Viscosity may be called resistance to flow. Thus, milk will not flow with the same velocity as water.

1-6. DISEASES TRANSMITTED THROUGH MILK

The pathogenic organisms that may gain entry to milk may be placed into two groups--those organisms that contaminate the milk due to a diseased cow and those that contaminate the milk due to milk handling.

a. **Animal to Man.**

(1) Tuberculosis. The causative organism, Mycobacterium bovis, is one of the most heat-resistant of the nonsporeforming pathogenic bacteria. Fortunately, it is destroyed by pasteurization. The organism may enter the milk directly from an infected udder or by way of infected dust and manure particles entering the milk. In the United

States today, milkborne cases of tuberculosis are relatively uncommon, but it is a serious problem in some areas where adequate control measures are not in effect.

(2) Brucellosis. This disease is caused by a group of organisms known as Brucella. The disease is called undulant fever in man. In cattle, it is often called Bang's disease or contagious abortion. It is usually spread by contact with infected animal materials or by consumption of raw milk from diseased animals. As with tuberculosis, programs for eradication are in effect to eliminate brucellosis in dairy herds.

(3) Q fever. This disease is a pneumonia-like disease caused by a rickettsial organism, Coxiella burnettii. It is commonly disseminated by airborne organisms, by contact with infected animals, or by consumption of raw milk from infected cows. The heat resistance of this organism is reflected in the need to use a time-temperature combination of 145°F (63°C) for 30 minutes or equivalent high temperature short time pasteurization temperatures.

(4) Mastitis. Mastitis is an infection of the cow's udder. It may be caused by mechanical injury or by several species of the Streptococcus and Micrococcus organisms. Some species of these groups are pathogenic and are a potential source of disease to the consumer.

(5) Salmonellosis. There are a number of diseases caused by the genus Salmonella, which contains a wide variety of "species" pathogenic for both man and animals. They may be transmitted from animal to man. Three clinically distinguishable forms of salmonellosis occur in man: enteric fevers, septicemias, and acute gastroenteritis.

b. **Man to Man.** The contamination of milk, milk products, or milk-handling equipment by persons recovering from an infectious disease, or acting as a carrier of a disease, is perhaps the most common cause of milkborne disease. Typhoid and paratyphoid fever, scarlet fever, septic sore throat, diphtheria, cholera, amebic dysentery, and infection by organisms of the Salmonella genus may be transmitted in this manner.

1-7. CONTROL OF MILKBORNE DISEASES

a. **Healthy Cows.** Milk for dairy product production should be extracted from healthy cows only. Dairy herds are tested and inspected by state and/or federal veterinarians.

b. **Healthy Employees.** Dairy farm milk handlers and dairy plant personnel must pass periodic medical examinations. Employees must be free of communicable disease, open sores, and cuts. Good personal hygiene must be practiced at the farm, milking parlor, collection vehicles and stations, dairies, and retail outlets.

c. **Sanitation.** Milk is an extremely perishable product and an excellent media for microbial growth. Sanitation policies and procedures must be constantly reviewed to ensure that the possibilities for contamination are eliminated. Food sanitation education must be provided on a recurring basis to all personnel handling milk.

d. **Refrigeration.** Storage temperature is the most important factor in maintaining the quality of pasteurized dairy products. For chilled products, the ideal storage temperature range is from 32° to 40°F (0° to 4°C). For frozen products, the ideal storage temperature range is from 0° to -10°F (-18° to -23°C).

e. **Thermal Processing.** Two benefits are realized by thermal processing, which is the application of heat to the product. First, all disease-causing microorganisms (pathogens) can be destroyed through exposure to a high enough temperature over a long enough period of time. This process is termed pasteurization. Secondly, the deterioration of milk can be slowed and the shelf-life extended by destroying nonpathogenic spoilage microorganisms as well. This produces sterilized milk or aseptically processed milk.

1-8. DAIRY PRODUCTS

a. **General Definition.** Dairy products may generally be defined as products derived from the milk of the cow and, in some cases, other milk-producing animals.

b. **Classes of Dairy Products.** For military purposes, dairy products are subdivided into three classes: fresh dairy products, frozen desserts, and manufactured dairy products. Section II of this lesson will discuss fresh dairy products; section III will discuss frozen desserts; and section IV will discuss manufactured dairy products.

Section II. FRESH DAIRY PRODUCTS

1-9. FRESH DAIRY PRODUCTS

a. **Description of Fresh Dairy Products.** Fresh dairy products are all items described in Part II, Section I, paragraph N, of the "Grade A Pasteurized Milk Ordinance (PMO) - 1993, Recommendation of the United States Public Health Service." These milk products include cream, light cream, light whipping cream, heavy cream, heavy whipping cream, whipped cream, whipped light cream, sour cream, acidified sour cream, cultured sour cream, half-and-half, sour half-and-half, acidified sour half-and-half, cultured half-and-half, reconstituted or recombined milk and milk products, concentrated milk, concentrated milk products, skim milk, lowfat milk, frozen milk concentrate, eggnog, buttermilk, cultured buttermilk, cultured milk, cultured lowfat milk, cultured skim milk, yogurt, lowfat yogurt, nonfat yogurt, acidified milk, acidified lowfat milk, acidified skim milk, low-sodium milk, low-sodium lowfat milk, low-sodium skim milk, lactose-reduced milk, lactose-reduced lowfat milk, lactose-reduced skim milk,

aseptically processed and packaged milk and milk products as defined in this section, milk or lowfat milk or skim milk with added safe and suitable microbial organisms, and any other milk product made by the addition or subtraction of milkfat or addition of safe and suitable optional ingredients for protein, vitamin, or mineral fortification of milk products defined herein.

b. **Items Not Described.** This description/definition is not intended to include milk products such as evaporated milk, evaporated skim milk, condensed milk (sweetened or unsweetened), dietary products (except as defined herein), infant formula, ice cream and other desserts, dry milk products, canned eggnog in a rigid metal container, butter, or cheese, except when they are combined with other substances to produce any pasteurized or aseptically processed milk or milk product defined herein.

c. **Aseptically Processed Milk and Milk Products.** Aseptically processed milk and milk products are products hermetically sealed in a container and so thermally processed in conformance with Title 21, Code of Federal Regulations (CFR), Part 113, and the provisions of the pasteurized milk ordinance (PMO), so as to render the product free of microorganisms capable of reproducing in the product under normal non-refrigeration conditions of storage and distribution. The product shall be free of viable microorganisms (including spores) of public health significance.

1-10. DEFINITIONS

a. **Fresh (Fluid) Dairy Products.** The basic difference between the various types of fluid dairy products is the amount of milkfat present.

(1) Whole milk. Whole milk is the lacteal secretion obtained by the complete milking of one or more healthy cows. Whole milk contains not less than 8.25 percent milk solids-not-fat and not less than 3.25 percent milkfat. Whole milk is practically free from colostrum. (NOTE: Colostrum is secreted in the first few days after a cow has given birth. It is high in protein and immune bodies.)

(2) Lowfat milk. This is milk from which sufficient milkfat has been removed to one of the following milkfat contents: 1/2, 1, 1 1/2, or 2 percent.

(3) Skim milk. This is milk from which a sufficient amount of the milkfat has been removed to reduce its milkfat content to less than 0.5 percent.

(4) Half-and-half. This is a mixture of milk and cream that contains not less than 10.5 percent but less than 18 percent milkfat.

(5) Heavy Cream. Cream is the sweet, fatty liquid separated from milk, with or without the addition of milk or skim milk. Heavy cream, or whipping cream, contains not less than 36 percent milkfat.

(6) Light Cream. Cream is the sweet, fatty liquid separated from milk, with or without the addition of milk or skim milk. Light cream contains not less than 18 percent but less than 30 percent milkfat.

(7) Flavored milk or milk products. This is whole milk to which a flavor and/or sweetener has been added.

(8) Flavored drink. This is lowfat milk to which a flavor and/or sweetener has been added.

(9) Concentrated milk. This is milk or milk products that have had a portion of the water content removed under vacuum. They are concentrated in order to reduce transportation and warehouse space.

(10) Recombined milk. This is whole milk dried, including milkfat and milk-solids-not-fat. The dry product is recombined with water into a fluid milk product.

(11) Reconstituted milk. This is skim milk dried, with solids-not-fat, but no milkfat. The dry product is rehydrated or reconstituted with water into a fluid milk product.

(12) Filled milk. This is similar to recombined milk, except milkfat is replaced with vegetable fat. Normally coconut oil is used. The dry product is recombined with water into a fluid milk product.

b. **Starters.** When starters are added to the milk product, the resulting products are called fresh cultured dairy products. There are two kinds of starters. One ingredient that is added is an acidifying ingredient, generally lactic acid. In this case, the product is labeled acidified. The other ingredient added is a starter of microbial organisms. In this case, when the starter is bacteria, the product is labeled cultured.

c. **Fresh Cultured Dairy Products.**

(1) Buttermilk. A fluid product resulting from the manufacture of butter from milk or cream. It contains not less than 8.25 percent of milk solids-not-fat.

(2) Buttermilk, cultured. A fluid product that results when pasteurized skim milk is soured by lactic acid-producing bacteria or similar culture.

(3) Sour cream. A fluid or semifluid cream that results from the souring of pasteurized cream by lactic-acid-producing bacteria or similar culture.

1-11. RAW MILK HANDLING AND STORAGE

a. **Approved Herds.** Raw milk should come from approved herds (milksheds) that are known to be free of diseases such as brucellosis and tuberculosis. (A milkshed

is a geographical area which supplies the dairy with raw milk.) The cows should be milked under sanitary conditions.

b. **Cooling and Storing.** In order to produce Grade A milk, the dairy farm must have a separate milkroom or milkhouse where the milk is cooled, handled, and stored prior to shipment. Milk containers, utensils, and milking equipment must be washed, sanitized, and properly stored in the milkroom or milkhouse. Both pathogenic and quality-destroying organisms may multiply in milk if the milk is not promptly and properly cooled or delivered immediately to the processing plant.

(1) The two-hour rule. Milk delivered to the pasteurization plant within 2 hours after milking need not be cooled on the dairy farm.

(2) The temperature requirement. If not delivered within 2 hours, raw milk, immediately after milking, should be cooled to 45°F (7°C) or lower until pasteurized at the dairy plant.

c. **Transportation.** Every effort must be made to preclude contamination / adulteration while on the farm and during transport to the dairy plant. Insulated bulk tanks, equipped with pumps and sampling equipment and lined with stainless steel, are normally used in transporting milk to pasteurization plants. With this method, milk is pumped directly from the farm bulk tank to the truck. In areas where big collecting stations are utilized, large insulated bulk tank trailers transport the milk.

1-12. DELIVERING MILK TO THE PLANT

Milk is usually delivered direct from the farm to the pasteurization plant in the city. The raw milk is received from the farm, weighed, sampled, cooled, and held in storage prior to pasteurization. Raw milk (milk which is unpasteurized) is normally delivered to the milk pasteurization plant by bulk tank trucks and trailers. In some instances, milk may be delivered in rail tank cars.

a. **Inspection of Raw Milk.** Raw milk is examined at time of delivery by the plant management and local health officials. The frequency and thoroughness of the examination varies according to the plant and local health officials. Military inspection personnel responsible for the inspection must review plant and health inspection results and programs to assure that they are satisfactory. These procedures, when in compliance with current directives, are accepted to prevent duplication of inspection by the military inspectors. Receiving examinations are simple initial quality checks.

(1) Temperature check. Another platform check is for the temperature of the milk. This is done daily in warm areas. Since bacterial growth must be retarded, raw milk is promptly cooled and maintained at a reasonably low temperature until processed. The USPHS "Grade A Pasteurized Milk Ordinance" requires milk to be cooled at 45°F (7°C) or less and maintained there at until processed.

(2) Sediment test. A sediment test may be performed on the platform. This test is made by filtering one pint of the raw milk through a special cotton linen disc and comparing the results with a set of standard discs that represent all degrees of cleanliness.

(3) Laboratory tests. Laboratory tests consist of more complicated physical, chemical, and bacteriological procedures. Some of the tests included here are the acidity test, the direct microscopic test, a standard plate count, the resazurin test, the methylene blue test, and coliform tests.

b. **Determining Amount Delivered.** One method for determining the amount of milk delivered is to use a calibrated measuring rod. The rod is submerged in the delivery tank and the amount of milk delivered is determined by where the milk line appears on the calibrated rod. The standard method today is to measure the raw product being received by use of a meter gauge. Milk pumped from the delivery vehicle and passes through a gauge that measures the milk in gallons.

c. **Transferring Milk from Carrier to Plant.** Milk from tank trucks is pumped into receiving tanks. Maintaining proper sanitary standards of the transport vehicle, receiving area, and storage tanks is extremely important.

d. **Storage of Milk.** Milk is usually stored in storage tanks prior to being pasteurized or other processing. The milk is cooled to 45°F (7°C) or lower and maintained at that temperature in the insulated storage tanks. These tanks vary in capacity from 100 to 40,000 gallons. Milk processing includes clarification, standardization, separation, homogenization, and pasteurization, followed by cooling and packaging.

1-13. CLARIFICATION

The purpose of clarification in processing milk is to remove heavy sediment particles and foreign materials by mechanical means; namely, centrifugation. This can be done with either cold or warm milk; however, warm clarification is more efficient. The centrifugal clarifier consists of an enclosed bowl and any number of cone-shaped discs which rotate at a high rate of speed causing a centrifugal force. Milk is pumped into the bowl, subjected to the centrifugal force, and then pumped out. The force throws the foreign materials and heavy sediment to the walls of the bowl where they remain until the clarifier is cleaned. The material removed from the milk includes visible dirt, blood cells, hair, fragments of udder cells, and slime. Clarification cleans milk; it does not purify it or remove any bacteria.

1-14. STANDARDIZATION

Standardization is the process of raising or lowering of the percentage of milkfat in milk or cream to attain the desired standard. In order to minimize contamination of the finished product, standardization should take place prior to pasteurization. Raw milk

is standardized by adding skim milk to whole raw milk to reduce the percent of milkfat, by adding cream to milk in order to raise the percentage of milkfat, or by passing the raw milk through a separator to produce standardized milk. Milk procured for the Armed Forces must contain a minimum of 3.25 percent milkfat.

1-15. SEPARATION

Separation is the process of removing the cream from whole milk, leaving skim milk. Separation is more efficient when the milk is warmed, usually between 90° to 100°F (32° to 38°C), prior to the separation. The separator operates on the principle of centrifugal force whereby the lighter cream is separated from the heavier milk. The cream and the milk are removed from the separator by different outlets. Most separators have an adjustment device by which the percent of milkfat in the cream removed from whole milk may be regulated.

1-16. HOMOGENIZATION

Homogenized milk is whole milk in which the fat globules are reduced in size and are evenly dispersed throughout the milk so that after 48 hours of quiescent storage, no visible cream separation occurs. The milkfat percentage in the top 100 cc will not vary more than 10 percent from the milkfat percentage in the remaining portion of a 1-quart bottle of milk. Homogenization is accomplished more efficiently when the milk is warm. The homogenizer operates by using high pressure to force milk through a minute orifice. Homogenizers are operated at pressures of 2,000 to 3,000 pounds per square inch. Milkfat particles normally ranging in size from 1 to 18 microns in diameter (averaging 7 microns) are reduced in size to an average diameter of 1 1/2 microns.

1-17. PASTEURIZATION

Pasteurization is a process of heating every particle of milk to a definite temperature for a specific period of time. It is the most effective method of destroying pathogenic bacteria without materially altering the flavor or consistency of the milk. The Grade A Pasteurized Milk Ordinance (PMO), U.S. Public Health Service, defines pasteurization as the process of heating every particle of milk or milk product to at least 145°F (63°C) and holding it continuously at or above this temperature for at least 30 minutes; or to at least 161°F (72°C) and holding it continuously at or above this temperature for at least 15 seconds; or to one of the temperatures given in Table 1-1 and held continuously at or above that temperature for at least the corresponding specified time. In addition, milk products that have a higher milkfat content than milk or contain added sweeteners (cream, half-and-half, chocolate flavored milk) must be heated to at least 150°F (66°C) and held continuously for at least 30 minutes in the vat method; or to at least 166°F (74.4°C) and held continuously for at least 15 seconds in the high-temperature, short-time (HTST) method. Diagrams of two types of pasteurizers are shown in figures 1-1 and 1-2. (Figure 1-3 shows the milk flow through the HTST pasteurizer.) The time and temperature combination of four types of pasteurizers are shown in table 1-1.

Type	Temperature	Time
Vat or batch (holding method)	145°F (63°C)	30 min
High-temperature, short-time (HTST) (continuous flow)	161°F (72°C)	15 sec
Higher-heat, shorter-time (HHST) (continuous flow)	191°F (88.5°C)	1.0 sec
	194°F (90°C)	0.5 sec
	201°F (94°C)	0.1 sec
	204°F (96°C)	0.05 sec
	212°F (100°C)	0.01 sec
Aseptically processed (UHT milk) (continuous flow)	280° - 302°F (138° - 150°C)	2 to 5 sec

Table 1-1. Pasturizing temperature/time requirements.

1-18. VAT OR BATCH PASTEURIZER

Vat or batch pasteurization is the process of heating milk in a vat or holding type pasteurizer and is primarily used in small dairy plants or for processing by-products and specialty products. The vat pasteurizer (see figure 1-1) consists of a jacketed vat that is capable of maintaining the temperatures and holding times required for pasteurization. A properly designed vat will protect the product from contamination and be equipped with leak-protector inlet/outlet valves, a recording thermometer, an indicating thermometer, an air space thermometer, and an agitator. An air space heater is normally included also. During operation of the vat pasteurizer, the product may be heated in the vat or partially/totally preheated prior to filling the vat. In any event, it is critical that the holding time of 30 minutes commences after the minimum temperature has been reached and the filling of the vat has been completed.

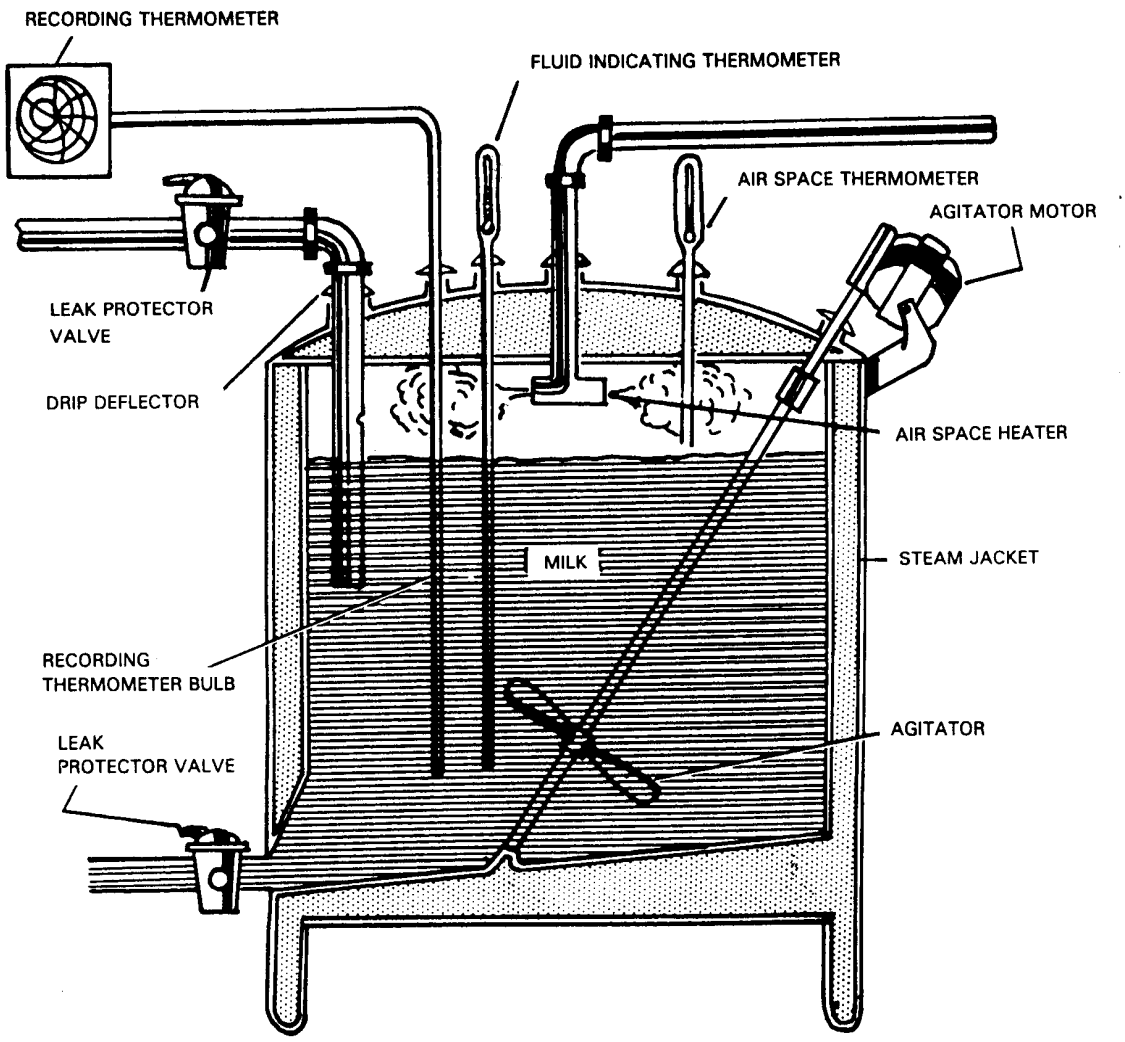


Figure 1-1. Vat (Batch) Pasteurizer.

1-19. HIGH TEMPERATURE, SHORT TIME (HTST) PASTEURIZER

The high-temperature, short-time pasteurizer is used to a far greater extent than the vat pasteurizer. The main difference is that progressively higher temperatures and shorter times are used. The HTST system is a "continuous" process whereas vat pasteurization is a "batch" process. See figures 1-2 and 1-3. The steps in this method are:

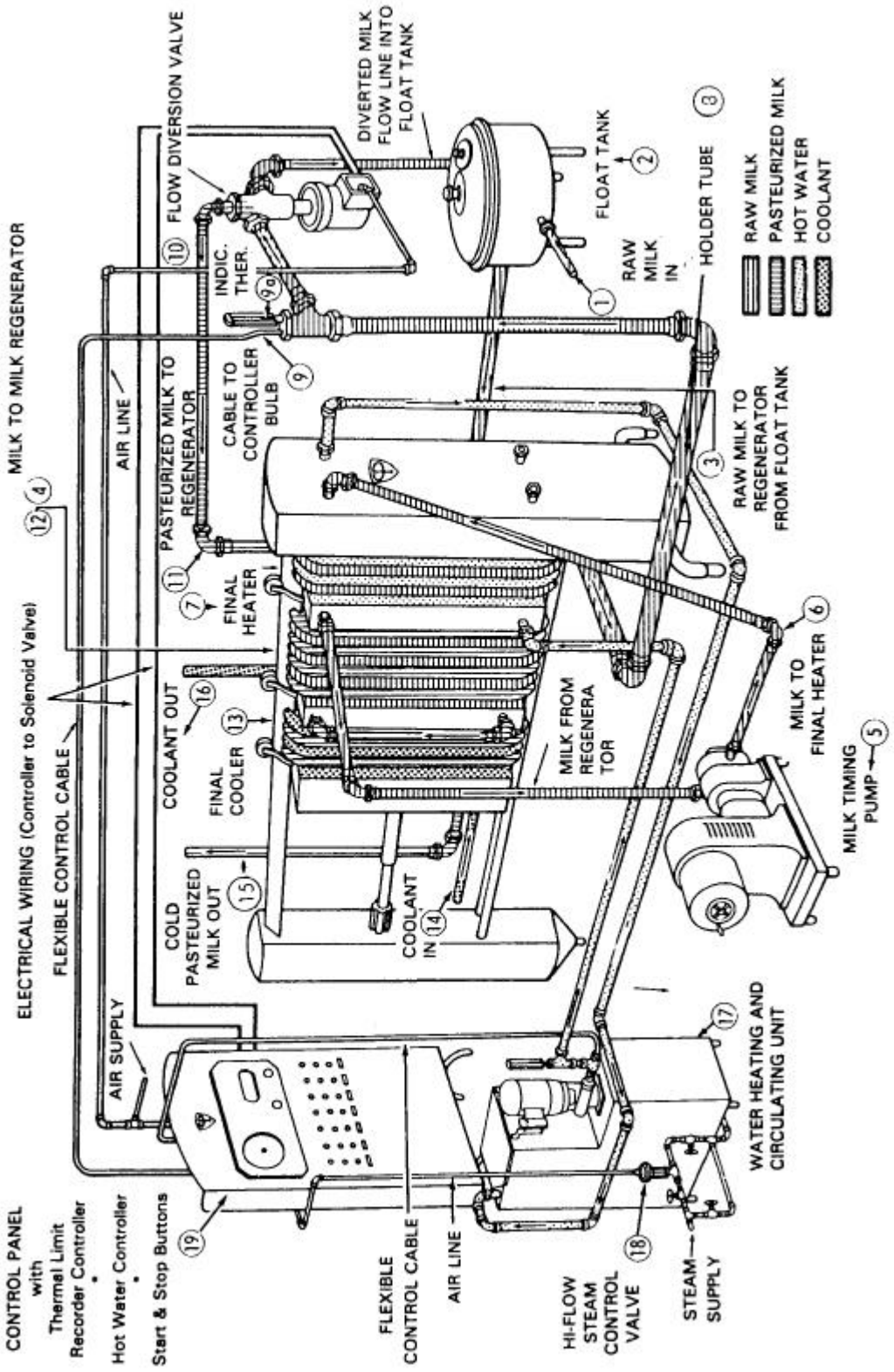


Figure 1-2. High temperature, short time (HTST) pasteurizer.

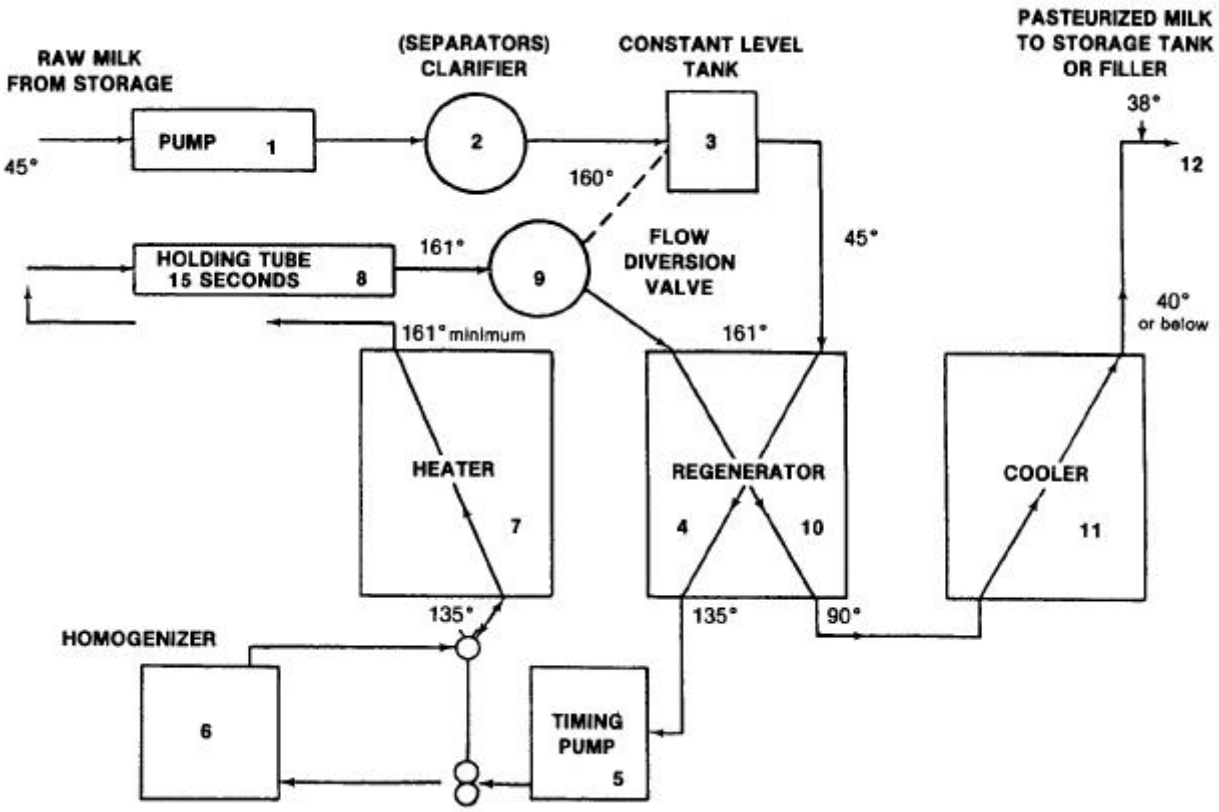


Figure 1-3. Milk flow through a HTST pasteurizer (typical temperature).

a. **Raw Milk Storage.** Raw milk is received at the pasteurization plant at a temperature of 45°F (7°C) or less and pumped into raw milk storage tanks (see block 1, figure 1-3). This raw milk must be maintained at 45°F (7°C) or less until processed. The steps in processing raw milk will vary at different processing plants and the type of equipment used will also cause a variation in the processing steps. Raw milk that is to be packaged as whole milk is normally clarified, homogenized, pasteurized, and cooled prior to packaging. The sequence of these steps is not always in the same order. If the batch (vat) pasteurizer is used, the raw milk may be clarified and homogenized prior to pasteurization. These steps may also be accomplished after the milk is pasteurized.

b. **Clarifier.** Clarification is a mechanical means of removing foreign matter, such as dirt, hair, manure, and blood cells from milk. The clarifier (see block 2, figure 1-3) operates on the principle of centrifugal force. It consists of a bowl and a series of cone-shaped discs enclosed within the bowl. As the bowl revolves at several thousand revolutions per minute, the foreign matter, being heavier than the milk, is deposited on the inside walls of the clarifier bowl in the form of slime. This clarifier will not always be located at the same place at all pasteurization plants. The milk may be clarified immediately after it is pumped from the raw milk storage tanks and prior to entering the pasteurizer; it may be clarified after it is heated in the regenerator section (HTST); or it may be clarified after pasteurization and/or cooling. Some milk plants often use a standardizing clarifier. This piece of equipment can be used as a clarifier, separator,

and standardizer. Cream may be separated from whole milk, leaving skim milk. When the butterfat percent of milk is higher than desired, the milk may be standardized (the fat percent adjusted by adding skim milk) to the desired fat percent.

c. **Balance or Float Tank.** From the raw milk storage tank, the milk is pumped into a balance or float tank (also referred to as constant-level supply tank) (see block 3, figure 1-3). The balance tank is equipped with a float valve that keeps the milk at a constant level and maintains a constant supply for the pasteurizer, as well as for other steps in processing.

d. **Regenerator (Heat Exchange Section).** From the balance tank, the cold raw milk is drawn into the regenerator section (see block 4, figure 1-3) of the HTST by a displacement timing pump. The timing pump is located at the exit of the regenerator section, which accounts for the principle of the raw milk being drawn or sucked into the regenerator. In the regenerator section, the cold raw milk is heated to approximately 135°F (57°C) by hot pasteurized milk flowing in a counter direction on the opposite sides of the thin stainless steel plates. (This hot pasteurized milk is also cooled to approximately 90°F (32°C) by the raw milk.) The pressure in the pasteurized side of the regenerator is always greater than the pressure on the raw milk side, which eliminates the possibility of contaminating the pasteurized milk with raw milk if flaws or leaks develop in the plates and gaskets.

e. **Timing Pump.** The positive displacement timing pump (see block 6, figure 1-3) draws the raw milk out of the regenerator section and pumps it under pressure through the rest of the HTST pasteurization system. The timing pump regulates the flow of milk through the final heater, holding tube, regenerative cooler, and final cooler. The pump must be regulated and controlled so that it will take 15 seconds for every particle of milk to flow through the holding tube of the HTST pasteurizer.

f. **Homogenizer.** It is a common practice to connect the homogenizer (see block 6, figure 1-3) between the timing pump and the final heating section of the HTST. (The clarifier may also be installed after the homogenizer and prior to the milk being pumped into the final heater.) In the homogenizer, the fat globules of the milk are reduced in size as the milk is forced between small openings under pressure ranging from 2,000 to 3,000 pounds per square inch. The breaking up of the fat globules allows them to be evenly distributed throughout the milk and prevents the formation of a cream layer. The Grade A Pasteurized Milk Ordinance defines homogenized milk as "milk which has been treated to ensure breakup of the fat globules to such an extent that, after 48 hours of quiescent storage at 45°F (7°C), no visible cream separation occurs on the milk, and the fat percentage of the top 100 milliliters of milk in a quart, or of proportionate volumes in containers of other sizes, does not differ by more than 10 percent from the fat percentage of the remaining milk, as determined after thorough mixing."

g. **Final Heater.** From the homogenizer, the milk is pumped through the heater section (see block 7, figure 1-3) of the HTST pasteurizer. The milk, already preheated

in the regenerator section, passes over stainless steel plates where it is heated by hot water or steam on the opposite side of the plates to a temperature of at least 161°F (72°C).

h. **Holding Tube.** From the final heater, the milk flows through the holding tube (see block 8, figure 1-3) where it is "held" for at least 15 seconds. The "holding time" shall be taken to mean flow time of the fastest particle of milk, at or above 161°F (72°C), throughout the holding tube section. The maximum velocity of the milk through the holding tube is governed by the speed of the timing pump, the diameter and length of the holding tube, and surface friction. The Grade A Pasteurized Milk Ordinance requires that the holding time be tested by the health authority when the equipment is initially installed and semiannually thereafter, and, also, at any time an alteration or repair may offset the holding time, or when the seal of the speed-setting device on the timing pump has been broken.

i. **Flow Diversion Valve.** After the milk flows through the holding tube, it passes the recorder-controller sensor. The recorder-controller sensor regulates the forward or diverted flow position of the flow-diversion valve (see block 9, figure 1-3). If milk passing the recorder-controller sensor is 161°F (72°C) or higher, the flow-diversion valve assumes a forward-flow position and the milk flows forward into the pasteurized section of the regenerator. If the milk is less than 161°F (72°C) when it passes the recorder-controller sensor, the flow-diversion valve assumes a diverted-flow position and the inadequately heated milk is diverted back into the raw milk balance tank.

j. **Regenerator (Cooling Section).** Properly heated milk flows through the flow-diversion valve into the pasteurized side of the regenerator section of the HTST (see block 10, figure 1-3). In the regenerator section, the pasteurized milk is cooled to approximately 90°F (32°C) by incoming cold raw milk on the opposite side of the stainless steel plates. The warm pasteurized milk then passes through the cooling section of the HTST (see block 11, figure 1-3), where a coolant, on the opposite side of stainless steel plates, reduces the temperature to 40°F (4°C) or below. The cold pasteurized milk then passes to a storage tank to await packaging.

1-20. HHST PASTEURIZER

Some processing companies operate a type of pasteurizer that reduces the pasteurization time even more than the HTST. Some units are similar to the HTST plate pasteurizer, except that the hot water in the heating unit is replaced by steam under pressure and the holding tube is shortened. In this type pasteurizer, the milk is heated from 191°F (88°C) to 212°F (100°C) and held for no more than 1 second. (See the temperature and time requirements shown in Table 1-1.)

1-21. ULTRA PASTEURIZED

The term "ultra-pasteurized," when used to describe a dairy product, means that such a product shall have been thermally processed at or above 280°F (138°C) for at least 2 seconds, either before or after packaging, to effect a product which has an extended shelf life under refrigerated conditions.

1-22. ASEPTICALLY PROCESSED AND PACKAGED

Aseptic processing and packaging is designed to produce a milk product that is shelf stable (does not require refrigeration). This is accomplished by first thermally processing a product to render it commercially sterile (for example, all pathogenic microorganisms are killed and all spoilage microorganisms are either killed or rendered incapable of reproducing) and then packaging it in sterilized containers, which are then hermetically sealed. Aseptically processed milk is considered to be a "low acid canned food" and must conform to the same regulations that govern the canning of low acid foods (for example, Title 21, Code of Federal Regulations (CFR), Part 113). Heating the milk to the required temperatures is accomplished using a direct and/or indirect method. Direct heating consists of exposing the product directly to live steam. Indirect heating consists of using plate/tubular heat exchangers like those described in the HTST system. In any case, the product is normally preheated to at least 167°F or even up to 176°F (75° up to 80°C), heated to the final process temperature of a minimum of 284°F or a maximum of 302°F (140° up to 150°C), and then packaged. The filled container is not subjected to any additional heating or cooling steps. The packaging system uses a container constructed of a laminate normally consisting of paper, metal foil, and plastic. The cartons are sterilized prior to filling using hydrogen peroxide, ultraviolet light, and/or heat. The sterilized cartons are then filled and hermetically sealed in a sterile environment.

1-23. COOLING AND STORAGE

Immediately after pasteurization, milk is chilled to 45°F (7°C) or lower, and it must be held at that temperature during storage. There are several types of cooling units such as surface coolers, cabinet coolers, and the plate-type cooler. Milk should be packaged as soon as possible after pasteurization.

1-24. PACKAGING

The chilled, pasteurized milk is packaged in various types of containers. The more common containers and their capacities are listed below.

a. **One-Gallon Containers and Less.**

(1) Paper cartons with wax coating. There are two general types of cartons: those received at the dairy either broken down or in roll form and those prefabricated at a factory. The first mentioned cartons are formed, glued, and waxed just before filling,

whereas the prefabricated cartons are only filled and sealed at the dairy plant. Examples of cartons received at the dairy either broken down or in roll form are Pure Pak, Seal King, and Tetra Pak. An example of the prefabricated carton is the Canco. Figure 1-4 shows these types of milk cartons. The primary carton used by the dairy industry to package fluid milk is the Pure Pak carton. The Pure Pak carton is identified by the "steeple" at the top.

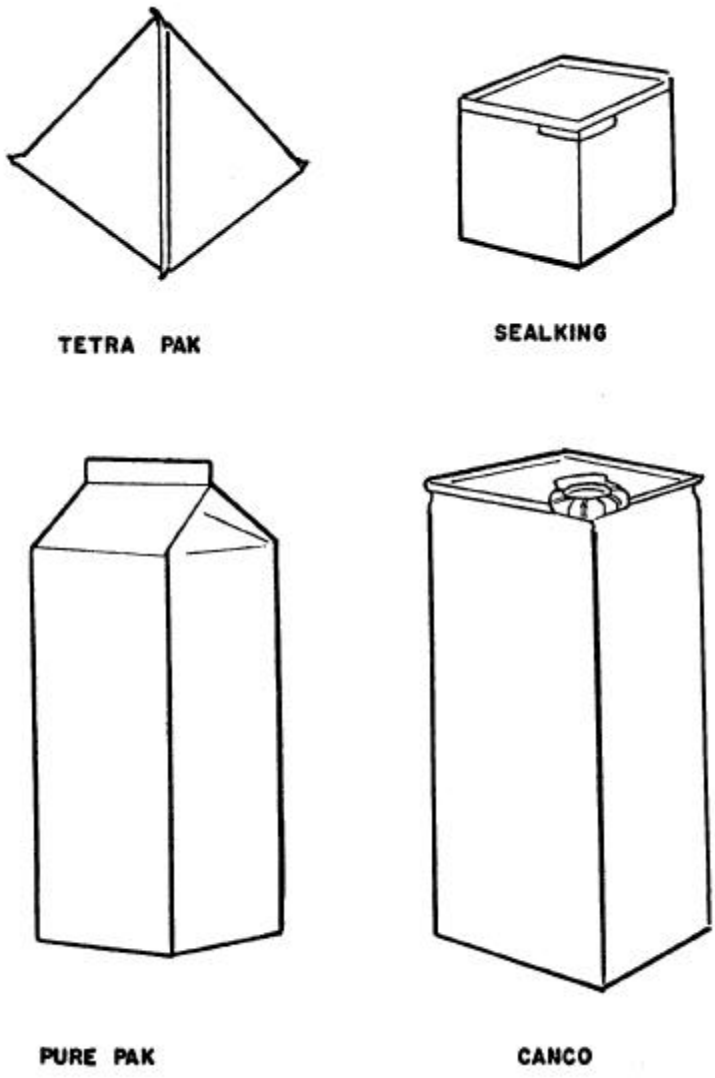


Figure 1-4, Types of Milk Cartons

(2) Glass containers. Glass is cheaper than paper containers because bottles can be reused; however, bottles are bulky and heavy and are susceptible to breakage. Glass containers also must be washed and sanitized before being used.

(3) Polyethylene jugs. These are a type of single service milk container.

b. **Bulk Milk Containers.** Two types of containers are used to hold bulk milk: single-service containers and multiple-service containers. Either type may be used for shipping or dispensing bulk milk. The common sizes of these containers are 3, 5, 6, and 7 gallons.

(1) Single-service shipping container. This is a container made from paperboard, plastic, or other material used to enclose a single-service dispenser container. It is so constructed that its reuse is precluded. It is discarded after use.

(2) Single-service dispenser container (plastic bag). This is a primary container fabricated from a plastic material (normally a heavy duty plastic bag) which is approved as a milk-contact surface by the Federal Food and Drug Administration (FDA). The single-service dispenser container is enclosed in or is an integral part of either a single-service or a multiple-service shipping container.

(3) Multiple-service shipping container. This is a container made from dairy metal or other material approved by the FDA as a milk-contact surface that is used to enclose a single-service dispenser. The container can be reused after thorough cleaning.

(4) Multiple-service dispenser container. This is a container made from dairy metal or multiple-use plastic materials which is suitable for reuse after it has been thoroughly cleaned and sanitized by an approved bactericidal process. A multiple-service dispensing container usually is its own shipping container.

(5) Single-service delivery tube. Dispenser containers are equipped with single-service delivery tubes. These are tubes or pipes of rubber, plastic, or plastic-type material used to dispense milk or milk products from any dispenser container in a sanitary manner. Its surfaces are of material approved by the FDA.

1-25. TESTING MILK PRODUCTS

The following are brief descriptions of some of the tests performed to determine wholesomeness and quality of milk and milk products. All these tests are not performed routinely and they do not apply to all products. Inspectors should be guided by the requirements of the applicable specification.

a. **Tests For Wholesomeness.**

(1) Standard plate count (SPC). The standard plate count test is a bacteriological method of estimating the number of bacteria in milk. The SPC provides information on the approximate total number of bacteria in milk. In this method, a small, known volume of milk is diluted with a known volume of sterilized water and mixed in a petri dish with nutrient agar (a jelly-like medium with nutrient material that favors the growth of bacteria). This media is placed in an incubator for 48 hours (±3 hours) at a temperature of 90°F (32°C), plus or minus 1° (for either F or C).

As bacteria grows on the media, a mass forms that is visible to the naked eye. This mass, known as a colony, corresponds to one group of bacteria originally present in the milk added to the media. With the aid of a magnifying lens, the number of colonies are counted and multiplied by a dilution factor. This gives the estimated number of bacteria per milliliter of milk. This test is not performed on cultured products where bacteria are intentionally added (such as buttermilk, cottage cheese, and sour cream).

(2) Coliform test. The coliform test is a bacteriological examination of dairy products to detect bacteria of the coliform group. Bacteria of both fecal and nonfecal origin are members of this group. This test provides information on contamination of milk after pasteurization. The coliform test is not specifically intended to detect coliform organisms but to measure the sanitary practices used to control bacterial contamination of dairy products. Since those organisms are easily destroyed by pasteurization, their presence in pasteurized products usually indicates contamination following pasteurization. The test procedures are similar to those for the standard plate count (SPC) except that the media is prepared by using violet red bile agar or desoxycholate lactase agar. The plates are incubated at 90°F (32°C) for 24 hours (±2 hours). Coliform organisms appear as dark red colonies on the red agar media.

(3) Yeast and mold counts. An estimate of the yeast and mold count of dairy products is sometimes desirable if the product is contaminated. Such counts are made on manufactured dairy products, such as cheese, butter, condensed and dry dairy products, and cultured dairy products such as cottage cheese. A positive test indicates contamination after pasteurization. Yeast and mold are easily destroyed by pasteurization; therefore, their presence in a finished product is an indication of improper processing and/or plant sanitation. An acidified potato glucose agar is used to prepare the media for yeast and mold growth. The plates are incubated at 75°F (±3°), which is 24°C (±2°), for five days, and the colonies are reported as combined yeast and mold count.

(4) Phosphatase test. The phosphatase test is a chemical test to determine the efficiency of pasteurization. Phosphatase is an enzyme found in raw milk that is inactivated when the proper time and temperature combinations are reached for adequate pasteurization. Therefore, the presence of the phosphatase enzyme in a pasteurized product is an indication of improper pasteurization or contamination of a properly pasteurized product with raw product.

(5) Keeping Quality Testing (KQ). The Mosely Keeping Quality Testing, a special program, will provide valuable objective indications of how well a plant's sanitation program and pasteurization equipment function to preclude post-pasteurization contamination. While no regulatory or contractual action can be taken based strictly on this information, it is the best objective measure of plant performance that we currently have available. Three samples of regular milk, lowfat, or skim milk, are selected for submission to the laboratory. The samples must be maintained at 40°F or less until received by the laboratory. One sample of each line

item will be tested immediately upon arrival at the laboratory, the second sample on day five, and the third sample on day seven of the Mosely 45°F Keeping Quality (KQ) incubation.

b. **Tests For Quality.** Testing for quality refers to chemical testing which may be conducted to determine percentage of milkfat, the weight of total solids and percentage of solids-not-fat in milk, the percentage of acidity (an indicator of age and bacterial activity), the addition of water (to adulterate the product), and special testing such as for pesticide content and antibiotics. Chemical testing is not conducted routinely. Select testing of chemical characteristics of milk are conducted solely upon written request of the procurement agency (the purchasing activity), as deemed necessary.

1-26. STANDARDS FOR MILK AND MILK PRODUCTS

All Grade A raw milk for pasteurization and all Grade A pasteurized milk will be processed and pasteurized to conform with the following requirements.

a. **Grade A Raw Milk For Pasteurization.**

(1) Temperature. Cooled to 45°F (7°C) or less and maintained there until processed.

(2) Bacterial limits. Milk from the individual producer must not exceed 100,000 per milliliter prior to commingling with other producer milk. The bacterial limit may not exceed 300,000 per milliliter of commingled milk prior to pasteurization.

b. **Grade A Pasteurized Milk.**

(1) Temperature. Cooled to 45°F (7°C) or less and maintained thereat.

(2) Bacterial limits. Not to exceed 20,000 per milliliter.

(3) Coliform limit. Not to exceed 10 per milliliter.

(4) Aseptically processed milk. The bacterial limit is no bacterial growth at all.

1-27. FRESH CULTURED DAIRY PRODUCTS

Cultured dairy products are those to which a selected species of bacteria (starter culture) is added to milk to produce a desired effect. Some of these effects are an increased acidity, increased viscosity, and production of certain flavors and aromas.

a. **Lactic Acid.** When it is desired to produce lactic acid, the culture consists predominantly of Streptococcus cremoris or Streptococcus lactis. The lactic acid

organisms present in a culture are chosen for their ability to produce acid under various conditions. The organisms mentioned are active at room temperature. At the higher temperatures needed in the manufacture of cheese, other strains are used. For high yields of lactic acid, organisms such as Lactobacillus bulgaricus are used. For a combination of acidity, flavor, and aroma, the cultures contain Streptococcus citrovorum or Streptococcus paracitrovorum.

b. **Other Effects.** Starter cultures fulfill a number of functions in the preparation of fermented milks and in the manufacture of some varieties of cheese. The acidity these cultures produce helps rennet to coagulate the milk in cheesemaking. Cultures containing Streptococcus thermophilus and other special types of bacteria are used in the manufacture of Swiss and other kinds of cheese. Propioni-bacterium shermanii is important because it uses the lactic acid produced by other organisms to form propionic acid, acetic acid, and the carbon dioxide gas which give Swiss cheese its characteristic flavor and forms the "eyes."

c. **Types of Fresh Cultured Products.** Some of the types of fresh cultured dairy products are:

(1) Sour cream. This is the fluid or semifluid cream resulting from the souring by lactic acid-producing bacteria or similar culture, and of pasteurized cream, which contains not less than 0.20% acidity expressed as lactic acid. Other names for sour cream are salad cream, Hampshire cream, or cream dressing.

(2) Cultured buttermilk. This is the fermentation of milk or skim milk with lactic acid bacteria. The pasteurized milk used for the preparation of cultured buttermilk is inoculated with up to 1% of starter and held at a temperature around 70°F (21°C) until the desired acidity is reached. (0.7-0.9% acidity expressed as lactic acid.)

(3) Yogurt. This is the fermented milk of the lactic acid type. The starter is prepared by growing separate cultures of Streptococcus thermophilus and Lactobacillus bulgaricus and mixing them just before adding them to the milk that is to be fermented. A number of different fruits and flavors may be added to the yogurt.

(4) Cottage cheese. This is a lactic acid, unripened, soft-curd cheese. Cottage cheese is made commercially from skim milk, reconstituted skim milk, or nonfat dry milk. The most common starters used are Streptococcus lactis or cremoris.

d. **Steps in Manufacture.** The following steps are applicable in the manufacture of most fresh cultured dairy products.

(1) Pasteurization.

(2) Cooling the milk.

(3) Inoculation or introducing the bacteria.

(4) Incubation.

(5) Breaking or cutting the curd, when applicable.

(6) Cooking the curd, when applicable.

(7) Washing the curd, when applicable.

(8) Cooling the curd.

(9) Creaming and salting, when applicable.

(10) Packaging.

(11) Storage or delivery.

1-28. FRESH CONCENTRATED WHOLE MILK

Concentrated whole milk is a dairy product with a portion of the water removed. The water is removed by the application of heat (evaporation), usually under a vacuum. The raw milk used to process concentrated whole milk must comply with the requirements for *No. 2 Milk, Federal Specification C-M-381*. The concentrated product is pasteurized by one of two methods: vat at 155°F (68.3°C), held continuously for 30 minutes; or HTST at 175°F (79.4°C), held for 25 seconds. The product may be homogenized before or after pasteurization. Immediately after pasteurization, the finished product is cooled to 40°F (4.4°C) or lower. The desirable storage temperature is 38° to 40°F (3.3°-4.4°C). The finished product contains at least 9.75 percent butterfat and 34.50 percent total solids. Concentrated whole milk is used for processing reconstituted milk, as a substitute for cream, and for baking purposes. Concentrated whole milk is reconstituted by adding 2 quarts of water to 1 quart of the concentrated product. No other processing is necessary.

1-29. FILLED MILK

Filled milk is a product manufactured by reconstituting solids-not-fat with water and adding a vegetable fat (normally soybean fat or coconut oil). The vegetable fat is used in place of the animal fat (milkfat) of regular milk. The U.S. Government has several filled milk plants overseas. The plants are furnished with government-owned equipment, supplied with government-owned ingredients, and normally managed under contract by a civilian contractor. These plants are established to produce all the troop issue and commissary resale milk products required.

Section III. FROZEN DESSERTS

1-30. INTRODUCTION

Frozen desserts include a variety of frozen products. Some of them contain a high percentage of dairy products while others are void of any dairy product. Most frozen desserts are high in nutritional value. The veterinary food inspection specialist's responsibility is to ensure that frozen desserts are of the highest quality at time of procurement and that the quality is maintained from time of acceptance at destination until the desserts are issued to dining facilities for troop consumption.

1-31. FROZEN DESSERTS

a. For military purposes frozen desserts include ice cream, sherbet and ices, and imitation ice creams and ice milk.

b. Definitions of some of the frozen desserts are given below.

(1) Ice cream. Ice cream is a frozen dairy product consisting basically of milk, cream, sweetening, and flavoring. Ice cream must contain not less than 10% milkfat and 10% milk solids-not-fat. Bulky ingredients (fruits and nut portions), stabilizers, and emulsifiers may be added. When all products are combined, the end product is known as the mix. The mix is pasteurized and homogenized prior to adding any bulky ingredients. It is frozen after bulky ingredients are added.

(2) Custard. Custard is ice cream cooked to a custard before freezing. It contains a generous amount of eggs and has a rich color. Additional amounts of flavoring and coloring may be added.

(3) Parfait. This is a frozen custard with a high fat content.

(4) Ice milk. This is a product similar to ice cream except that it contains only 2 to 7 percent milkfat with 12 to 15 percent milk solids-not-fat. It is sweetened, flavored, and frozen to the consistency of ice cream.

(5) Ices. An ice is a product made of fruit juices, sugar, and stabilizers, with or without additional fruit acid, color, flavoring, or water, and frozen to the consistency of ice cream. It usually contains 28 to 30 percent sugar, 20 to 25 percent overrun (air introduced during the freezing process), and no dairy products.

(6) Sherbet. Sherbet is a product made of fruit juices, sugar, stabilizer, and milk products. It is similar to an ice, except milk, either whole, skim, condensed, or powdered, or ice cream mix, is used in place of all or of part of the water used in ices. Sherbet contains 1% to 2% milkfat.

(7) Novelties. A novelty ice cream or frozen confection is a specially shaped individual serving whose main appeal is its shape, size, color, or convenience for eating. Some novelty items are:

(a) Candy or chocolate-coated ice cream bars, with or without sticks, such as Eskimo pies.

(b) Candy or chocolate-coated ice milk bars, with or without sticks.

(c) Ice cream sandwiches.

(d) Popsicles and fudgesicles.

(8) Mellorine-type products. These are products similar to ice cream, but the milkfat is replaced with a suitable vegetable or animal fat.

1-32. ICE CREAM INGREDIENTS AND THEIR FUNCTION

a. **Milk and Milk Products.** Milkfat is the most important ingredient in ice cream. It contributes a characteristic richness and mellowness to produce a full, rich creamy flavor which ice cream should have. Milk solids-not-fat include such items as the solids of skim milk, protein, milk sugar, and mineral matter. They are high in food value, but they add very little to flavor except indirectly by improving the body and texture. The milk solids-not-fat increase the viscosity and resistance to melting and also lowers the freezing point.

b. **Sweetening Agents.** Sweeteners are the sugars used in the manufacture of frozen desserts. Their main function is to increase acceptance of the product, not only by making it sweeter but also by enhancing the pleasing creamy flavor and the desirable fruit flavors. Sugars increase the viscosity and the total solids concentration of the milk, which improves the body and texture of the finished product. Sugar lowers the freezing point of the mix that results in slower freezing and requires a lower temperature for proper hardening. Common sweeteners are cane and beet sugar and corn sugar or
corn syrup.

c. **Flavoring.** Flavor is an important characteristic of frozen desserts and the primary purpose of flavoring is to provide variety, assortment, and increase acceptance. Flavoring is the result of blending the flavors of all ingredients so that the intensity of the flavor is only strong enough to be easily recognized and delicately pleasing to the taste.

d. **Egg Yolks.** Egg yolks increase the whipping capability of ice cream and impart a characteristic flavor to the product. They also improve the body and texture of ice cream. The egg yolks used may be fresh, frozen, or dried.

e. **Coloring.** The coloring used in frozen desserts should have a delicate, attractive color which suggests or is readily associated with the corresponding flavor.

f. **Emulsifiers.** These are substances added to the frozen dessert mix to suspend the solids as minute globules. Emulsifiers are used in ice cream mainly to improve the whipping quality of the mix. They also aid in the production of a drier ice cream with a smoother body and texture.

g. **Stabilizers.** These are substances added to frozen dessert mix to hold the emulsion in suspension. Stabilizers are used to prevent the formation of objectionable, large ice crystals in the frozen dessert. Their primary function is to prevent a coarse texture in the product. Stabilizers are of animal origin or vegetable origin and they increase viscosity without affecting the freezing point of frozen desserts.

h. **Salt.** Table salt is not commonly used but may be used in small amounts in custards and other frozen desserts to improve the flavor.

i. **Water.** Water provides bulk, dissolves other ingredients, and acts as a dispersion medium for the other ingredients.

j. **Acids.** Acids are used only in ices and sherbets and cause the tart flavor in these products. Citric acid is most commonly used. Other acids are ascorbic, lactic, and phosphoric.

k. **Air (Overrun).** Another important ingredient of ice cream is air. Without the incorporation of air, the ice cream mix would freeze as a solid mass as hard as an ice cube. The addition of air into the mix is accomplished during the freezing process. This process, known as overrun, increases the volume of the product. The usual range of overrun is from 80 to 100 percent. Thus, 1 gallon of ice cream mix will make about 2 gallons of finished ice cream. To protect against excessive addition of air, Federal Specification EE-I-116 specifies the minimum weight for a gallon of ice cream. Ice cream with excessive overrun will not meet the minimum weight requirements. It will also lack body and will melt rapidly.

1-33. MANUFACTURE OF ICE CREAM

Steps in the manufacture of ice cream include receiving and storing the raw ingredients, combining and mixing the ingredients, pasteurizing the mix, homogenizing the mix, cooling the mix, aging the mix, adding flavoring, freezing, adding bulk flavoring, packaging, hardening, and storing the end item product.

a. **Raw Ingredients.** The end item quality is dependent upon the raw ingredients used for manufacture. They must be selected, handled, and stored in such a manner so as to produce a high quality product.

b. **Mix Preparation.** Ingredients are assembled and mixed in a vat. A vat pasteurizer is often used for this purpose. Liquid ingredients are added to the vat first followed by the addition of the dry ingredients. When frozen ingredients are used, they must be thawed prior to their being added to the mix. Bulk flavorings are not added at this time; they are added at the time of freezing.

c. **Pasteurization of Mix.** The same equipment and methods used to pasteurize other fresh dairy products (milk) are used here, but higher pasteurization temperatures are required because of the density of the mix. In the vat method, a temperature of 155°F (68°C) is maintained for 30 minutes. In the HTST method, the temperature is 175°F (79°C) for 25 seconds.

d. **Homogenization.** This step is necessary to disperse the fat and solids to produce a smoother mix, to make whipping easier, and to prevent churning of the fat in the freezer. This is most efficiently done after pasteurization while the mix is hot.

e. **Cooling.** After homogenization, the mix is cooled in a vat or continuously by means of a surface cooler or plate cooler to 32° to 40°F (0° to 4°C). Low temperature retards bacterial growth.

f. **Aging.** At one time, it was a common practice to age the pasteurized, homogenized mixture for 4 to 24 hours prior to freezing. This procedure aided in freezing and gave the ice cream a better body and texture. However, the modern methods of using stabilizers and emulsifiers together with the addition of solids-not-fat have made long aging periods unnecessary.

g. **Freezing.** Freezing is the process of converting the liquid mix into a semisolid, frozen, crystalline form. The process includes the incorporation of air into the product: called overrun. Bulk flavors, fruit, and nuts are added during the freezing process. The internal temperature of the ice cream is reduced to 21° to 25°F (-6° to -4°C).

h. **Packaging.** The ice cream may be packaged in bulk directly from the freezer or it may be packaged in various styles of containers by means of special packaging machines. The net weight of one gallon of ice cream must be at least 4.5 pounds.

i. **Hardening and Storing.** Hardening is a continuation of freezing. It may be accomplished in a hardening tunnel or in a room with temperatures of -20°F (-29°C) or lower. Ice cream may be stored for relatively long periods at -10° to-20°F (-23° to -29°C).

1-34. TYPES OF ICE CREAM

There are 10 types of frozen desserts according to Federal Specification EE-I-116. Most types are subdivided by grade or by class. Although the types are listed below, the discussion is directed primarily toward regular vanilla ice cream.

a. Type I--Ice cream, regular, vanilla.
Grade 1--General, 10.0 percent fat (minimum).
Grade 2--Premium, 14.0 percent fat (min).
Grade 3--Intermediate, 12.0 percent fat (min).

b. Type II--Ice cream, regular, chocolate, fruit, nuts or other bulky flavors.
Grade 1--General, 8.0 percent fat (min).
Grade 2--Premium, 12.0 percent fat (min).
Grade 3--Intermediate, 10.0 percent fat (min).

c. Type III--Ice milk, regular.

d. Type IV--Sherbet, regular.

e. Type V--Water ice.

f. Type VI--Novelties.
Class 1--Coated ice cream bar.
Class 2--Ice bar confection.
Class 3--Sherbet/ice cream bar confection.
Class 4--Frozen fudge bar confection.
Class 5--Ice cream sandwich.
Class 6--Ice cream cone (preformed).

g. Type VII--Mellorine and mellorine types, vanilla.
Class 1--General, 10.0 percent fat (min).
Class 2--Premium, 14.0 percent fat (min).
Class 3--Intermediate, 12.0 percent fat (min).

h. Type VIII--Mellorine and mellorine types, chocolate, fruit, nuts, or other bulky flavors.
Class 1--General, 8.0 percent fat (min).
Class 2--Premium, 12.0 percent fat (min).
Class 3--Intermediate, 10.0 percent fat (min).

i. Type IX--Ice milk, mellorine, and mellorine types.

j. Type X--Sherbet, mellorine, and mellorine types.

1-35. STYLES OF ICE CREAM

The product will be delivered as specified. The applicable styles in the size and kind of containers are as follows:

a. **Bulk**--1 gallon, 2 1/2 gallon, 3 gallon, or 5 gallon.

(1) Multiple-service containers.

(2) Single-service containers.

b. **Cartons**--solid pack, fiber, or plastic.

(1) Pint.

(2) Quart.

(3) Half-gallon.

(4) Gallon.

c. **Slices**--6 or 8 slices per quart, each slice individually encircled with parchment.

d. **Molded Individual Portions (Bars) or Filled Individual Cups**--2, 2 1/2, 3, 3 1/2, 4, or 5 fluid ounces, each individually wrapped in paper or foil or contained in a carton or cup.

e. **Other Styles**--molded bars, cones with sealed cap (preformed), and sandwiches, each individually wrapped in paper or foil.

Section IV. MANUFACTURED DAIRY PRODUCTS

1-36. MANUFACTURED DAIRY PRODUCTS

a. For military purposes, manufactured dairy products include cheese, processed cheese, butter, dried milk, dried skim milk, dried whey, dried buttermilk solids, evaporated milk, condensed milk, milk fat, stabilized milk and cream, sterilized dairy drink, and all other dairy foods which do not fall into fresh dairy products and frozen desserts category.

b. Definitions of some of these manufactured dairy products are given below.

(1) Butter. This is a product made exclusively from cow's milk or cream. It is churned, or processed so that the fat globules break away from the fluid in the milk. The butter must contain not less that 80 percent milkfat, may have common salt added, and may or may not have color added. Unsalted butter (commonly called sweet butter) is used primarily for cooking and as an ingredient in commercial food manufacturing.

(2) Cheese. This is dairy food made from the curd (coagulated portion) of milk. It is classified as natural or processed.

(a) Natural cheese. Natural cheese is made by coagulating milk through the use of a starter to produce lactic acid, then eliminating the liquid portion by cooking, draining, and washing the curd. After the whey is removed, the curd is consolidated and packaged.

(b) Processed cheese. Processed cheese is manufactured by grinding, mixing, and heating one or more types of natural cheese and an emulsifying agent into a homogeneous mass. Acidifying agents, cream, water, salt, and artificial coloring may also be added.

(3) Plain condensed milk. This is whole or skim milk from which a portion of the water has been removed under vacuum.

(4) Sweetened condensed milk. Essentially, this is plain condensed milk, to which sugar has been added.

(5) Evaporated milk. Essentially, this is he same as plain condensed milk, except that it is sterilized with heat.

(6) Dry milk (powdered milk). This is milk from which a major portion of the moisture has been removed. In contrast to fresh whole milk with approximately 87 percent moisture and evaporated milk with approximately 74 percent, dry milk normally has less than 2.5 percent moisture.

1-37. INTRODUCTION TO BUTTER

The military purchases many forms of dairy products in addition to milk. One of these is butter. Butter is generally marketed wholesale according to its score or grade. These scores or grades are given to the butter by competent judges who make detailed sensory evaluations of the product. Although demands for flavor, body, texture, degree of saltiness, shades of color, and kinds of packaging may vary in different sections of the country, the basis for evaluating, scoring, and judging butter remains fairly uniform from one section to another. Because butter is a relatively expensive dairy product, knowledge of what constitutes good quality is important to assure that the Government gets proper value for the money it spends on this product.

1-38. BUTTER

Butter is made from milk and cream, with or without common salt, with or without coloring matter, and contains not less than 80 percent by weight of butterfat. Cream used in making butter is separated from milk produced by healthy cows.

a. **Pasteurizing.** The cream is pasteurized at a temperature of not less than 165°F (74°C) and held continuously in a vat at such temperature for not less than 30 minutes; or pasteurized at a temperature of not less than 185°F (85°C) for not less than 15 seconds. Proper agitation of the cream during pasteurization is important. The

cream is heated to a higher temperature than is whole milk because the cream has a high milkfat content, 32 to 40 percent.

b. **Starter**. After pasteurization of the cream, it is cooled and placed in storage tanks until it is to be churned. Since high-quality cream may produce a butter with a flat taste, the cream may be aged or ripened. This is a delicate operation since the amount of culture and length of time required for culturing must be exact for proper ripening. The usual procedure is to place the cream in a vat-type pasteurizer and heat it to about 70°F (21°C) which is the incubation temperature of the culture or starter. A culture of desirable organisms known as a starter is added to the cream and the cream is gently agitated to assure even distribution of the organisms. The starter used is normally a strain of Streptococcus lactis. The cream is incubated for 4 to 5 hours prior to churning. The cream is brought to a temperature of 46° to 48°F (8° to 9°C) in summer and 54° to 56°F (12° to 13°C) in winter before it is put into the churn.

c. **Churning.** Churns can be classified according to the materials used in their construction; that is, metal churns or wooden churns. The purpose of churning is to convert the fat-in-skim milk emulsion to a water-in-fat suspension. This is accomplished by agitating the cream to form large fat globules and finally large masses of butter. Churning usually requires 30 to 45 minutes. An accepted theory of churning is that agitation of the cream causes the fat globules to strike one another and adhere. As the agitation continues, the fat globules become larger and larger and the natural buttermilk is gradually set free until the fat and serum portion of the cream are completely separated. After the butter has formed in the churn, the buttermilk is removed.

d. **Washing.** After the buttermilk has been drawn off, the butter in the churn is washed with potable water to remove any remnants of buttermilk which adhere to the butterfat, to control the body and texture of the butter, and to aid in controlling the composition of the butter. The amount of water added to the churn should equal the volume of buttermilk withdrawn. The temperature of the water should be 2° to 4°F lower than that of the buttermilk drawn off.

e. **Salting and Working.** Salt is added to the butter just before working. Sweet butter is butter with no salt added. Also, a certified coloring may be added to the butter to maintain a constant color throughout the year and to satisfy the market demand. The butter is worked in order to evenly distribute the salt and butter coloring that may have been added, to produce a more compact mass of butterfat, and to expel excess buttermilk and water. Working is accomplished within the churn by the action of rolls or baffels which pick up the butter and drop it to the bottom of the churn.

f. **Printing and Packing.** After the butter has been worked, it is removed from the churn, placed in bulk containers, and put in storage at 40°F (4°C) or less to harden prior to printing. Butter may be printed in the plant where it was churned or shipped to another plant to be printed. The bulk butter, chilled or tempered to assure the necessary degree of firmness, is removed from its container and the bulk blocks cut into smaller blocks which can be placed in the hopper of the printing machine. In the printer,

the butter is forced out under pressure into the type prints desired: 1-pound prints, 1/4-pound prints, or patties. Patties may be in cuts of 48, 60, 72, or 90 per pound of butter. After printing, the butter is wrapped in parchment paper, waxed paper, or a commercial foil paper. It is then placed in master containers and normally stored with eggs or other dairy products. It is never stored with strong smelling cheeses, fruit, or vegetables. The storage temperature should be 35°F (2°C).

1-39. GRADING OF BUTTER

a. **Grades of Butter.** Grades of butter are based on the descriptions in the USDA document entitled, "US Standards for Grades of Butter." The grades are:

(1) U.S. Grade AA or U.S. score 93.

(2) U.S. Grade A or U.S. score 92.

(3) U.S. Grade B or U.S. score 90.

NOTE: The grades of butter purchased by the U.S. military are: Grade AA or U.S. score 93, Grade A or U.S. score 92, and Grade B or U.S. score 90.

b. **Four Grading Factors.** Butter is graded on the basis of four factors: flavor, body, color, and salt (if used). When grading butter, the first and most important characteristic to consider is flavor, followed by body, color, and then salt. When more than one flavor is present in butter, the flavor classification must be on the basis of the flavor that carries the lowest rating. (See figure 1-6.) Body, color, and salt characteristics are then noted and any defects are disrated in accordance with the established classification. (See figure 1-7.) The final US grade for the sample is then established in accordance with the flavor classification, subject to disratings for body, color, and salt. When the disratings for body, color, and salt exceed the permitted amount for any flavor classification, the final U.S. grade will be lowered accordingly. (See figure 1-5.)

Flavor Classification	Total disratings	U.S. grade
AA	1/2	A
AA	1	A
AA	1 1/2	B
A	1	B
B	1/2	B

Figure 1-5. Flavor Classification Permitted in Butter by Grade

	Flavor Classifications		
Identified flavors[1]	AA	A	B
Feed.....	S	D	P
Cooked (fine).....	D	---	---
Aged.....	---	S	D
Bitter.....	---	S	D
Coarse-acid.....	---	S	D
Flat.....	---	S	---
Smothered.....	---	S	D
Storage.....	---	S	D
Cooked (coarse).....	---	D	---
Lipase.....	---	---	S
Malty.....	---	---	S
Musty.....	---	---	S
Neutralizer.....	---	---	S
Scorched.....	---	---	S
Utersil.....	---	---	S
Weed.....	---	---	S
Whey.....	---	---	S
Woody.....	---	---	S
Old Cream.....	---	---	D

Figure 1-6. Classification of Flavor Characteristics of Butter.

Body			
	Disratings		
Characteristics	S	D	P
Crumbly.....	1/2	1	-
Gummy.....	1/2	1	-
Leaky.....	1/2	1	2
Mealy or grainy.....	1/2	1	-
Short.....	1/2	1	-
Weak.....	1/2	1	-
Sticky.....	1/2	1	-
Ragged boring.....	1	2	-
Color			
	Distratings		
Chararcteristics	S	D	P
Wavy.....	1/2	1	-
Mottled.....	1	2	-
Streaked.....	1	2	-
Color specks.....	1	2	-
Salt			
	Disratings		
Characteristics	S	D	P
Sharp.....	1/2	1	-
Gritty.....	1	2	-

Figure 1-7. Characteristics and disratings in body, color, and salt in butter.

1-40. INTRODUCTION TO CHEESE

a. **How Cheese Is Made.** Cheese is a dairy food product made from the curd of milk and it consists primarily of casein, butterfat, and moisture. Natural cheese is made by coagulating milk and then eliminating the whey (liquid portion) by means of cooking, draining, and washing the curd (solid portion). Coagulation is caused by lactic acid production resulting from the addition of a starter, with or without the addition of rennet. (Rennet contains a milk-coagulating enzyme found naturally in the stomach of calves.) Some cheeses are made from goat's milk. Process cheese is prepared from a blend of one or more types of natural cheese and an emulsifying agent. It is manufactured by grinding, mixing, and heating the mixture into a homogeneous mass along with the addition of such optional ingredients as cream, water, salt, spices, artificial coloring, and acidifying agents.

b. **A Legend About the Discovery of Cheese.** The history of cheese dates back thousands of years. According to legend, the first cheese was made by accident when an Arab merchant getting ready for a journey across the desert put his supply of milk in a pouch made from the stomach of a sheep. The pouch apparently was carelessly cleaned, if indeed it was cleaned at all, for when the Arab stopped for his evening meal he found the milk changed to what we know as curd and whey. The pouch containing the milk also must have contained rennet from the lining of the sheep's stomach and this, plus the heat of the desert, caused the curd in the milk to coagulate and the whey to separate. The merchant found that the curd satisfied his hunger and the whey satisfied his thirst. The taste of the curd probably improved each day of the journey.

c. **Popularity of Cheese.** Cheeses have proved to be delightful foods and have contributed variety and interest to our diets. Cheeses also are a source of nutrients and several cheeses today are considered to be a gourmet food. Americans are eating more cheese now than in the past. In 1990, Americans nibbled 24.5 pounds per capita as compared to 14.5 pounds per capita in 1974 and 10.6 pounds per capita in 1968. Current consumption has increased to more than three times what it was in 1954.

1-41. CLASSIFICATION OF CHEESE

The use of cheese as a food has spread throughout most of the world and each country has developed its own characteristic cheeses. There are now more than 800 varieties of natural cheeses listed in the USDA publication, "Cheese Varieties and Descriptions." This publication, in addition to listing the worldwide varieties of cheeses, provides descriptions of over 400 cheeses, many of which are similar in nature but different in name, depending upon where they were originally produced. There are about 18 distinct, basic varieties of natural cheeses.

a. **Four Categories.** We divide all cheeses into four major categories based on the moisture content of the finished product. The categories are: very hard, hard,

semisoft, and soft. They are depicted in figure 1-8, which names a few varieties as examples of the cheese category.

Categories	Examples	Percent of moisture (expressed in terms of "not more than")
Very Hard (grating)		
Ripened by bacteria	Parmesan	NMT 32
	Romano	NMT 34
Hard		
Ripened by bacteria (without eyes)	Cheddar	NMT 39
	Granular	NMT 39
	Colby	NMT 40
Ripened by bacteria (with eyes)	Swiss	NMT 41
Semisoft		
Ripened principally by bacteria	Brick	NMT 44
	Muenster	NMT 44
Ripened by bacteria and surface micro-organisms	Limburger	NMT 50
Ripened principally by blue mold in mold	Roquefort	NMT 45
Soft		
Ripened	Camembert	NMT 80
Unripened	Cottage cheese	NMT 80

Figure 1-8. Cheese categories.

b. **Very Hard.** Very hard cheeses have a low moisture content and therefore they can be kept almost indefinitely. These cheeses are usually made from skimmed or partly skimmed milk. They can easily be grated and are commonly used on salads, in soups, and with spaghetti and macaroni.

(1) Parmesan. Parmesan is the name of a group of very hard cheeses originating in Italy. It includes Parmigiano, Reggiano, Lodigiano, Lombardy, Emiliano, Veneto, and Begozza. Parmesan cheese is usually made from partially skimmed cow's milk. After manufacture, it is cured for about one year before being marketed.

(2) Romano. Romano cheese is a very hard cheese which may be made from the milk of a goat or a ewe. In the United States it is made from cow's milk. It is usually made round, about 10 inches in diameter and 6 inches thick, and weighs between 15 and 20 pounds. Manufacture of Romano cheese is similar to Parmesan cheese and after curing for about a year can be used as a grated cheese. It can be used as a table cheese after curing only 5 to 8 months.

c. **Hard.** Hard varieties of natural cheese contain a higher moisture content than very hard cheeses. Hard cheese may be eaten fresh or after it has been cured. If hard cheeses are made from unpasteurized milk, they must be cured at least 60 days at a temperature of not less than 35°F (2°C) before they can be marketed. "American" is a descriptive term used in the dairy industry to denote such hard cheeses as Cheddar, Colby, Granular, and Soaked Curd.

(1) Cheddar. Cheddar cheese, which originated in Somersetshire, England, and which is made from whole fresh milk, accounts for about 75 percent of all cheese manufactured in the United States. One step in the manufacture of Cheddar cheese is to mat the curd by stacking curd upon curd and allowing them to knit together. This process is called cheddaring. After the curd is cheddared, it is milled, salted, hooped, pressed, and ripened (cured) for varying periods of time.

(2) Granular (stirred) cheese. Granular or stirred curd cheeses are similar to Cheddar except the curd is not matted or milled. The curd is cut, stirred, and heated (as in Cheddar); then the curd is alternately stirred and drained. The curd is salted and continuously stirred until it is of the proper texture. It is then hooped and pressed like Cheddar cheese.

(3) Colby. Colby cheese is similar to Cheddar and Granular types. However, it has a softer body and more open texture than Cheddar. The steps in manufacturing are similar to Granular cheese. The one major difference is that cold water is added to the Colby cheese to cool the curd after part of the whey has been removed.

(4) Swiss. Swiss cheese is a hard cheese with characteristic gas holes or "eyes." Swiss cheese is usually made in "wheels" about 36 inches in diameter, 6 inches thick, and 185 to 210 pounds in weight. Several types of organisms are used in the starter with propionic acid-forming organisms responsible for the formation of the characteristic gas holes. After the milk has been inoculated with the starter, it is allowed to set about 30 minutes. The creamy layer on top is then pushed back and mixed with the curd at a later time. The curd is cut, forked, cooked, stirred, and dipped out of the kettle in a large cloth. The curd is then hooped and pressed. Special temperatures are used for curing to produce proper eye formation. The kettles used by the Swiss are usually made of copper because the cheesemakers in Switzerland consider copper necessary in the production of Swiss cheese. However, excellent Swiss cheese can be made in stainless steel kettles.

d. **Semisoft.** Semisoft cheeses have a higher moisture content and a softer and more elastic body than hard cheeses. Ripening of semisoft cheeses may be accomplished by the action of bacteria on the surface or by mold or bacteria on the interior of the cheese. Very distinct flavors and odors are associated with the semisoft cheeses.

(1) Brick. Brick cheese is a semisoft cheese which is ripened by bacteria and has a flavor between Cheddar and Limburger. The body of Brick cheese is softer than Cheddar and has an open texture with numerous round and irregular shaped eyes. After the curd is cooked only a portion of the whey is removed. When the curd is as firm as desired, the curd-whey mixture is dipped from the vat, placed into forms, and lightly pressed. The forms are removed the following day and the cheeses are salted and cured.

(2) Muenster. Muenster cheese is a semisoft, whole milk cheese, similar to Brick cheese in manufacture and finished product.

(3) Limburger. Limburger cheese is a semisoft, surface- ripened cheese with a characteristic strong aroma and flavor. During the curing process, yeasts first predominate on the surface. Later, they are replaced by bacteria, Brevibacterium linens, which produce a characteristic reddish-yellow pigment.

(4) Roquefort. Roquefort cheese is a semisoft, blue-veined cheese ripened by the action of blue mold, Penicillium roqueforti. True Roquefort is made only from ewe's milk in the Roquefort area in France. Bleu cheese is a Roquefort-type cheese made in the United States from cow's milk. A powder containing the mold spores is added to the curd as it is placed in the hoops. Sixty or more holes are punched into each cheese to provide air for growth of the mold.

e. **Soft.** Soft cheeses have a very high moisture content compared to the other natural cheeses. They may be consumed fresh or ripened. Normally, the keeping quality of soft cheeses is of short duration.

(1) Camembert. Camembert cheese is a soft, surface-ripened cheese native to Normandy, France. It may appear yellow and waxy, creamy, or almost fluid in consistency. The curd is placed in hoops as soon as it is firm enough to be handled. About 2 days later, the cheeses are removed from the hoops and salted. They may be inoculated with a culture of mold and bacteria. If made from pasteurized milk, Camembert is usually cured for about 3 weeks. If it is made from raw milk, it is cured at least 8 weeks.

(2) Cottage cheese. Cottage cheese is a soft, unripened cheese made from pasteurized skim milk.

(3) Cream cheese. Cream cheese is made from homogenized, pasteurized cream. It is a soft, uncured cheese which has a rich milk-like flavor.

1-42. MAKING CHEDDAR CHEESE

The manufacture of Cheddar cheese is the basis for manufacture of all cheeses. The various varieties of cheeses are created by adding or subtracting steps. Cheddar cheese in the United States is made from the milk of healthy cows. A brief description of the Cheddar cheese making process follows.

a. **Milk.** The milk used in the manufacture of Cheddar cheese determines the quality of the finished product. Raw or pasteurized milk may be used. When raw milk is used, the cheese must be aged at least 60 days at temperatures between 35°F and 50°F (2°C and 10°C).

b. **Additives.** After the cheese vat has been filled with milk, then the starter, color, calcium chloride, and rennet are added.

(1) Starter. The starter is a culture of bacteria which produces acid, usually lactic acid. The starter also produces desirable flavors and the acid prevents other bacteria from growing. It is added after the milk in the vat is brought to a temperature of about 88°F (31°C). The amount of starter added is usually less than one percent of the milk in the vat.

(2) Color. If color is added, it must be uniform throughout.

(3) Calcium chloride. Calcium chloride may be used to assist the rennin in forming the curd. The amount added shall not exceed 0.02 percent of the weight of the milk.

(4) Rennet. Rennet is a commercial preparation of the enzyme rennin and is added to coagulate the casein to form the curd. The amount added is usually between 2 to 4 ounces per 1,000 pounds of milk and is added 15 to 30 minutes after adding the starter.

c. **Setting.** Setting is the process of allowing the casein to coagulate and form curd. It normally takes about 25 to 30 minutes.

d. **Cutting the Curd.** The curd is cut into small cubes to facilitate the escape of whey. Cutting is done after the desired firmness is reached and the size of the cuts are uniform so that the drainage of whey will be uniform throughout the curd pieces.

e. **Cooking.** After the curd is cut, the curd and whey in the cheese vat are heated to a temperature of 102° to 105°F (39° to 41°C) for 30 to 45 minutes. The purposes of cooking are to firm the curd, assist in the escape of the whey, and increase the formation of acid. During the cooking process, the curd is stirred continuously to prevent matting.

f. **Ditching.** When the curd has reached the proper texture and the desired amount of acid has developed, the whey is removed from the vat by a process known as ditching. Ditching is done by drawing the curd to the sides of the vat and letting the whey drain down the center to an outlet.

g. **Matting and Cheddaring.** After the whey has been removed, the curd, which is about 6 to 8 inches deep along the sides of the vat, is allowed to mat together for 10 to 15 minutes. After proper matting, the curd is cut into slabs about 8 inches wide. These slabs are piled on one another, usually 4 slabs high, and the piles turned every 10 to 15 minutes. This piling increases the weight on the lower slabs, which forces more whey from the product. This process of piling the slabs on one another is called cheddaring, the distinctive process in making Cheddar cheese.

h. **Milling.** After cheddaring, the slabs of cheese are run through a machine called a mill which cuts the slabs into cubes about 1/2-inch in size. The purposes of milling are to permit the further escape of whey, permit the curd to cool more quickly, and provide more surface area for salting.

i. **Salting.** After the curd has been milled, it is spread over the bottom of the vat and forked until the cut surfaces have dried slightly. Salt is then spread over the curd in two or three applications. The amount of salt added varies, but it is usually about 2 1/2 pounds of salt per 1,000 pounds of milk.

j. Hooping and Pressing. After salting, the cheese cubes are ready to be pressed and formed. The hooping and pressing operation is the same for Cheddar cheese whether it is to be rindless or rinded and paraffin coated. Hooping is the placing of the curd in hoops or molds lined with cheese cloth. Pressing is done by forming the style or shape of the cheese under pressure. The pressure exerted may be up to 60 pounds per square inch for 14 to 16 hours.

k. **Curing.** Curing or aging is the process of holding the cheese for varying periods of time under controlled temperature and humidity. The temperature range is 35° to 50°F (2° to 10°C), and the humidity must not exceed 80 percent. Both rindless cheese and rinded and paraffin coated cheese are cured. Curing increases the acidity, improves the flavor, changes protein to a more soluble form, and changes the body of the cheese from a rubbery to a waxlike texture. The end item must contain no more than 39 % moisture. The total solids must have at least 50% fat. For example, if the cheese consists of 38% moisture and 62% solids, there must be a minimum of 31% fat. Cheese is aged to increase the acidity, which further breaks down the protein. The cheese increases in sharpness with age and this sharpness is due to the increase in acid content of the cheese.

1-43. CLASSES OF CHEDDAR CHEESE

Cheddar cheese will be of the following classes:

a. **Class 1**--Fresh or current (pasteurized, minimum age 30 days; unpasteurized, minimum age 60 days).

b. **Class 2**--Medium cured (minimum age 3 months).

c. **Class 3**--Cured or aged (minimum age 9 months).

1-44. STYLES OF CHEDDAR CHEESE

The Cheddar cheese will be of the following styles to include weight:

a. **Style a:** cheddars--70 to 78 pounds.

b. **Style b:** flats or twins--32 to 37 pounds.

c. **Style c:** daisies or triplets--20 to 25 pounds.

d. **Style d:** longhorns--11 to 13 pounds.

e. **Style e:** print loaves--5 pounds.

f. **Style f:** rindless cheese, Cheddar--may be in 80-pound block, 60-pound block, 40-pound block, 40-pound precut into two 20-pound loaves or four 10-pound loaves or eight 5-pound loaves, 20-pound loaf, or 10-pound loaf.

1-45. GRADING CHEDDAR CHEESE

a. **Grades of Cheese.** The military procures Cheddar cheese in Grade A quality or better, in accordance with US Standards of Grade for Cheddar Cheese. The USDA grades cheese in these four grades: Grade AA, Grade A, Grade B, and Grade C.

b. **Quality Factors.** Cheddar cheese is graded on the basis of quality factors contained in the United States Standards for Grades of Cheddar Cheese. The four quality factors established are: flavor, body and texture, color, and finish and appearance.

c. **Rating Required for Each Quality Factor.** Cheddar cheese is graded, according to the degree of curing, on the basis of flavor, body and texture, color, and finish and appearance. (For example, a flavor characteristic is assigned in accordance with the corresponding age of the cheese.) The rating of each quality factor is

established on the basis of characteristics present in any vat of cheese. The final U.S. Grade is established on the basis of the lowest rating of any one of the quality factors.

d. **Establishing a Grade.** When establishing a grade for Cheddar cheese, all grading factors must be considered, since no cheese can be graded higher than its lowest quality factor.

Example:
Flavor..... Grade A
Body and Texture.....Grade AA
Color.....Grade B
Finish and Appearance.....Grade A

Final U.S. Grade.....Grade B

e. **Example of Grading.** An example of grading is: a sample of Cheddar cheese 100 days old (this classifies it as medium cured). It has a slight feed flavor (this classifies the sample as tentative Grade A). The body and texture are slightly curdy (this classifies the sample as Grade A). The color is normal for a classification of Grade AA. The finish and appearance are excellent for a classification of Grade AA. The final grade assigned to this Cheddar cheese is U.S. Grade A. The military does not procure U.S. Grade C.

f. **Detailed Quality Factors.** The quality factors for US Grade A of Cheddar cheese, according to U.S. Standards for Grades of Cheddar Cheese, are provided in figures 1-9 and 1-10. U.S. Grade AA is, of course, a little better and U.S. Grade B a little poorer than the factors specified.

1-46. EVAPORATED MILK

a. **Definition.** Evaporated milk is a concentrated homogenized dairy product resulting from the removal of a portion of water to a point that the finished product contains not less than 7.9 percent milkfat and not less than 25.9 percent total milk solids. It is the most widely used concentrated milk. Evaporated milk is essentially the same as plain condensed milk except that it is sterilized with heat.

b. **Processing and Use.** The characteristic venthole can is used to package evaporated milk. After the milk is canned, the cans are placed in a sterilizer and heated under pressure to a temperature between 235° and 245°F (113° to 118°C) for approximately 15 minutes. After sterilization, the product is cooled to approximately 90°F (32°C), coded, labeled, and packed. Evaporated milk is used for cooking purposes, as a substitute for fresh milk and cream, as coffee cream, and as a resale item in commissaries for use as baby food and other household needs.

c. **Two Common Defects.** Defects will occasionally develop during the storage of evaporated milk. Two of the most common are fat separation and salt separation. Fat separation may be caused by improper homogenization and excessive heat during

the sterilization process. Salt precipitation, which appears as a crystalline or gritty deposit on the side of the can, usually results from extended storage without inverting the cans. To prevent salt precipitation, it is recommended that the cans be turned (inverted) at monthly intervals and that the storage temperature be maintained between 32° and 72°F (0° and 22°C).

d. **Other Defects.** Other defects that may be found in evaporated milk are: bacterial spoilage indicated by coagulation, gas formation, and bitterness; bulging of cans from hydrogen swells or filling cans with cold milk; and protein precipitation appearing as sludge in the bottom of the can, usually resulting from long term storage. Defects may also be caused by improper stabilization.

1-47. DRIED MILK PRODUCTS

a. **Two Common Products.** Dry milk (powdered milk) is milk from which a major portion of the moisture has been removed. The two most commonly recognized dry milk products are dry whole milk and nonfat dry milk. Dry whole milk has only the water removed, while nonfat dry milk has both the water and butterfat (milkfat) removed. The butterfat of the finished dry whole milk product, regardless of the drying process used, is approximately 26 percent. Nonfat dry milk should have 1.25 percent or less milkfat in the finished product.

b. **Moisture Content of Dry Whole Milk.** Dry whole milk manufactured for the military services must be processed in accordance with USDA Standards for Grades of Dry Whole Milk. The atmospheric roller process and the spray process are two methods of processing dry whole milk. With the atmospheric roller process, the moisture is reduced to approximately 4.0 percent. When the spray process is used, the moisture content is reduced to approximately 2.25 percent.

c. **Shelf Life of Dried Milk.** Dry whole milk has a much shorter shelf life than nonfat dry milk due to its relatively high fat content. This makes it very susceptible to oxidative rancidity and the development of oxidized and/or tallowy flavors. The shelf life of dry whole milk can be extended by reducing its moisture content to less than 3.5 percent, packaging it in hermetically sealed containers, and storing it under refrigerated conditions. Nonfat dry milk, on the other hand, has a relatively long shelf life without the need for special packaging or refrigeration, and, as a result, is used much more extensively by the military.

Fresh or current	Medium cured	Cured or aged
(a) *Flavor:* Shall possess a pleasing flavor. May be lacking in flavor development or may possess slight characteristic cheddar cheese flavor. May possess very slight acid, slight feed but shall not possess any undesirable flavors and odors.	Shall possess a pleasing characteristics cheddar cheese flavor and aroma. May possess a very slight bitter flavor and the following flavors to a slight degree: feed and acid.	Shall possess a pleasing characteristics cheddar cheese flavor and aroma with moderate to well developed degrees of flavor or sharpness. May possess the following flavors to a slight degree: bitter, feed, and acid.
(b) *Body and texture:* A plug drawn from the cheese shall be firm, appear smooth, compact, close and should be slighty translucent but may have a few mechanical openings if not large and connecting. May possess not more than two sweet holes per plug but shall be free from other gas holes. May be definitely curdy or partially broken down if nmore than 8 weeks old.	A plug drawn from the cheese shall be reasonably firm, appear reasonably smooth, waxy, fairly close and translucent but may have a few mechanical openings if not large and con- necting. may be slightly curdy or not entirely broken down. may possess not more than two sweet holes per plug but shall be free from other gas holes. May possess the following other characteritiscs to a slight degree: mealy, short and weak.	A plug drawn from the cheese should be fairly firm, appear smooth, waxy, fairly close and translucent but may have a few mechanical openings. Should be free from curdiness. May possess not more than two sweet holes per plug but shall be free from other gas holes. May possess the following other characteristics to a slight degree: crumbly, mealy, short, weak and pasty.
(c) *Color:* Shall have a fairly uniform, bright attractive appearance. May have slight white lines or seams or be very slightly wavy. May be colored or uncolored but if colored, it should be a medium yellow orange.	Shall have a uniform, bright attractive appearance. May have slight white lines or seams. May be colored or uncolored but if colored, it should be a medium yellow orange.	Shall have a uniform, bright attractive appearance. May have slight white lines or seams and numerous tiny white specks. May be colored or uncolored, but if colored, it should be a medium yellow orange.
(d) *Finish and appearance: Bandaged and paraffin dipped.* Shall possess a sound, firm rind with the bandage and paraffin coating adhering tightly but may possess the following characteristics to a very slight degree: soiled surface and surface mold; and to a slight degree: rough surface, irregular bandaging, lopsided and high edges.	*Bandaged and paraffin dipped.* Shall possess a sound, firm rind with the bandage and paraffin coating adhering tightly but may possess very slight mold under bandage and paraffin and the following other characteritics to a slight degree: soiled surface, surface mold, rough surface, irregular bandaging, lopsided and high edges.	*Bandaged and parafiin dipped.* Shall possess a sound, firm rind with the bandage and paraffin coating adhering tightly but may possess the following characteristics to a slight degree: soiled surface, rough surface, mold under bandage and paraffin, irregular bandaging, lopsided and high edges; and surface mold to a definite degree.

Fresh or current	Medium cured	Cured or aged
Rindless. The wrapper or covering shall be practically smooth, properly sealed with adequate overlapping at the seams or by an other satisfactory type of closure. The wrapper or covering shall be neat and adequately and securely envelop the cheese. May be slightly wrinkled but shall be of such character as to fully protect the surface of the cheese and not detract from the initial quality. Shall be free from mold under the wrapper or covering and shall not be huffed but may be slightly lopsided.	*Rindless.* Same as for current, except very slight mold under wrapper or covering permitted.	*Rindless.* Same as for medium.

Figure 1-9. Detailed quality factors for US Grade A Cheddar cheese.

Identification of flavor characteristics	AA			A			B			C		
	Fresh or current	Medium cured	Cured or aged	Fresh or current	Medium cured	Cured or aged	Fresh or current	Medium cured	Cured or aged	Fresh or current	Medium cured	Cured or aged
Feed	VS	VS	VS	S	S	S	D	D	D	P	P	P
Acid	---	---	---	VS	S	S	S	D	D	D	P	P
Flat	---	---	---	---	---	---	S	S	S	D	D	D
Bitter	---	---	---	---	VS	S	S	D	D	D	P	P
Fruity	---	---	---	---	---	---	S	D	D	D	P	P
Utensil	---	---	---	---	---	---	S	D	D	D	P	P
Metallic	---	---	---	---	---	---	---	---	---	S	D	D
Sour	---	---	---	---	---	---	---	---	---	S	D	D
Whey-Taint	---	---	---	---	---	---	S	D	D	D	P	P
Yeasty	---	---	---	---	---	---	S	S	S	D	D	D
Malty	---	---	---	---	---	---	S	S	S	D	D	D
Old Milk	---	---	---	---	---	---	S	S	S	D	D	D
Weedy	---	---	---	---	---	---	S	S	S	D	D	D
Onion	---	---	---	---	---	---	VS	VS	VS	S	S	S
Barny	---	---	---	---	---	---	S	S	S	D	D	D
Lipase	---	---	---	---	---	---	S	S	S	D	D	D
Sulfide	---	---	---	---	---	---	---	---	S	---	S	D

Figure 1-10. Classification of flavor according to degree of curing of Cheddar cheese.

Continue with Exercises

EXERCISES, LESSON 1

REQUIREMENT. The following exercises are to be answered by marking the lettered response that best answers the question, or by completing the incomplete statement, or by writing the answer in the space provided at the end of the question.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. What is milk? Milk is the _____ _____ obtained by the complete milking of one or more healthy cows, and is practically free from _____.

2. Colostrum is the lacteal secretion produced immediately before and after _____.

3. The chemical properties of milk (approximate composition) are as follow. Fill in the correct percentage.

   a. Water. ___ percent average.

   b. Milkfat. ___ percent average.

   c. Protein. ___ percent average.

   d. Lactose. ___ percent average.

   e. Solids-not-fat. ___ percent average.

   f. Minerals. ___ percent average.

4. Whole milk must contain not less than _____ percent milkfat and not less than _____ percent solids-not-fat.

5. Water is necessary in milk because it holds the constituents of milk in _____, _____, or _____.

6. Match the term in Column I to the description in Column II.

COLUMN I	COLUMN II
(1) ___ Cream.	a. A sugar found only in milk.
(2) ___ Skim milk.	b. The essential amino acids necessary for proper maintenance of the body.
(3) ___ Curds.	c. Calcium and phosphorus are the two most important of these in milk.
(4) ___ Whey.	d. Contains most of the milkfat or butterfat.
(5) ___ Lactose.	e. Contains most of the solids-not-fat.
(6) ___ Protein.	f. Contains most of the milkfat, casein, and fat-soluble vitamins.
(7) ___ Minerals.	g. Contains most of the water, lactose, and water-soluble vitamins.

7. Which of the following vitamins found in milk are fat-soluble?

a. Vitamin B_{12}.

b. Riboflavin and niacin.

c. Vitamin C.

d. Vitamin A.

8. Select the enzyme present in raw milk that causes milk to become rancid if not heat treated.

a. Phosphatase.

b. Lipase.

c. Amylase.

d. Lactase.

e. Lactose.

9. Select the enzyme that is destroyed by the same time and temperature required to pasteurize milk.

a. Phosphatase.

b. Lipase.

c. Amylase.

d. Lactase.

e. Lactose.

10. The freezing point of milk is _____ F (_____ C).

The _____ is the instrument used to determine the freezing point of milk.

11. Milk is sticky to the touch because of the presence of _____(milk sugar) and _____.

12. Is milk more viscous than water?

a. Yes.
b. No.

13. Match the disease transmitted from animal to man in Column I to the description in column II.

COLUMN I	COLUMN II
(1) ___ Tuberculosis.	a. A pneumonia-like disease caused by a rickettsial organism.
(2) ___ Brucellosis.	b. An infection of the cow's udder.
(3) ___ Salmonellosis.	c. The causative organism is the most heat-resistant nonspore-forming pathogenic bacteria.
(4) ___ Q fever.	d. Called undulant fever in man and contagious abortion in cattle.
(5) ___ Mastitis.	e. Three clinically distinguishable forms occur in man.

14. Factors in the control of milkborne diseases are:

a. Healthy cows.

b. Healthy _____.

c. _____.

d. Refrigeration.

e. _____ _____.

15. The three classes of dairy products are:

a. _____ dairy products.

b. _____ desserts.

c. _____ dairy products.

16. Fresh dairy products are described in Part II, Section I, paragraph N of the Grade A _____ ____ _____, which is issued by the U. S. _____ _____ _____.

17. Whole milk must contain not less than:

a. _____ percent milkfat.

b. _____ percent milk solids-not-fat.

18. Which of the following is lowfat milk to which a flavor and/or sweetener has been added?

a. Flavored milk.

b. Flavored drink.

c. Reconstituted milk.

d. Buttermilk.

19. Match the fluid dairy product in Column I to the percentage requirement for milkfat in Column II.

COLUMN I	COLUMN II
(1) ___ Half-and-half.	a. 0.5 to 2 percent.
(2) ___ Light cream.	b. Less than 0.5 percent.
(3) ___ Heavy cream.	c. 10.5 percent.
(4) ___ Lowfat milk.	d. 18 percent.
(5) ___ Skim milk.	e. 36 percent.

20. Match the fluid dairy product in Column I to the description in Column II.

COLUMN I	COLUMN II
(1) ___ Filled milk.	a. Product with a portion of the product removed under vacuum.
(2) ___ Reconstituted milk.	b. Whole milk dried, rehydrated with water.
(3) ___ Recombined milk.	c. Skim milk dried, rehydrated with water.
(4) ___ Concentrated milk.	d. Dry product, rehydrated; milkfat replaced by vegetable fat.

21. How a cultured dairy product is labeled depends on the starter. Write in the correct product label.

STARTER	LABELED
a. Acidifying ingredient	_____
b. Microbial organisms	_____

22. Which of the following fresh dairy products results from the manufacture of butter from cream or milk?

a. Sour cream.

b. Cultured buttermilk.

c. Buttermilk.

23. A separate facility where milk is cooled, handled, and stored prior to shipment is called a:

a. Milkhouse.

b. Milkshed.

24. Milk delivered to the pasteurization plant within _____ hours after milking need not be cooled on the dairy farm.

a. 1.

b. 1 1/2.

c. 2.

d. 3.

e. 4.

25. Milk is normally delivered to the milk pasteurization plant by _____ _____ _____ and trailers.

26. Prior to being pasteurized, milk is stored in insulated storage tanks. These tanks vary in capacity from _____ to _____ gallons.

27. Homogenizers reduce milkfat particles from an average diameter of ___ microns to ___ microns.

28. Match the process in Column I to the description in Column II.

COLUMN I	COLUMN II
(1) ___ Homogenization.	a. Removing foreign materials and heavy sediment by mechanical means.
(2) ___ Separation.	b. Raising or lowering the percentage of milkfat in milk or cream.
(3) ___ Standardization.	c. Removing the cream from whole milk, leaving skim milk.
(4) ___ Clarification.	d. Fat globules are reduced in size, and evenly dispersed throughout the milk.

29. Match the type of pasteurizer in Column I to the corresponding time and temperature combination in Column II.

COLUMN I	COLUMN II
(1) ___ Vat or batch.	a. 191°-212°F; 1 to .01 sec.
(2) ___ HTST.	b. 280°-302°F; 2 to 5 sec.
(3) ___ HHST.	c. 145°F; 30 min.
(4) ___ Aseptically processed.	d. 161°F; 15 sec.

30. Which pasteurizer is primarily used in small dairy plants or for processing specialty products?

a. Aseptically processed.

b. HHST.

c. HTST.

d. Vat or batch.

31. Complete the following statements related to the sequence of steps in the HTST pasteurization process.

a. Another name for the balance tank or float tank is the _____ _____ _____ tank.

b. In the regenerator (heat exchange system), the temperature of the raw milk is heated to _____ .

c. The positive displacement _____ _____ regulates the flow of milk from the regenerator through the rest of the pasteurization system.

d. The _____ heater elevates the temperature of the milk to a minimum of _____ .

e. The _____ _____ section holds every particle of milk for at least ___ seconds at or above the temperature of ____.

f. Inadequately heated milk can be diverted back into the raw milk balance tank by the _____ _____ valve.

g. Back in the regenerator, the pasteurized milk is cooled to _____.

h. In the _____ section, a coolant reduces the temperature to _____ or below.

i. The cold pasteurized milk passes to a _____ ____ to await packaging.

32. Which of the following is a shelf stable product?

a. HHST pasteurized.

b. Ultra-pasteurized.

c. Aseptically processed and packaged.

33. Which of the following cartons has a "steeple" at the top?

a. Tetra Pak.

b. Pure Pak.

c. Seal King.

d. Canco.

34. Can polyethylene jugs be used more than once?

a. Yes.

b. No.

35. What are the two types of containers used to hold bulk milk?

a. _____ containers.

b. _____ containers.

36. Select the bulk milk container that is suitable for reuse and is usually its own shipping container.

a. Single-service shipping container.

b. Single-service dispenser container.

c. Multiple-service shipping container.

d. Multiple-service dispenser container.

37. Is it common practice in the dairy industry to reuse bulk milk delivery tubes (or pipes) after they been thoroughly cleaned and sanitized by an approved bactericidal process?

a. Yes.

b. No.

38. Match the test for wholesomeness in Column I to its description in Column II.

COLUMN I	COLUMN II
(1) ___ Yeast and mold counts.	a. Samples tested day 1, day 5, day 7; objective measure of a plant's performance.
(2) ___ Phosphatase test.	b. Plate incubates for 48 hours; total number of bacteria indicated.
(3) ___ Coliform test.	c. Plate incubates for 5 days; indicates contamination after pasteurization.
(4) ___ Keeping quality testing.	d. Tests for presence of enzyme; determines efficiency of pasteurization.
(5) ___ Standard plate count (SPC).	e. Plate incubates for 24 hours; indicates contamination after pasteurization.

39. Which of the following tests for wholesomeness uses nutrient agar?

a. Yeast and mold counts.

b. Coliform test.

c. Standard plate count (SPC).

40. In which of the following tests for wholesomeness are the plates incubated at 90°F for 24 hours?

a. Standard plate count (SPC).

b. Coliform test.

c. Yeast and mold counts.

41. The bacterial limit for Grade A raw milk (for pasteurization) from the individual producer must not exceed _____ per milliliter.

a. 100,000.

b. 300,000.

42. What are the standards for Grade A pasteurized milk?

a. Bacterial limits. Not to exceed _____ per milliliter.

b. Bacterial limit for aseptically processed milk. _____ bacterial growth.

c. Coliform limits. Not to exceed _____ per milliliter.

d. Temperature. Must be cooled to ____ F (____ C) or less and maintained thereat.

43. Select the starter culture that produces lactic acid that is active at room temperature:

a. Steptococcus cremoris.

b. Propionibacterium shermanii.

c. Streptococcus thermophilus.

44. For a combination of acidity, flavor, and aroma, the starter culture should contain:

a. Lactobacillus bulgaricus.

b. Streptococcus lactis.

c. Streptococcus citrovorum.

d. Propionibacterium shermanii.

45. Which of the following fresh cultured products contains not less than 0.20% acidity expressed as lactic acid?

a. Yogurt.

b. Sour cream.

c. Cultured buttermilk.

d. Cottage cheese.

46. Complete the names of the separate cultures that are combined at the last minute when yogurt is being made.

a. Streptococcus _____.

b. Lactobacillus _____.

47. Steps in the manufacture of fresh cultured dairy products are in Column II. They are not listed in the order in which they are performed. In Column I, rearrange the steps in correct sequence.

COLUMN I	COLUMN II
(1) ___	a. Creaming and salting.
(2) ___	b. Packaging and storage or delivery.
(3) ___	c. Washing and cooling the curd.
(4) ___	d. Cooking the curd.
(5) ___	e. Breaking or cutting the curd.
(6) ___	f. Pasteurization and cooling of milk.
(7) ___	g. Inoculation and incubation of bacteria.

48. Complete the statements related to concentrated whole milk.

a. The product is homogenized _____ pasteurization.

b. The finished product contains at least _____ percent milkfat and _____ percent total solids.

c. The product is reconstituted by adding ___ quarts of water to 1 quart of the concentrated product.

d. The product is used for _____ purposes and as a substitute for _____.

49. Filled milk is commonly used overseas. Animal fat is replaced with vegetable fat. What vegetable fat is used?

_____ oil or _____ fat.

50. Match the frozen dessert listed in Column I to the description in Column II.

COLUMN I	COLUMN II
(1) ___ Custard.	a. Consists of fruit juices, sugar, stabilizer, and milk products.
(2) ___ Parfait.	b. Specially shaped individual serving, convenient for eating.
(3) ___ Ice milk.	c. Similar to ice cream; milkfat replaced with vegetable fat.
(4) ___ Ices.	d. Frozen custard with a high fat content.
(5) ___ Sherbet.	e. Similar to ice cream; less milkfat, more solids-not-fat.
(6) ___ Novelties.	f. Consists of fruit juices, sugar, stabilizer, and water; frozen to consistency of ice cream.
(7) ___ Mellorine-type products.	g. Contains a generous amount of eggs; cooked to a custard before freezing.

51. Match the ice cream ingredient in Column I to its function in Column II.

COLUMN I	COLUMN II
(1) ___ Sweetener.	a. Improves body and texture; increases viscosity and resistance to melting.
(2) ___ Flavoring.	b. Improves whipping quality; drier ice cream with smoother body/ texture.
(3) ___ Egg yolk.	c. Prevents large crystals; increase viscosity.
(4) ___ Coloring.	d. Enhances flavor; improves body and flavor; lowers the freezing point.
(5) ___ MSNF.	e. Provides variety, assortment, and increases acceptance.
(6) ___ Emulsifier.	f. Increases the whipping capability; improves body, texture, and flavor.
(7) ___ Stabilizer.	g. Suggests the corresponding flavor.

52. Which of the following frozen desserts contains 2 to 7% milkfat?

a. Sherbet.

b. Ice cream.

c. Mellorine.

d. Custard.

e. Ice milk.

53. Complete statements related to overrun (air) in ice cream.

a. The addition of air into the ice cream is accomplished during the _____ _____.

b. The usual range of overrun is from ___ to ____ percent.

c. One gallon of ice cream mix will make about ___ gallons of ice cream.

54. Complete statements related to the manufacture of ice cream.

a. Bulk _____, _____, and nuts are added during the freezing process, after pasteurization of the mix.

b. Overrun is accomplished when the internal temperature of ice cream is reduced to a range from ____ to _____ F.

c. The minimum weight requirement for ice cream is ____ pounds per gallon.

d. Ice cream may be stored for relatively long periods at a temperature of ____ to ____ F, which is ____ to ____ C.

55. What is the minimum percent fat for premium ice cream (Grade 2)?

a. 8%.

b. 10%.

c. 12%.

d. 14%.

56. What is the minimum percent fat for general ice cream (Grade 1) with chocolate, fruit, nuts, or other bulky flavors added?

a. 8%.

b. 10%.

c. 12%.

d. 14%.

57. A coated ice cream bar is listed in Federal Specification EE-I-116 as:

a. Type VIII, Class 1.

b. Type VII, Class 1.

c. Type VI, Class 1.

d. Type VI, Class 4.

e. Type VIII, Class 3.

58. Which of the following frozen desserts has the higher fat content?

a. Type VII, Class 3.

b. Type VIII, Class 2.

c. Type VI, Class 3.

d. Type VII, Class 2.

e. Type II, Class 2.

59. Which of the following frozen desserts has no dairy products in it?

a. Type IV.

b. Type V.

c Type VI.

d. Type III.

e. Type IX.

60. What is the largest bulk container of ice cream mentioned in the text?

a. 2 1/2 gallon container.

b. 3 gallon container.

c. 5 gallon container.

61. Ice cream slices have _____ slices per quart.

    a. 4 to 6.

    b. 6 to 8.

    c. 8 to 10

62. According to the text, ice cream slices are individually wrapped in:

    a. Parchment.

    b. Foil.

    c. Paper.

63. When butter is made, the cream is pasteurized at ____ and held for _____.

    a. 165°F; 30 minutes.

    b. 185°F; l5 seconds.

    c. 150°F; 30 minutes.

    d. 166°F; 15 seconds.

    e. Either "a" or "b" above.

64. Unsalted butter is called:

    a. Lowfat butter.

    b. Sweet butter.

    c. Commercial butter.

65. During the making of butter, what is the preferred incubation temperature when a starter is placed in the pasteurized cream?

a. 70°F.

b. 54°F.

c. 48°F.

66. Complete the following statements related to butter.

a. Butter must contain not less than ___ percent of butterfat by weight.

b. Streptococcus _____ is the starter normally used in making butter.

c. The pasteurized cream (with starter) must be ripened and incubated for ___ to ___ hours prior to churning.

d. Churning causes large _____ _____ to form. Finally, large _____ of butter are formed.

e. The _____ and _____ portion of the cream are completely separated.

f. The _____ is drawn off and the churn is washed with _____ water.

g. _____ is added to the churn, equal to the volume of buttermilk drawn off.

67. Complete additional statements related to the process of making butter.

a. The process of _____ evenly distributes salt and butter coloring that may have been added. It also produces a more compact mass.

b. _____ or _____ pick up the butter and drop it into the bottom of the _____.

c. Bulk butter, properly chilled, is placed in the hopper of the _____ machine.

d. There are __ pound prints, ___ pound prints, or _____.

e. Butter is wrapped in _____ paper, _____ paper, or a commercial _____ paper.

f. Butter is stored with _____ or with fresh dairy products.

68. The storage temperature for butter should be:

a. 30°F.

b. 32°F.

c. 35°F.

d. 40°F.

69. Butter that has been inspected receives a U.S. score of 89. Is it acceptable for military purchase?

a. Yes.

b. No.

70. List the four factors used in grading butter.

a. _____.

b. _____.

c. _____.

d. _____.

71. Butter that is being inspected has a pronounced feed flavor and a slight wild onion flavor. In addition, it is slightly grainy, definitely sharp, and slightly wavy. (See figures 1-5, 1-6, and 1-7.) With these factors in mind, what is its classification?

a. AA.

b. A.

c. B.

d. C.

72. Complete the following statements related to cheese.

a. Cheese is made from the curd of milk and it consists primarily of _____, _____, and _____.

b. _____ cheese is prepared from a _____ of one or more types of natural cheese and an _____ agent.

c. There are more than ____ varieties of _____ cheeses listed in the USDA publication, "Cheese Varieties and Descriptions."

d. There are about ___ distinct, basic varieties of natural cheeses.

73. Match the kind of cheese in Column I to the category of cheese classification in Column II.

COLUMN I	COLUMN II
(1) ___ Cottage cheese.	a. Very hard.
(2) ___ Colby.	b. Hard.
(3) ___ Muenster.	c. Semisoft.
(4) ___ Romano.	d. Soft.
(5) ___ Camembert.	
(6) ___ Parmesan.	
(7) ___ Bleu cheese.	
(8) ___ Swiss.	
(9) ___ Limburger.	
(10) ___ Cheddar.	

74. Select the cheese with a percent of moisture requirement of NMT 44%.

a. Camembert.

b. Swiss.

c. Colby.

d. Muenster.

75. Which cheese is cured for about a year before being marketed?

a. Bleu cheese.

b. Camembert.

c. Swiss.

d. Brick.

e. Parmesan.

76. Which cheese has cold water added to cool the curd after part of the whey has been removed?

a. Bleu cheese.

b. Colby.

c. Cottage cheese.

d. Brick.

e. Swiss.

77. Which cheese is usually made in "wheels" about 36 inches in diameter, 6 inches thick, and l85 to 210 pounds in weight?

a. Cheddar.

b. Romano.

c. Swiss.

d. Muenster.

e. Colby.

78. Which cheese is a Roquefort-type cheese made in the United States?

a. Bleu cheese.

b. Limburger.

c. Cream cheese.

d. Camembert.

e. Granular cheese.

79. Steps in the manufacture of Cheddar cheese are in Column II. They are not listed in the order in which they are accomplished. In Column I, re-arrange the steps in correct sequence.

COLUMN I	COLUMN II
(1) ___	a. Salting.
(2) ___	b. Hooping and pressing.
(3) ___	c. Curing.
(4) ___	d. Cooking.
(5) ___	e. Ditching.
(6) ___	f. Matting and cheddaring.
(7) ___	g. Milling.
(8) ___	h. Adding the additives.
(9) ___	i. Setting.
(10) ___	j. Cutting the curd.

80. Complete the following statements related to cheesemaking.

a. The starter for cheese is added after the milk in the cheese vat is brought to a temperature of about _____.

b. Calcium chloride and rennet are added to the milk to _____ the _____ so as to form the _____.

c. The process of forming the curd takes _____ minutes.

d. After the curd is cut and cooked, the whey is drained. Then, the curd is permitted to ____ _____ for a short time, about _____ minutes.

e. Slabs of curd are piled on one another, usually ___ slabs high, and the piles turned every _____ minutes. This process is called _____ .

81. Running slabs of cheese through a machine that cuts the product into 1/2 inch cubes is called:

a. Ditching.

b. Matting.

c. Cutting.

d. Milling.

e. Setting.

82. Placing prepared cheese cubes in molds lined with cheesecloth is called:

a. Setting.

b. Matting.

c. Hooping.

d. Cooking.

e. Curing.

83. Holding cheese at a temperature range of 35° to 50°F, with humidity of not more than 80 percent, is called:

a. Setting.

b. Cooking.

c. Matting.

d. Pressing.

e. Curing.

84. Complete the following statements related to aging cheese.

a. Cheese is aged to increase the _____ and improve the flavor. Cheese increases in _____ with age.

b. Aging, or curing, changes the body of the cheese from a rubbery to a _____ texture.

85. Fill in the blanks related to the 3 classes of Cheddar cheese.

a. Class 1. _____. Minimum age, pasteurized, ___ days; unpasteurized, ___ days

b. Class 2. _____. Minimum age, ___ months.

c. Class 3. _____. Minimum age, ___ months.

86. Match the style of Cheddar cheese in Column I to the description and weight range in Column II.

COLUMN I	COLUMN II
(1) ___ Style a.	a. Rindless cheese, 40 to 80 pound blocks or loaves of 5 to 20 pounds.
(2) ___ Style b.	b. Daisies or triplets, 20 to 25 pounds.
(3) ___ Style c.	c. Longhorns, 11 to 13 pounds.
(4) ___ Style d.	d. Print loaves, 5 pounds.
(5) ___ Style e.	e. Cheddars, 70 to 78 pounds.
(6) ___ Style f.	f. Flats or twins, 32 to 37 pounds.

87. The weight of style "a" Cheddar cheese is:

a. 20 to 25 pounds.

b. 32 to 37 pounds.

c. 60 pounds.

d. 70 to 78 pounds.

e. 80 pounds.

88. The weight of style "d" Cheddar cheese (longhorns) is:

a. 5 pounds.

b. 11 to 13 pounds.

c. 20 to 25 pounds.

d. 32 to 37 pounds.

89. List the quality factors for grading Cheddar cheese.

a. _____.

b. _____.

c. _____.

d. _____.

90. A plug from Grade A Cheddar cheese is slightly crumbly, mealy, short, weak, and pasty. It has a moderate degree of flavor or sharpness, and it has the following flavors to a slight degree: bitter, feed, and acid. The class is:

a. Class 1.

b. Class 2.

c. Class 3.

91. If the flavor of cheddar cheese is definitely acid and definitely bitter, what is the grade?

a. AA.

b. A.

c. B.

d. C.

92. Complete the following statements related to evaporated milk.

a. Evaporated milk contains not less than _____ percent milkfat and not less than _____ percent total milk solids.

b. Two common storage defects are ____ separation and ____ separation.

c. It is recommended that cans be inverted once every _____and that storage temperature be maintained between ___ and ___ F.

93. How much butterfat is there in:

a. Dry whole milk? _____ percent.

b. Nonfat dry milk? _____ percent.

94. When the spray process is used to prepare dry whole milk, what is the moisture content?

a. 1.25 percent.

b. 2.25 percent.

c. 3.5 percent.

d. 4.0 percent.

95. Which of the following products is used more extensively by the military services?

a. Nonfat dry milk.

b. Dry whole milk.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. Lacteal secretion, colostrum. (para 1-2a)

2. Calving. (para 1-2a)

3. a. 87.20.
   b. 3.70.
   c. 3.50.
   d. 4.90.
   e. 9.10.
   f. 0.70. (para 1-2a)

4. 3.25; 8.25 (para 1-2a)

5. Solution; suspension; emulsion (para 1-2b)

6. (1) d
   (2) e
   (3) f
   (4) g
   (5) a
   (6) b
   (7) c (para 1-2d,e)

7. d (para 1-2c(2))

8. b (para 1-4b)

9. a (para 1-4a)

10. 31.01°F; -0.55°C; cryoscope (para 1-5c)

11. lactose; casein (para 1-5d)

12. a (para 1-5e)

13. (1) c
    (2) d
    (3) e
    (4) a
    (5) b (para 1-6a)

14. b. employees
    c. Sanitation
    e. Thermal processing (para 1-7)

15. a. Fresh
    b. Frozen
    c. Manufactured (para 1-8b)

16. a. Pasteurized Milk Ordinance.
    b. Public Health Service. (para 1-9a)

17. a. 3.25
    b. 8.25 (para 1-10a(1))

18. b (para 1-10a(8))

19. (1) c
    (2) d
    (3) e
    (4) a
    (5) b (para 1-10a(2)-(6))

20. (1) d
    (2) c
    (3) b
    (4) a (para 1-10a(9)-(12))

21. a. Acidified
    b. Cultured (para 1-10b)

22. c (para 1-10c)

23. a (para 1-11b)

24. c (para 1-11b(1))

25. bulk tank trucks (para 1-12)

26. 100; 40,000 (para 1-12d)

27. 7; 1 1/2 (para 1-16)

28. (1) d
    (2) c
    (3) b
    (4) a (paras 1-13, 1-14, 1-15, 1-16)

29. (1) c
(2) d
(3) a
(4) b (para 1-17)

30. d (para 1-18)

31. a. constant level supply (para 1-19c)
b. 135°F (para 1-19d)
c. timing pump (para 1-19e)
d. final; 161°F (para 1-19g)
e. holding tube; 15; 161°F (para 1-19h)
f. flow diversion (para 1-19i)
g. 90°F (para 1-19j)
h. cooling; 40°F (para 1-19j)
i. storage tank (para 1-19j)

32. c (para 1-22)

33. b (figure 1-4)

34. b (para 1-24a(3))

35. a. Single-service
b. Multiple-service (para 1-24b)

36. c (para 1-24b(3))

37. b (para 1-24b(5))

38. (1) c
(2) d
(3) e
(4) a
(5) b (para 1-25)

39. c (para 1-25a(1))

40. b (para 1-25a(2))

41. a (para 1-26a(2))

42. a. 20,000
b. Zero or No
c. 10
d. 45°; 7° (para 1-26b)

43. a (para 1-27a)

44. c (para 1-27a)

45. b (para 1-27c(1))

46. a. thermophilus
b. bulgaricus (para 1-27c(3))

47. (1) f
(2) g
(3) e
(4) d
(5) c
(6) a
(7) b (para 1-27d)

48. a. before or after
b. 9.75; 34.50
c. 2
d. baking; cream (para 1-28)

49. coconut; soybean (para 1-29)

50. (1) g
(2) d
(3) e
(4) f
(5) a
(6) b
(7) c (para 1-31)

51. (1) d
(2) e
(3) f
(4) g
(5) c
(6) a
(7) b (para 1-32)

52. e (para 1-31b(4))

53. a. freezing process
b. 80 to 100
c. 2 (para 1-32k)

54. a. flavors, fruits
    b. 21° to 25°
    c. 4.5
    d. -10° to -20°; -23° to -29° (para 1-33g,h,i)

55. d (para 1-34a)

56. a (para 1-34b)

57. c (para 1-34f)

58. d (para 1-34g)

59. b (para 1-34e)

60. c (para 1-35a)

61. b (para 1-35b)

62. a (para 1-35c)

63. e (para 1-38a)

64. b (para 1-36b(1))

65. a (para 1-38b)

66. a. 80
    b. lactis
    c. 4 to 5
    d. fat globules; masses
    e. fat; serum
    f. buttermilk; potable
    g. Water (para 1-38b,c,d)

67. a. working
    b. rolls or baffels; churn
    c. printing
    d. 1; 1/4; patties
    e. parchment; waxed; foil
    f. eggs (para 1-38 e,f)

68. c (para 1-38f)

69. b (para 1-39a)

70. a. Flavor
b. Body
c. Color
d. Salt (para 1-39b)

71. d (figures 1-5, 1-6, 1-7)

72. a. casein; butterfat; moisture
b. Process; blend; emulsifying (para 1-40a)
c. 800; natural
d. 18 (para 1-41)

73. (1) d
(2) b
(3) c
(4) a
(5) d
(6) a
(7) c
(8) b
(9) c
(10) b (figure 1-8; para 1-41)

74. d (figure 1-8)

75. e (para 1-41b(1))

76. b (para 1-41c(3))

77. c (para 1-41c(4))

78. a (para 1-41d(4))

79. (1) h
(2) i
(3) j
(4) d
(5) e
(6) f
(7) g
(8) a
(9) b
(10) c (para 1-42)

80. a. 88°F
b. coagulate; casein; curd (para 1-42b)
c. 25 to 30 (para 1-42c)
d. mat together; 10 to 15
e. 4; 10 to 15; cheddaring (para 1-42g)

81. d (para 1-42h)

82. c (para 1-42j)

83. e (para 1-42k)

84. a. acidity; sharpness
b. waxlike (para 1-42k)

85. a. Fresh or current; 30; 60
b. Medium cured; 3
c. Cured or aged; 9 (para 1-43)

86. (1) e
(2) f
(3) b
(4) c
(5) d
(6) a (para 1-44)

87. d (para 1-44a)

88. b (para 1-44d)

89. a. Flavor
b. Body and texture
c. Color
d. Finish and appearance (para 1-45b)

90. c (figure 1-9)

91. c (figure 1-10)

92. a. 7.9; 25.9
b. fat; salt
c. month; 32° and 72° (para 1-47a)

93. a. 26
    b. 1.25 (para 1-47a)

94. b (para 1-47b)

95. a (para 1-47c)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Inspection of Dairy Products
TEXT ASSIGNMENT	Paragraphs 2-1 through 2-19.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

2-1. Identify dairy product inspection procedures and related terminology.

2-2. Identify specific examinations conducted to include checking the temperature and age of a product.

2-3. Identify the correct procedures for extracting samples from bulk containers.

2-4. Identify abnormalities of fresh dairy products, ice cream, and manufactured dairy products.

2-5. Identify keeping quality examination procedures for fresh dairy products.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

INSPECTION OF DAIRY PRODUCTS

Section I. INSPECTION PROCEDURES

2-1. TERMS AND DEFINITIONS

a. **Origin Inspector.** The origin inspector is provided by the veterinary food inspection activity that has responsibility for the geographical area in which the contractor's production facility is located.

b. **Destination Inspector.** The destination inspector is provided by the military food inspection activity (Army or Air Force) responsible for performing the inspection of food at the point of acceptance by the government.

c. **Characteristic.** A characteristic is any requirement, specified or referenced, or an adulterant, which may be evaluated by test or examination.

d. **Fresh and Cultured Dairy Products.** These dairy products are milk products as defined by the United States Public Health Service Pasteurized Milk Ordinance (USPHS-PMO), as amended. This includes cottage cheese, filled and imitation milk products, yogurt mix, and aseptically processed and packaged milk. See Lesson 1 for more detailed information.

e. **Frozen Desserts.** Frozen desserts are described in Lesson 1. They include ice cream, ice milk, sherbet, mellorine, water ice, ice cream mix, ice milk mix, milk shake mix, and other similar frozen desserts, including all frozen novelties.

f. **Testing for Quality.** Testing for quality refers to physical and chemical determinations that are performed. For example, fat content, amount of milk-solids-not-fat, total amount of solids, acidity, net weight (volume).

g. **Testing for Wholesomeness.** This type of testing refers to any specific test that may be required by the Pasteurized Milk Ordinance (PMO), the specification, or the contract. For example, standard plate count (SPC), coliform count (COLI), and yeast and mold counts.

h. **Type of Product.** Type of product refers to a specific product processed in one plant, regardless of the type or size of packaging. The number of contracts or the number of delivery points are not relevant to type of product.

i. **Line Item of Product.** This refers to a type of product that is a specific contract item, which is identified by number, package size, and unit price.

j. **Frequency of Examination.** This term is used in relation to each line item. Frequency of examination depends on the established reliability record (quality history).

k. **3-out-of-5 Concept.** This refers to an evaluation of the reliability of individual contractors based on sequential microbiological test results whereby a type of product is monitored for conformance to wholesomeness requirements and evaluated for enforcement actions.

l. **Imminent Health Hazard.** This warning phrase refers to a product or practice that creates or appears to create a significant threat of danger to health. In such instances, products can be rejected without waiting for the results of laboratory testing (which establishes a quality history record).

m. **Status.** Status refers to the current condition of a specific characteristic of a product, which is produced by a single contractor. It applies contractually to the results of laboratory testing. Status is designated by one of the following terms.

(1) Excellent.

(2) Notice (1 out of 4 laboratory testing failures).

(3) Warning (2 out of 4 laboratory testing failures).

(4) Suspension/Termination (3 out of 5 laboratory testing failures).

(5) Re-instatement.

n. **Inspection.** An inspection is a product examination that is conducted to determine compliance with contract requirements, with or without the aid of testing.

2-2. INSPECTION RESPONSIBILITY

a. **Origin Inspection.** The origin inspector is responsible for sanitary inspections (as applicable), wholesomeness testing of products, quality assurance visits, and maintenance of a quality history record for each production plant located within the assigned geographical location.

b. **Destination Inspection.** The destination inspector is responsible for examination of the product at time of delivery for those characteristics that are verified at destination. Additionally, upon request of the origin inspector, the destination inspector will submit samples of the product to the laboratory for wholesomeness testing and/or keeping quality testing.

c. **Destination Inspection Procedures/Responsibilities.** The paragraphs that follow provide general information concerning the responsibilities of destination inspectors and the procedures followed during product examination.

2-3. USE THE CORRECT CONTRACTUAL DOCUMENTS.

Inspectors must extract the subsistence item's inspection requirements from the agreement under which the products were purchased. The inspector will extract requirements such as the required internal temperature of the product at delivery, product age at delivery requirements, delivery vehicle physical and sanitary requirements, approved source listing requirements, and the required quantity or size. Every contract is different and the inspector must know what they are looking for before they begin their inspection.

a. For prime vendor deliveries, initially refer to the current Subsistence Prime Vendor Interpreter (SPVI) catalog to determine the applicable standard for the evaluation. If the SPVI does not provide required information, the inspector will have to utilize the Federal Supply Catalog Stock List or the Subsistence Prime Vendor Local Stock Number Catalog to find the product's characteristic requirements.

b. Deliveries to Defense Commissary Agency (DeCA) facilities will be inspected in accordance with the Joint Receipt Food Inspection Manual. Requirements for these inspections will be in the ROA, blanket purchase agreement, DSCP contract, or other purchasing tool.

c. Inspection requirements for products delivered to Army and Airforce Exchange Serivce (AAFES) facilities can be found in Exchange Service Regulation 1-2 (ESR 1-2).

d. When contractual requirements can not be obtained, notify your supervisor immediately and continue to inspect the product for characteristics associated with that product.

2-4. INSPECT THE CONVEYANCE OR STORAGE AREA, IF NECESSARY.

The inspector must determine the sanitary status of the delivery conveyance. Three primary characteristics must be considered. The conveyance is required to be clean, closed, and refrigerated.

a. **Clean.** The conveyance must be suitable: clean, free of objectionable odors, foreign materials, debris, and non-compatible items.

b. **Closed.** The conveyance must provide the subsistence items being transported with protection from the elements.

c. **Refrigerated.** The conveyance must be capable of maintaining required transit temperatures to assure that minimum temperature requirements are complied with at time of delivery into government stocks.

d. **Unsanitary.** If the vehicle is determined to be unsanitary, all of the deficiencies will be reported to the accountable officer and the section supervisor immediately.

2-5. SELECT THE SAMPLES IAW THE INSPECTION DATA PACKET.

Military food inspection personnel are required to select and test samples of subsistence, which represents a larger quantity that is being shipped or stored. The number of samples to select will be based on the lot size of the item being inspected. The lot size for dairy products will be expressed as the number of shipping containers. Strict random sampling is usually not required, but inspectors should insure they select their samples from throughout the lot to ensure that what they are examining represents the entire lot. During surveillance inspections, samples should be drawn so as to be representative of the lot, but special attention is paid to obtaining some of the sample units from possible areas of storage stress, such as along warehouse walls, near the ceiling, close to cooling coils and doors, etc.

a. Sample size for prime vendor inspections will be in accordance with local standing operating procedure.

b. Sample size for wholesale and retail activities (other than prime vendor) will be extracted from the Joint Receipt Food Inspection Manual (JRFIM).

c. Sample size for all surveillance inspections is determined IAW AR 40-656 or the purchasing agency directives.

d. Samples should be selected in the presence of the delivery driver when applicable.

2-6. DETERMINE IF THE PRODUCT IS FROM AN APPROVED SOURCE.

The destination inspector must determine that the product being offered for inspection originated from an approved source of supply for military procurement. There are three important reference documents discussed below that list approved sources of supply. They are the Interstate Milk Shippers listing (IMSL), the USDA listing, and VETCOM Circular 40-1. The U.S. Public Health Service (USPHS), the U.S. Department of Agriculture (USDA), state and local health agencies, the dairy industry, and the military veterinary service are all involved with ensuring quality dairy products.

a. Verify the products approved source listing or exempt status. (See subcourse MDO694, Basic Food Inspection Procedures I, for more information concerning approved source verification)

b. Sources of fluid dairy products may be listed in the Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers List (IMS List). This publication is on the World Wide Web at: http://vm.cfsan.fda.gov/~ear/mlist.html.

c. Sources for manufactured dairy products may be listed in the United States Department of Agriculture publication, "Dairy Plants Surveyed and Approved for USDA Grading Service". This publication is on the World Wide Web at: http://www.ams.usda.gov/dairy/dypubs.htm.

d. Other sources may be listed in VETCOM Circular 40-1. This document is available on the World Wide Web to military food inspection personnel

e. Being listed in one of the directories above ensures that the establishment providing dariry products to the military meets sanitary and manufacturing standards. These standards are established by:

(1) The U.S. Public Health Service. The U.S. Public Health Service publishes the Grade A Pasteurized Milk Ordinance (PMO), which regulates the inspection of dairy farms and milk plants and the examination, labeling, pasteurization, distribution, and sale of dairy products. This Grade "A" PMO is voluntary for use by states but is required for plants shipping milk or fluid milk products in interstate commerce. In addition, The U.S. Public Health Service publishes the "Sanitation Compliance and Enforcement Ratings of Interstate Milk Shippers" (IMSL), which is a list of those plants inspected by state inspectors using the PMO and having a compliance rating of 90 or more.

(2) State and Local Health Agencies. Personnel of the state and local health agencies, trained and certified by the U.S. Public Health Service, use the PMO to perform the actual inspections.

(3) The USDA. The U.S. Department of Agriculture establishes grades for manufactured products, such as dry milk, butter, and cheese. This department also provides grading service and inspection service for establishments that process manufactured dairy products. Establishments that have this grading and inspection service are listed in "Dairy Plants Surveyed and Approved for USDA Grading Service" published by the USDA.

(4) The Military Veterinary Service. Personnel of the military veterinary service inspect those dairy plants that are not IMSL-listed or USDA-listed but that desire to sell dairy products to the military. Those plants in CONUS inspected by the military and approved for sanitation are listed in the "Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement."

(5) Special Case--Ice Cream. Ice cream plants must be inspected by the military veterinary service because ice cream is not a Grade A dairy product and is not rated under the IMSL. These plants may be listed in the Armed Forces Listing.

(6) Dairy Industry Standards. The dairy industry sets standards and guidelines for its members to follow.

2-7. DETERMINE COMPLIANCE WITH THE REQUIREMENTS FOR CORRECT PACKING, PACKAGING, MARKING, AND LABELING.

a. **Adequate Packaging.** The packaging and packing is inspected to ensure that it will adequately protect the dairy products from contamination during storage, distribution, and resale.

b. **Careful Inspection.** At each delivery, randomly selected line items must be examined carefully to determine if they are clean and not leaking.

c. **Individual Container Examination.** In order to identify top-leaking containers of fresh fluid milk products, invert the container for five seconds. Do not squeeze. If the seal is incomplete, product will drip from the container. While the container is inverted, the carton bottom should also be examined for evidence of leakage.

d. **Evidence of Leaking.** Evidence of leaking container or "leakers" may be suspected if product is seen on the floor of the conveyance or inside the packing containers.

e**. In Storage.** To prevent salt precipitation, it is recommended that the cans of evaporated milk be turned (inverted) at monthly intervals and that the storage temperature be maintained between 32° and 72°F.

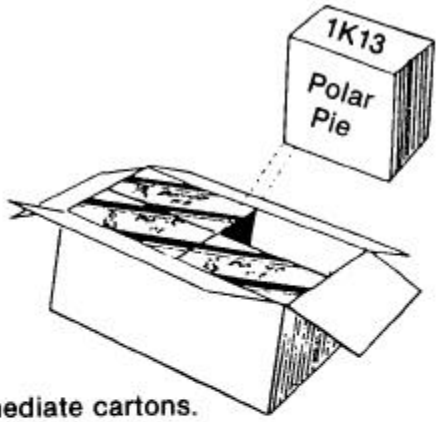
2-8. DETERMINE COMPLIANCE WITH THE REQUIREMENTS FOR AGE AT DELIVERY AND REMAINING SHELF LIFE.

a. **Coding.** The dairy contractor normally identifies each production lot with a code. The government does not require a standard coding method to be used. It is a common practice, however, to code dairy products with a date in the future, called an "Advance Code," which also establishes the potential shelf life. The contractor is required to furnish the inspector with the code key (interpretation of the code) so that the actual product age can be determined. See figure 2-1 for examples of coding.

b. **Varying Requirements.** Contractual requirements for age of product may vary from product to product. Depending on the type of product and potential shelf life, the age of product may begin with the date of pasteurization, processing, manufacturing, or packaging.

c. **Requirements for Freshness.** The contractor must review the contractual data packet to determine computation of "Age of Product." Normally, fresh, fluid milk must be delivered within 72 hours after date of pasteurization and buttermilk must be delivered within 96 hours of packaging.

Individual primary containers of one pint size and larger.



Intermediate cartons.

Containers and cartons should be coded so that the date of manufacture can be readily determined.

Codes on fluid dairy products are normally found on the top of labeled containers.

Products packed in cups will normally have the code stamped on the bottom.

Figure 2-1, Examples of Coding

d. **Age of Product Determination.** Age of product determination is a simple mathematical process. All that is required is to subtract the date of pasteurization from the date of delivery and the difference is the actual age of product at time of delivery. An example follows below.

Date of delivery.....	17 July
Date of pasteurization.....	15 July
Age of product at time of delivery.....	2 days (48 hours)

e. **Examples.** Age of product should always be expressed in accordance with the requirement.

(1) Fresh whole milk must be delivered within 72 hours after date of pasteurization. Therefore, the age must be expressed in hours.

(2) Cottage cheese must be delivered within 10 days of packaging. Therefore, the age must be expressed in days.

(3) The maximum age of ice cream at time of delivery must not exceed 90 days.

2-9. DETERMINE COMPLIANCE WITH THE REQUIREMENTS FOR GROSS PRODUCT IDENTITY.

The veterinary food inspection specialist (the inspector) must determine that the product being received is the same as specified in the inspection data packet and that the product received is the same one that was shipped. This can be accomplished by review of the origin inspection documentation accompanying the shipment, the invoice or manifest, vehicle identification, inspection stamps, labels, and product examination. The product is examined to determine that it is the correct type, class, style, and grade, as applicable, and is packaged in the correct type and size of containers. The product must be labeled in accordance with requirements and, at a minimum, must include the name of the product, the lot identification, the pasteurization date, and the contractor's name and address.

2-10. DETERMINE COMPLIANCE WITH THE REQUIREMENTS FOR INTERNAL TEMPERATURE OF THE PRODUCT.

a. Maintenance of dairy product temperature is critical. It is said that a 5°F fluctuation in product temperature will reduce the shelf life 50%. For example, if a fluid milk product is allowed to reach 50°F, its remaining shelf life is halved.

b. **Temperature Check.** It is a requirement that product temperature be checked in every shipment of dairy products. Temperatures should be taken before the

product is removed from the conveyance. The requirement for chilled items, for both fresh and manufactured dairy products, is 32° to 45°F. For frozen desserts, the requirement is 0°F or less.

c. **Sampling of Small Containers.** It is recommended that one of the sample units selected for the temperature check should be a 1/2-pint container (if present). The reason for this is that temperature changes are more readily observed in smaller containers.

d. **Determining Internal Temperature.** Accurate internal temperatures are obtained by opening the container and inserting the thermometer. Approximately, five minutes are allowed for thermometer adjustment and then the results are read. For containers of one gallon size or less, the temperature is taken by inserting a thermometer into the product. In larger containers, a sample must be extracted from the container in order to determine the temperature.

e. **Alternative Method of Checking Temperature.** Product temperatures may be obtained by inserting the thermometer between cartons or containers or between items in a package. If the temperature meets the requirements, destructive sampling is not required.

f. **Nonconformances.** If a temperature is identified as nonconforming, a minimum of three temperatures of that line item must be taken and averaged in order to determine the final result. If, however, the temperature of a single sample exceeds the requirement by 5°F, the line item must be rejected, even if the average meets the requirement.

2-11. DETERMINE COMPLIANCE WITH THE REQUIREMENTS FOR OBVIOUS CONDITION DEFECTS.

The veterinary food inspection specialist must determine that the product is in the condition required by the inspection data packet. The dairy products are examined to verify that they are fresh and not in off-condition. Inspectors will evaluate the product for conditions listed in this subcourse to include off odor, appearance, texture, and flavor.

2-12. REPORT INSPECTION FINDINGS.

Inspection findings should be reported providing a detailed description of any nonconformance to the accountable officer. This detailed description should include the percentage of the lot that is affected and industry terms for any discrepancies.

a. Report discrepancies to your supervisor.

b. Document the samples that are destroyed during testing using the appropriate sample receipt.

(1) Document samples at DeCA facilities using a DD Form 1222 sample receipt.

(2) Document samples at other facilities using a MEDCOM Form 57.

c. Report inspection findings on a DD Form 1232, unless otherwise directed.

Section II. SPECIFIC EXAMINATIONS PERFORMED

2-13. OBTAINING SAMPLES FROM BULK MILK DISPENSER CONTAINERS USING ASEPTIC TECHNIQUES

When an inspector is required to submit a sample of a bulk dairy product to the laboratory for testing, aseptic techniques must be utilized during the entire sample collection procedure to preclude the possibility of contamination of either the product or the sample bottle. Normally, only one bulk dispenser container will be selected to represent the inspection lot. However, more than one primary container may be selected when the veterinary food inspection specialist thinks such action is necessary. A minimum of one-half pint (8 fluid ounces) of product will be obtained for routine laboratory testing and examination purposes, unless the laboratory requires a larger amount.

a. **Preparation for Extracting Sample.**

(1) Agitate product. The primary container is used to agitate the product.

(a) Invert the container and return it to an upright position a minimum of five times. Two people, one on each side of the container, may be required, especially when the quantity of product per container exceeds 5 gallons.

(b) Place the primary container on the floor, grasp the handle, and forcibly rock the container in a 90° arc five times. This method of agitation, however, should only be used when the quantity of product per container exceeds 5 gallons and only one individual is available.

(c) If the container is 5 gallons or less invert the container and return it to an upright position a minimum of 5 times.

(2) Place the container on a clean table in a clean area protected from contamination.

(3) Release the free end of the dispenser tube from its secured position.

(4) Remove the protective covering, if present.

(5) Clamp the dispenser tube with a compression type clamp or forceps approximately 4 inches from the free tip of the dispenser tube.

(6) Sanitize the distal 3 inches of the free end of the dispenser tube thoroughly using a sterile swab saturated with 70 percent isopropyl alcohol.

(7) Sanitize the knife, razor blade, or other cutting device to be used for severing the dispenser tube by alcohol-flaming the instrument or by applying an equally acceptable germicidal treatment.

(8) Sever the dispenser tube in the alcohol cleansed area approximately 1 inch from the free end, using a technique that precludes contamination of the dispenser tube by the fingers. Use of a second pair of hemostatic forceps and cutting between the two forceps will eliminate unnecessary movement of the tubing. Use a technique that precludes contamination of the dispenser tube by the fingers.

(9) Extract a minimum of 1 pint (16 fl oz) of product through the dispenser tube prior to collecting the sample to be forwarded for laboratory testing. Such a procedure is necessary to ensure that the sample is obtained from the agitated contents of the container. Also, this initially extracted quantity of the product may be used for delivery temperature determinations and also sensory evaluation when sampled at destination.

(10) Relock the clamp on the dispenser tube.

b. **Collecting the Sample.**

(1) Aseptically remove the lid from a sterile sample bottle, which has a minimum capacity of 8 fluid ounces. If the inner surfaces of either the lid or the bottle becomes contaminated, a second sample bottle must be used and the first bottle discarded.

(2) Release the clamp so that milk flows freely through the dispenser tube.

(3) Immediately fill the sample bottle to near capacity by releasing the clamp or forceps and allowing milk to flow through the dispenser tube into the bottle.

(4) Relock the clamp on the dispenser tube.

(5) Carefully replace the sample bottle lid in a manner which precludes possible contamination. After the lid has been securely replaced, further seal the sample bottle by applying masking tape around the juncture of the bottle and lid to eliminate the possibility of the lid being loosened during transit as a result of vibration.

(6) Reseal the dispenser tube by folding the tube approximately 2 inches from the cut end, and then apply a piece of adhesive tape or other suitable material

around the folded portion in a manner that will prevent leakage. The dispenser tube should be replaced in its secured position to safeguard the product against contamination until the bulk container is used.

c. **Administrative Procedures.**

(1) Label the container. The bulk container must be tagged, or otherwise identified, to indicate that a portion of the contents have been extracted for test purposes and that the contents should be used as soon as possible.

(2) Label the sample bottle.

(3) Prepare MEDCOM FORM 676-R or DD FORM 1222 as applicable.

(4) Pack sample for shipment.

(5) Determine the disposition of the sample.

2-14. SENSORY EVALUATION

a. **Definition.** A sensory evaluation is a physical examination using all of one's senses (sight, smell, taste, touch, and hearing).

b. **When Performed.** A sensory evaluation should be conducted any time that destructive sampling is conducted.

c. **Purpose of Sensory Evaluation.** The primary purpose of a sensory evaluation is to detect off-flavors or off-odors, inadequate formulation, and color defects.

d. **Performing a Sensory Evaluation.** A sensory evaluation is performed to detect, identify, and evaluate characteristics of the dairy products utilizing all of the sensory pathways (olfactory, visual, gustatory, auditory, and tactile). A sensory evaluation will be required if:

(1) Temperature charts show fluctuation outside prescribed ranges.

(2) There are consumer complaints.

(3) There are bulging containers.

(4) Product is over age (older than normal).

(5) Directed by SOP or supervisor.

(6) Keeping quality examination requires sensory evaluation.

2-15. ABNORMALITIES OF FRESH DAIRY PRODUCTS

a. **Off-Flavors.** Examples of off-flavors to look for are: feed or weed (unnaturally sweet and aromatic), rancid (bitter or soapy), metallic (cardboardy), unclean (barny or cowy), malty or high acid (grapenut-like or sour), winey/fruity, salty, bitter, musty, yeasty, and/or cooked.

b. **Texture and Body Defects of Fluid Dairy Products.** Examples of texture and body defects to look for are: sweet curd (small, coagulated particles floating on the surface), chalky texture, ropiness (having a ropy body and long threads of slime), layering, stratification, and sedimentation of chocolate and milk components in chocolate milk and drink, feathering of cream (coagulation of cream forming small flakes).

c. **Texture and Body Defects of Cultured Dairy Products.** When examining cultured dairy products, the veterinary food inspection specialist should look for layers of watery liquid, matted curd, free whey, rubbery consistency (too firm), gelatinous consistency, and/or air pockets.

2-16. ABNORMALITIES OF ICE CREAM

a. **Off-Flavors.** Most off-flavors in ice cream are due to the use of milk or milk products containing off-flavors. Off-flavors include metallic, rancid cream, cooked, and bitter. Other undesirable flavors may occur because too much or too little of an ingredient or flavor has been used.

b. **Texture Defects.** The texture of ice cream should be smooth. Example of texture defects include:

(1) Large ice crystals. This is the most common texture defect and it is caused by slow freezing, thawing and refreezing, or poor homogenization.

(2) Snowy or flaky. This defect is the result of high over-run in a mix of low solids, low stabilizer, freezing too soft in the freezing machines, or improper whipping.

(3) Sandy. This defect is caused by the presence of lactose crystals in the ice cream.

(4) Buttery. This condition occurs when the ice cream contains lumps of butterfat of such size that they can be detected in the mouth. This buttery texture is caused by churning that has taken place during freezing and can be prevented by proper homogenization.

c. **Body and Melting Defects.** Body defects refer to the whole structure of ice cream and is largely influenced by the composition of the mix, whereas texture refers to

the makeup of the individual particles that form the body of the ice cream. Common body and melting behavior defects include:

(1) Crumbly and brittle. This defect can best be detected by noting the curled up or rough appearance as the edge of a spoon is drawn over the surface of the ice cream. It is caused by a combination of high overrun, coarse air cells, low gelatin content, low solids content, and/or poor homogenization.

(2) Heavy or soggy. This defect is caused by low overrun and high total solids. The higher the solids content, the higher must be the overrun to avoid this defect. The ice cream melts slowly.

(3) Gummy. Gumminess is caused mainly by too much stabilizer (especially gelatin) in the mix. A gummy ice cream has a pasty, elastic body with high melting resistance.

(4) Weak and watery. Weak and watery ice cream is the opposite of a gummy, pasty body and is invariably accompanied by a rapid melting to a water consistency. It has a low melting resistance. This condition is caused by low total solids and a low stabilizer content.

(5) Foamy. The use of too much egg product or gelatin will cause ice cream to be foamy.

(6) Curdled. A curdled condition is caused by aggregation or coagulation of the milk proteins. Ice cream with this defect has a dull, finely wrinkled surface when melted.

d. **Color.** If the color is too high or if there is a lack of color, the finished product may be objectionable. When coloring is added to represent the shades of various fruits, it should appear "natural" and evenly distributed.

e. **Loss of Volume (Shrinkage).** This condition involves the loss of air and a decrease in volume of the product. Some common causes of shrinkage are excessive overrun, insufficient solids, storage at high temperatures, transfer of ice cream from one container to another, and barometric pressure.

2-17. ABNORMALITIES OF MANUFACTURED DAIRY PRODUCTS

a. **Off-Flavors.** Manufactured Dairy Products have off-flavors similar to those found in fresh dairy products. Some of these off-flavors are: feed or weed, rancid, metallic, aged, unclean, malty or high acid, sour, winey/fruity, salty, bitter, musty, yeasty, and/or cooked.

b. **Defects of Butter.** Body characteristics that detract from the quality of butter include: crumbly (fat particles lack cohesion and do not stick together), gummy (butter

sticks to roof of mouth and gives gum like impression), leaky (shows beads or droplets of moisture), and grainy (lacks smooth waxy texture). Some defects of color found in butter are mottling and streaks. The color should be a natural shade of yellow, not excessively high, and uniform.

c. **Defects of Cheese.** The color of cheese should be uniform and free from mottles or light and dark portions. Uniformity of color is far more important than shade of color. Body and texture defects may also occur in cheese. Body as it is applied to cheese refers to the firmness of the cheese. Cheese should have a firm, waxy body and a silky, smooth texture. Some undesirable body defects are: dry, hard, crumbly, rubbery, flaky, grainy, gritty, and weak/soft. Some undesirable texture defects are: yeast holes, gassy, open, and fissures.

d. **Defects of Condensed Milk.** Body and texture defects found in condensed and evaporated milk are: buttery (fat separation), curdy (presence of coagulated particles), feathering, grainy, low viscosity (milk-like consistency), and sediment. The color of condensed and evaporated milk should be a light, uniform cream color but may tend toward a brown color.

e. **Defects of Dry Milk.** Some defects of dry milk products are: caked, lumpy, unnatural color, and visible dark particles.

2-18. TESTING (ANALYTICAL REQUIREMENTS)

a. **Product Quality Assurance.** The origin inspector has responsibility for laboratory testing, implementation of the 3-out-of-5 concept, and quality history maintenance, in order to assure contract compliance.

b. **Testing of Samples at Destination Inspection.** Since samples may be selected either at origin or at destination for official testing, the origin inspector may request the destination inspector to select and submit samples at time of delivery for testing by the medical laboratory.

c. **Recommended Testing.** When routine samples are being submitted for wholesomeness testing, it is recommended that additional samples be selected and submitted for Keeping Quality testing as well.

d. **Data Requirement.** Anytime that the destination inspector submits samples to the medical laboratory for testing, a copy of the MEDCOM FORM 676-R, Request For and Results of Testing, must be furnished the origin inspector. A copy is automatically provided to the origin inspector when block 17 of the DD Form 1222, the Inspection Responsibility Code (IRC), is filled in.

2-19. A KEEPING QUALITY EXAMINATION (MOSELY TESTING)

a. **Purpose of the Examination.** Keeping quality examinations are not currently contractual. The purpose is to check for levels of psychrophilic bacteria. This examination can provide a valuable source of feedback information on plant sanitation (post-pasteurization contamination) causing excessive contamination of the fresh dairy product by psychrophilic bacteria.

b. **Growth Rate of Psychrophilic Bacteria.** The word "psychrophilic" meaning, "cold loving" is somewhat of a misnomer in describing these bacteria. It is a relative term covering bacteria that have the ability to grow at somewhat lower temperatures than most such organisms. This should not be interpreted to mean that they prefer low temperatures for growth. In general, the growth rate in milk at 32°F (0°C) is so slow that more than one day may be required for a cell to divide once. At 40°F (4°C), several divisions may take place in a day. At 45°F (7°C), the divisions are markedly increased and are complicated by the slow growth of nonpsychrophilic bacteria whose initial contamination may have been much greater.

c. **Using Official Laboratories.** The official medical laboratories always conduct mosely Testing. When selecting samples for routine wholesomeness testing, additional samples should be selected and submitted for Mosely Testing.

d. **Shipment.** The veterinary food inspection specialist selects three containers of product, side by side, that have been maintained at 40°F or less. The samples are prepared for shipment to the laboratory. Sufficient refrigerant must be used to ensure that the arrival temperature at the laboratory is 40°F or less.

e. **Testing Results.** Upon arrival at the laboratory, one sample will be tested immediately. The second sample will be tested after 5 days. The final sample will be tested after 7 days. Any test result in excess of 1,000,000 standard plate count (SPC) is an indication of post-pasteurization contamination. Laboratory test results with SPC counts in excess of 1 million/mL 7 days after pasteurization for an unopened container of pasteurized milk (maintained at 45°F) indicate a post-pasteurization contamination with psychrophilic bacteria. A record of this in several products or repetitive high counts in several samples of the same product over time indicates that the plant may have a sanitation or equipment problem. In addition, it indicates the potential for introduction and proliferation of Listeria monocytogenes or Yersinia enterocolitia. Also, the presence of a high count of psychrophilic bacteria will shorten the shelf-life of the product and does not represent good manufacturing practices achievable with today's technology.

f. **Reporting Problems.** Any indication of keeping quality problems must be reported to the origin inspector. This type of result would dictate that a quality assurance visit (QAV) to the production plant be scheduled.

Continue with Exercises

EXERCISES, LESSON 2

REQUIREMENT. The following exercises are to be answered by marking the lettered response that best answers the question or by completing the incomplete statement or by writing the answer in the space provided at the end of the question.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers.

1. Match the term in Column I to the definition in Column II.

COLUMN I	COLUMN II
(1) ___ Characteristic.	a. Directly related to the established reliability record.
(2) ___ Type of product.	b. A specific contract item identified by number, package size, and unit price.
(3) ___ Line item of product.	c. A specific product processed in one plant, regardless of type or size of packaging.
(4) ___ Frequency of examination.	d. Any requirement or adulterant which may be evaluated by testing.

2. A product can be rejected without waiting for the results of laboratory testing. Such an action is called:

   a. Unreliability.

   b. 3-out-of-5 concept.

   c. Termination.

   d. Imminent health hazard.

3. Testing for fat content of a dairy product is testing for:

   a. Quality.

   b. Wholesomeness.

4. Complete the information related to status designations.

TERM	NUMBER OF LABORATORY TESTING FAILURES
a. Excellent.	N/A
b. Notice.	___ out of _____
c. Warning.	___ out of _____
d. Suspension/Termination.	___ out of _____
e. Re-instatement.	N/A

5. Match the responsibility in Column I to the responsible party in Column II.

COLUMN I	COLUMN II
(1) ___ Maintains the quality history record.	a. Origin inspector.
(2) ___ Submits samples to the laboratory for wholesomeness testing when requested to do so.	b. Destination inspector.
(3) ___ Makes quality assurance visits.	
(4) ___ Examines product for specific characteristics.	
(5) ___ Conducts sanitary inspections.	

6. Match the type of product in Column I to the listing of approved sources of supply in Column II.

COLUMN I	COLUMN II
(1) ___ Fluid dairy products.	a. Armed Forces listing.
(2) ___ Manufactured dairy products.	b. USPHS listing.
(3) ___ Ice cream.	c. USDA listing.
(4) ___ Products from dairy plants not IMSL-listed or USDA listed.	

7. Which of the following is NOT rated under the IMSL listing?

a. Whole milk.

b. Skim milk.

c. Ice cream.

d. Flavored drink.

e. Half-and-half.

8. Three things are necessary to maintain conveyances in sanitary condition. Conveyances must be:

a. _____.

b. _____.

c. _____.

9. For dairy products, must samples be selected in the presence of the truck driver (the contractor's representative)?

a. Yes.

b. No.

10. The temperature of cheddar cheese was checked at delivery and determined to be 45°F. The cheese was:

a. Conforming.

b. Nonconforming.

11. The temperature of ice cream was checked at delivery and determined to be 5°F. The ice cream was:

a. Conforming.

b. Nonconforming.

12. The date of delivery of buttermilk is 12 October. The date of pasteurization is 8 October. Determine the age of the product. The buttermilk is:

a. Conforming.

b. Nonconforming.

13. Cottage cheese was delivered on 5 October. The date of pasteurization was 24 September. Determine the age of the product. The cottage cheese is:

a. Conforming.

b. Nonconforming.

14. Complete the following statements related to coding.

a. It is common practice to code dairy products with a date in the future. This is called an _____ _____date.

b. This date establishes the potential _____ _____.

c. The contractor is required to furnish the inspector with the code _____ , which is the _____ of the code.

15. Ice cream was delivered with a code date of 1 October. If the product was advance coded 90 days, what was the actual date of pasteurization?

a. 1 July.

b. 2 July.

c. 3 July.

d. 4 July.

16. Codes on fluid dairy products are normally found:

a. On the lid of the container.

b. On the bottom of the container.

c. On the side of the container.

d. On the top of the container.

e. On the steeple of the container.

17. Complete statements related to container integrity.

a. Containers should be examined carefully to determine if they are _____ and not _____ .

b. In order to identify top-leaking containers of fresh fluid milk products, _____ the container for ___ seconds. Do not_____.

18. Complete statements related to obtaining samples from bulk milk dispenser containers.

a. Normally, only ___ bulk milk dispenser container is selected to represent the inspection lot. The inspector should invert the container and return it to an upright position a minimum of ___ times.

b. The initial extraction of product is ____ fluid ounces.

c. Initial extraction is used to determine delivery _____ and also for _____ evaluation at destination.

d. A minimum of ___ fluid ounces of product must be obtained for routine laboratory testing and examination purposes.

19. An inspector is tasked to obtain a sample from a bulk milk dispenser container. When preparing to extract the sample, which of the following steps is the earliest in the sequence of steps?

a. Extract a minimum of 1 pint of product.

b. Sever the dispenser tube 1 inch from the free end.

c. Sanitize the distal 3 inches of the free end of the dispenser tube.

d. Clamp the dispenser tube with a compression type of clamp.

e. Release the free end of the dispenser tube from its secure position.

20. In Column II, there are steps of administrative procedures that are required after a sample from a bulk milk dispenser container has been obtained. They are not listed in the order in which they are accomplished. In Column I, rearrange the steps in the correct sequence.

COLUMN I	COLUMN II
(1) ___	a. Prepare MEDCOM Form 676-R.
(2) ___	b. Pack sample for shipment.
(3) ___	c. Determine the disposition of the sample.
(4) ___	d. Label the bulk container.
(5) ___	e. Label the sample bottle.

21. In Column II, there are steps in the procedure of collecting a sample from a bulk milk dispenser container. They are not listed in the order in which they are accomplished. In Column I, rearrange the steps in correct sequence.

COLUMN I	COLUMN II
(1) _____	a. Relock the clamp on the dispenser tube.
(2) _____	b. Carefully replace the sample bottle lid.
(3) _____	c. Reseal the dispenser tube.
(4) _____	d. Aseptically remove the lid from a sterile sample bottle.
(5) _____	e. Release the clamp so that milk flows freely through the dispenser tube.
(6) _____	f. Fill the sample bottle to near capacity.

22. Match description of the off-flavors of dairy products in Column II to the off-flavor term in Column I.

COLUMN I	COLUMN II
(1) ___ Feed or weed.	a. Grapenut-like or sour.
(2) ___ Rancid.	b. Barny or cowy.
(3) ___ Metallic.	c. Cardboardy.
(4) ___ Unclean.	d. Bitter or soapy.
(5) ___ Malty or high acid.	e. Unnaturally sweet and aromatic.

23. List off-flavors of fresh dairy products or manufactured dairy products NOT listed above in exercise #22.

a. _____.

b. _____.

c. _____.

d. _____.

e. _____.

f. _____.

24. Match the type of fresh dairy product in Column II to the specific texture and body defect in Column I.

COLUMN I	COLUMN II
(1) ___ Matted curd.	a. Fluid dairy products.
(2) ___ Sweet curd.	b. Cultured dairy products.
(3) ___ Ropiness.	
(4) ___ Layers of watery liquid.	
(5) ___ Chalky texture.	
(6) ___ Rubbery consistency.	
(7) ___ Feathering of cream.	
(8) ___ Free whey.	
(9) ___ Layering.	
(10) ___ Stratification and sedimentation.	

25. Match the type of defect found in ice cream in Column II to the specific defect in Column I.

COLUMN I	COLUMN II
(1) ___ Crumbly and brittle.	a. Texture defect.
(2) ___ Weak and watery.	b. Body and melting defect.
(3) ___ Large ice crystals.	
(4) ___ Heavy or soggy.	
(5) ___ Curdled.	
(6) ___ Snowy or flaky.	
(7) ___ Gummy.	
(8) ___ Buttery.	
(9) ___ Foamy.	
(10) ___ Sandy.	

26. Match the manufactured dairy product in Column II to specific body defects in Column I.

COLUMN I	COLUMN II
(1) ____ Gummy.	a. Butter.
(2) ____ Rubbery.	b. Cheese.
(3) ____ Leaky.	
(4) ____ Hard.	
(5) ____ Flaky.	
(6) ____ Crumbly.	
(7) ____ Grainy.	

27. List undesirable texture defects in cheese.

a. _____.

b. _____.

c. _____.

d. _____.

28. Which of the following is NOT a defect of dry milk products?

a. Visible dark particles.

b. Unnatural color.

c. Caked.

d. Lumpy.

e. Curdy.

29. Complete statements related to keeping quality examinations (Mosely testing).

a. The veterinary food inspection specialist must ensure that there is sufficient refrigerant in each sample shipment to assure that the arrival temperature at the medical laboratory is _____ or less.

b. The presence of a high count of bacteria will shorten the _____ _____ of the product.

c. Any test result in excess of _____ SPC (standard plate count) is an indication of post-pasteurization contamination.

d. Repetitive high counts over time indicate that the dairy plant may have a _____ or _____ problem.

30. In Mosely testing (keeping quality examinations), the samples are tested on different days. The specified days for testing are:

a. Day 1, Day 5, Day 7.

b. Day 1, Day 3, Day 5.

c. Day 1, Day 3, Day 7.

d. Day 1, Day 4, Day 6.

e. Day 1, Day 5, Day 6.

31. The keeping quality incubation of fresh dairy products is accomplished at a temperature of:

a. 35°F.

b. 40°F.

c. 45°F.

d. 50°F.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. (1) d
   (2) c
   (3) b
   (4) a (para 2-1c,h,i,j)

2. d (para 2-1l)

3. a (para 2-1f)

4. b. 1 out of 4
   c. 2 out of 4
   d. 3 out of 5 (para 2-1m)

5. (1) a
   (2) b
   (3) a
   (4) b
   (5) a (para 2-2a,b)

6. (1) b
   (2) c
   (3) a
   (4) a (para 2-6e)

7. c (para 2-6e(5))

8. a. Clean
   b. Closed
   c. Refrigerated (para 2-4)

9. a (para 2-5d)

10. a (para 2-10b)

11. b (para 2-10b)

12. a (para 2-8c)

13. b (para 2-8e(2))

14. a. advance code
    b. shelf life
    c. key; interpretation (para 2-8a)

15. c (para 2-8d)

16. d (para 2-8a, figure 2-1)

17. a. clean; leaking (para 2-7b)
    b. invert; 5; squeeze (para 2-7c)

18. a. 1; 5
    b. 16
    c. temperature; sensory
    d. 8 (para 2-13)

19. e (para 2-13a(3))

20. (1) d
    (2) e
    (3) a
    (4) b
    (5) c (para 2-13c)

21. (1) d
    (2) e
    (3) f
    (4) a
    (5) b
    (6) c (para 2-13b)

22. (1) e
    (2) d
    (3) c
    (4) b
    (5) a (para 2-15a)

23. a. Winey/fruity
    b. Salty
    c. Bitter
    d. Musty
    e. Yeasty
    f. Cooked (paras 2-15a)

24. (1) b
    (2) a
    (3) a
    (4) b
    (5) a
    (6) b

(7) a
(8) b
(9) a
(10) a (para 2-15b,c)

25. (1) b
(2) b
(3) a
(4) b
(5) b
(6) a
(7) b
(8) a
(9) b
(10) a (para 2-16b,c)

26. (1) a
(2) b
(3) a
(4) b
(5) b
(6) a,b
(7) a,b (para 2-17b,c)

27. a. Yeast holes
b. Gassy
c. Open
d. Fissures (para 2-17c)

28. e (para 2-17d,e)

29. a. 40° F (para 2-19d)
b. psychrophilic; shelf life
c. 1,000,000
d. sanitation; equipment (para 2-19e)

30. a (para 2-19e)

31. c (para 2-19e)

End of Lesson 2

COMMENT SHEET

SUBCOURSE MD0715 Dairy **EDITION 100**

Your comments about this subcourse are valuable and aid the writers in refining the subcourse and making it more usable. Please enter your comments in the space provided. ENCLOSE THIS FORM (OR A COPY) WITH YOUR ANSWER SHEET **ONLY** IF YOU HAVE COMMENTS ABOUT THIS SUBCOURSE..

FOR A WRITTEN REPLY, WRITE A SEPARATE LETTER AND INCLUDE SOCIAL SECURITY NUMBER, RETURN ADDRESS (and e-mail address, if possible), SUBCOURSE NUMBER AND EDITION, AND PARAGRAPH/EXERCISE/EXAMINATION ITEM NUMBER.

PLEASE COMPLETE THE FOLLOWING ITEMS:

(Use the reverse side of this sheet, if necessary.)

1. List any terms that were not defined properly.

2. List any errors.

paragraph	error	correction

3. List any suggestions you have to improve this subcourse.

4. Student Information (optional)

Name/Rank _____
SSN _____
Address _____
_____
E-mail Address _____
Telephone number (DSN) _____
MOS/AOC _____

PRIVACY ACT STATEMENT (AUTHORITY: 10USC3012(B) AND (G))

PURPOSE: To provide Army Correspondence Course Program students a means to submit inquiries and comments.

USES: To locate and make necessary change to student records.

DISCLOSURE: **VOLUNTARY.** Failure to submit SSN will prevent subcourse authors at service school from accessing student records and responding to inquiries requiring such follow-ups.

U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL Fort Sam Houston, Texas 78234-6130