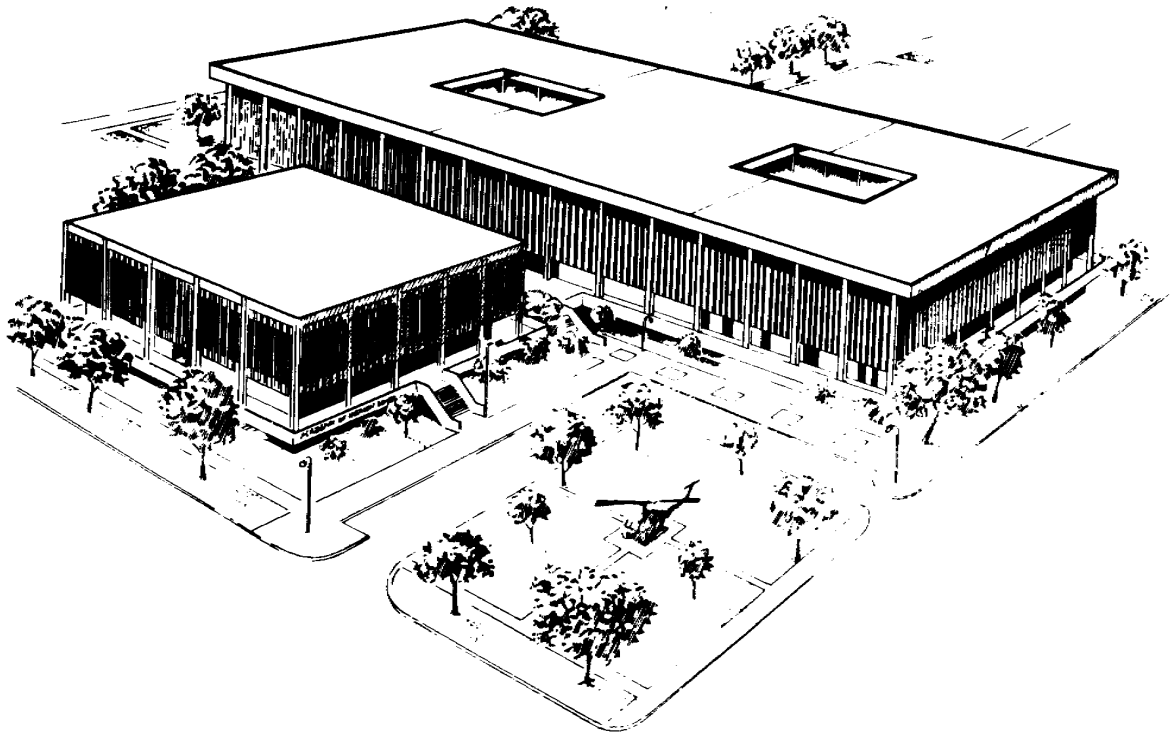


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U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL  
FORT SAM HOUSTON, TEXAS 78234-6100

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# WATERFOODS

SUBCOURSE MD0711

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.

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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.

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

**SUBCOURSE MD0711**

**WATERFOODS**

**INTRODUCTION**

The consumption of all waterfoods (fish and shellfish) in the U.S. rose 25% in the 1980's. In fact, fish farming (aquaculture) is one of the fastest growing industries in the world. Waterfoods are among the most perishable of all foods and need proper care from the moment they are caught until served or processed. The handling of waterfoods determines to what extent deterioration takes place. This subcourse will deal with the composition, anatomy, market forms, preservation, and deterioration of waterfoods. Destination and surveillance inspection procedures of waterfoods will also be covered, including determining net weight of fish.

The purpose of this subcourse is to provide you with basic (introductory) knowledge concerning waterfoods, which is essential for the veterinary food inspection specialist.

***Subcourse Components:***

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

Lesson 1, Inspection of Fish.

Lesson 2, Inspection of Shellfish.

***Credit Awarded:***

Upon successful completion of this subcourse, you will be awarded 10 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**

Inspection of Fish.

**LESSON ASSIGNMENT**

Paragraphs 1-1 through 1-16.

**LESSON OBJECTIVES**

After completing this lesson, you should be able to:

- 1-1. Identify major chemical components of fish.
- 1-2. Identify external and internal anatomical features of fish.
- 1-3. Identify market forms of fish.
- 1-4. Identify common methods used to preserve fish.
- 1-5. Identify characteristics of fresh, stale, and putrid fish.
- 1-6. Identify common parasites of fish.
- 1-7. Identify inspection procedures for fish.
- 1-8. Compute percentage of glaze on fish.
- 1-9. Determine net weight of a case of fish.

**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

### INSPECTION OF FISH

#### Section I. FISH: THEIR COMPOSITION, ANATOMY, PREPARATION, AND PRESERVATION

##### 1-1. INTRODUCTION

a. **Definition.** The term waterfood is applied to the fishery products procured by the Department of Defense (DOD). When applied, it encompasses all varieties of fresh and salt-water finfish and shellfish.

b. **Finfish.** Finfish are those species termed endoskeletal (the skeletal structure is contained within its body) containing vertebrae, rib bones, and a skull composed of numerous bones. They are fusiform (tapering at both ends), roundish, and usually slightly compressed. Some may be greatly compressed (for example, sun perch), or depressed (for example, flounder). Their shape offers little resistance to movement in water.

c. **Shellfish.** Shellfish are divided into two groups, mollusk and crustacean. They are referred to as exoskeletal as they have an outer shell covering the body.

d. **Quality.** There are many complex chemical changes that occur within waterfood after death. These changes, associated with bacteriological changes, determine the quality. The best quality available is a waterfood that is cooked and consumed immediately after death. To perform an adequate inspection, the veterinary food inspection specialist must be knowledgeable of the chemical composition of waterfood and the chemical and deteriorative changes that may take place.

##### 1-2. CHEMICAL COMPOSITION

The major chemical components of the edible flesh of waterfoods are:

a. **Water.** Water constitutes the largest component and ranges from 66% to 84%, averaging approximately 80%. The water is mostly intracellular which means that little water will be lost during normal handling. In fresh fish, the water contains the salt and minerals and is inversely related to the amount of fat present. The higher the water content, the lower the fat.

b. **Protein.** Protein is the second largest component. The amount of protein ranges from 6 to 28 percent, the average being 18 to 20 percent. Protein contains all of the essential amino acids required in man's daily diet, making fish an excellent meat product. It also contains a nitrogen compound which produces the odors associated



with deterioration. Protein is heat, water, and salt soluble and can be destroyed by improper handling and storage.

c. **Fat.** Fat, or lipid, content ranges from less than 1 percent to as much as 28 percent. Waterfoods containing 6 percent or less are referred to as lean fish while those that exceed 6 percent are classified as "fatty." Fish body fats are polyunsaturated fatty acids and combine easily with oxygen resulting in oxidation, a major storage problem. Because of the total properties of the fats, fish is an excellent meat for people on low cholesterol diets. Haddock is an example of lean fish and Chinook salmon is an example of "fatty" fish, with 12% fat.

d. **Inorganic Compounds.** Inorganic components make up the smallest percentage of the four major components. Practically every mineral element contained in sea water (for example, zinc, phosphorus, copper, iron, iodine, potassium, and chlorine) may be found in the flesh of fish. When present in the fish habitat, contaminants such as mercury, pesticides, herbicides, and radionuclides may also be found in fish flesh.

e. **Minor Chemical Components.** Vitamins are a minor chemical component in fish. Fish oils are high in levels of fat-soluble vitamins A, D, and E. Combined with minerals, vitamins constitute 0.8% to 2% of fish flesh.

### 1-3. ANATOMICAL TERMS

a. **General.** The inspector should be knowledgeable concerning the external anatomical features of fish, including anatomical terms of location. This is needed to identify different species. A familiarization with internal anatomical features is also necessary.

b. **Anatomical Terms of Location.** Anatomical terms of location are:

- (1) Posterior. Toward the rear; away from the head; tail area.
- (2) Anterior. Toward the head; away from the tail; head area.
- (3) Dorsal. Toward the backline.
- (4) Ventral. Toward the bellyline.
- (5) Medial. Toward the middle.
- (6) Lateral. Away from the middle.

#### 1-4. EXTERNAL IDENTIFICATION - CHARACTERISTICS

a. **Overview.** To be able to inspect waterfoods properly, the inspector must first be able to identify them. Fish identification characteristics are published in numerous books on fish identification, which are normally available at inspection points. Some of the external features for identifying species of fish are listed below. In addition, see Figure 1-1.

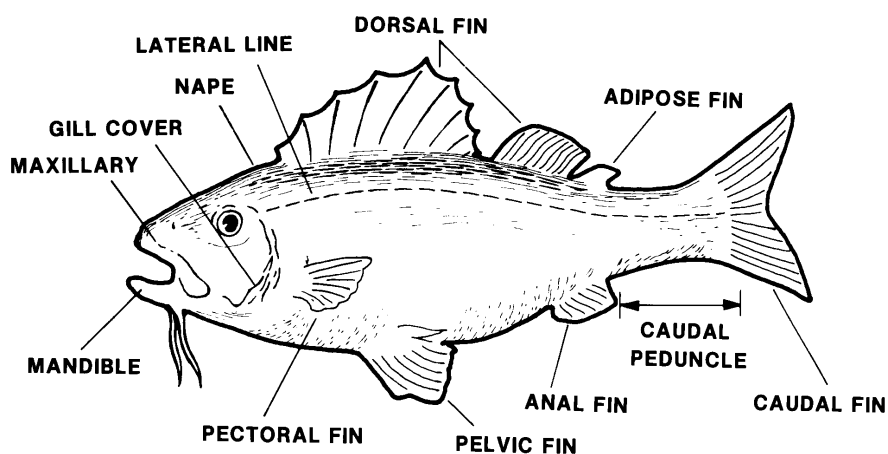


Figure 1-1. External Identification Features of Fish

b. **Color.** Color is sometimes used in identification. However, color is not completely reliable as most fish are capable of considerable color variation. In addition, the color of many fish fade after death.

c. **Pattern.** Patterns of the pigmented areas also change, although not as much as the color.

d. **Scales.** Scales are used for identification in two ways.

(1) Each species of fish has a specific number of scales across or along the lateral line.

(2) In many species of fish, the rate of growth differs markedly between winter and summer months. Both species and age can be determined by a microscopic examination of the scales.

e. **Lateral Line.** In most fish, the lateral line is a canal sunk into the skin that runs in a longitudinal line along each side of the body. It starts just posterior to the gill covers and extends the length of the body to the caudal (tail) fin. This canal contains many sensitive nerve endings. Through these nerve endings, the fish can detect such things as temperature changes, motion increasing or decreasing, and external pressure. The lateral line is normally darker than the balance of the body and opens to the exterior

by a series of pores. The lateral line is usually distinguished by modified and, often, different-colored scales.

f. **Barbels.** Barbels are fringes of skin (tentacles) that are normally located on the snout or lower jaw. Barbels are used to feel and possibly to smell food. An example of a fish with barbels is the Pacific Ocean perch.

g. **Gill Covers.** The gill cover is a protector for the gill openings (sometimes called operculum). It is located close to the nape area.

h. **Nape.** Generally, this is where the head is separated from the rest of the body.

i. **Caudal Peduncle.** This is the fleshy portion of the fish that extends from the posterior end of the anal fin to the end of the tail. It does not include the tail fin. The small amount of connective tissue found in fish flesh is more pronounced in this area, making steaks and fillets from this area less desirable.

## 1-5. EXTERNAL IDENTIFICATION - FINS

a. **General.** Fins are classified by their location (see anatomical terms above). Their functions are locomotion, balance, and protection. The type, number, location, and structure of fins are decisive in species identification. Fins are either medial (middle) or paired. See Figure 1-1.

### b. Medial Fins.

(1) Dorsal fin. Some species have one dorsal fin along the back, some two, while others may have three. The dorsal fin (located on the dorsal border) aids in stability while swimming. In some species, the dorsal fins contain hard needlelike bones (called rods) that may be used as a means of protection.

(2) Adipose fin. This is a fleshy appendage that has no specific function, yet is found on some species, for example, salmon.

(3) Caudal fin. The caudal fin (tail fin) is the main fin of movement and is located on the posterior end of the body. By flexing the muscles on one side of its body, the fish moves its caudal fin in that direction, Then, it moves the caudal fin in the opposite direction by flexing the muscle of the alternate side. Alternate flexing causes the fish to move forward, thus the term "fish tailing."

(4) Anal fin. Some species have one anal fin, some two. It assists in stabilization. It is located just posterior to the anus or vent.

c. **Paired Fins.**

(1) Pectoral fin. The pectoral fins are located posterior to the gill openings (and gill cover). They correspond in position to human arms.

(2) Pelvic fin. The pelvic fins are located on the belly (on the ventral border) posterior to the pectoral fins. They correspond in position to human legs.

**1-6. INTERNAL IDENTIFICATION - CHARACTERISTICS**

a. **General.** As a rule, internal anatomical features are of limited importance to the inspector since most fish are eviscerated prior to being offered to the military services. However, examination of the visceral cavity (the poke) is necessary to detect early deterioration. See Figure 1-2.

b. **Gills.** Gills are the respiratory system of the fish. They are set behind the cavity of the mouth and consist of bony arches to which the gill filaments are attached.

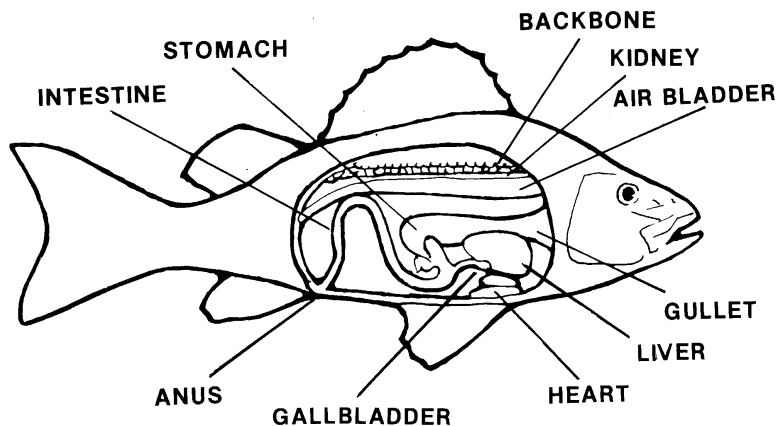


Figure 1-2. Internal features of fish.

c. **Mouth.** The shape, size, and location of the mouth vary greatly in different species. The jaws and various areas inside the mouth and gullet usually have true teeth.

d. **Air Bladder.** This is an elongated sac with a semitransparent wall that lies close to the backbone in the abdominal cavity. Its chief purpose is to provide proper buoyance for the fish. Many fish do not have an air bladder.

e. **Kidney.** This is an elongated dark organ resembling black jelly that lies in the abdominal cavity, close to the backbone. It is highly vascular and is one of the points where deterioration begins.

f. **Muscles.** The muscles of fish are segmented or layered, resulting in a flaked texture when cooked. The flesh of fish consists of two types of muscles (Figure 1-3).

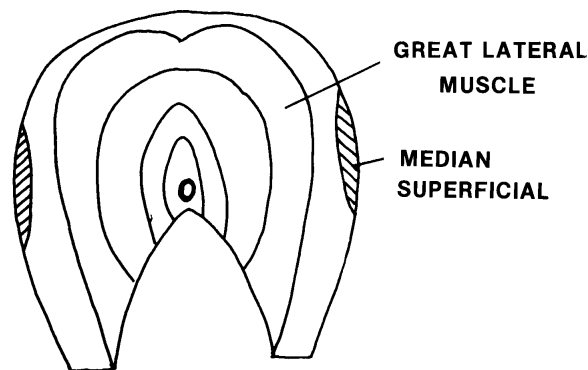


Figure 1-3. Muscles of Fish, Cross-Sectional Cut.

(1) The great lateral muscle. This muscle is the major muscle paralleling the body cavity and backbone from the nape to the caudal fin.

(2) The median superficial muscle. These muscles are thin muscle layers just beneath the skin in the same location as the lateral line. They are usually darker in color than the great lateral muscle and contain higher amounts of fat and blood pigments.

## 1-7. MARKET FORMS

a. **General.** Market form refers to the method used to prepare a product for consumer use. After capture, the fish is processed for resale. The preparation forms (methods) are described in purchasing specifications.

b. **Standard Market Forms.** See Figure 1-4.

(1) Form I, whole. Form I products are whole and uneviscerated. The fish is just as it comes from the water. Form I products are not procured by the military services (DOD).

(2) Form II, dressed or drawn. Form II products may be either dressed or drawn. Dressed fish is eviscerated, with gills and viscera removed. Other parts may also be removed, for example, head, scales, and fins, as specified by contract. Examples are red snapper or redfish. Fish products are drawn when just the viscera is removed but not the head or the tail. Examples are catfish and trout. Form II products are not purchased for troop issue, but they are procured for retail stores.

(3) Form III, fillets. Form III products are fish fillets. All of the flesh on one side of a fish is removed by making a single cut, starting at the nape and cutting posteriorly to the caudal fin. They may be skin-on or skinless. When double (or butterfly) fillets are required, the flesh is removed from both sides but left attached at the belly or ventral border of the poke. Examples of Form III products procured for troop issue are perch, cod, and Dover sole.

(4) Form IV, steaks. Form IV products are fish steaks. Crosscut sections are cut perpendicular to the backbone. Examples of Form IV products procured for troop issue are halibut and salmon.

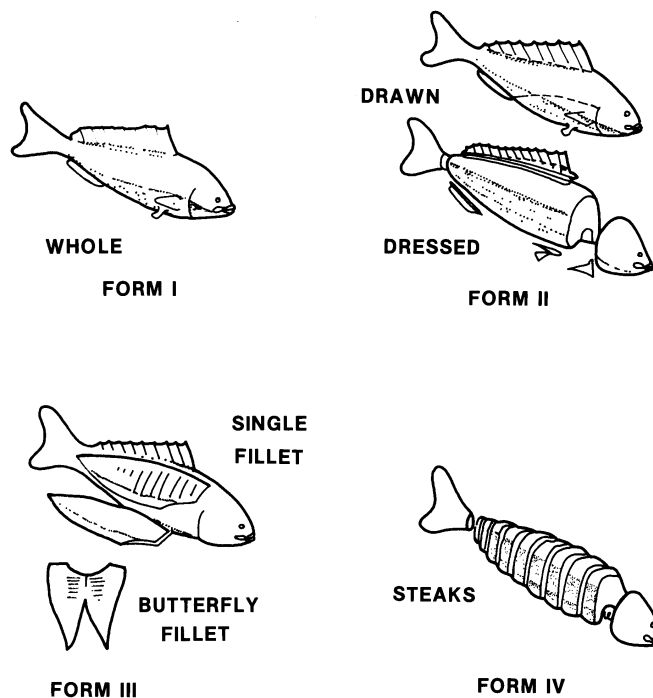


Figure 1-4. Market Forms of Fish.

**c. Other Market Forms.**

(1) Canning. Examples of canned products are salmon, tuna, and sardines. Canned salmon is produced from pieces of salmon that are placed in a 15 1/2 ounce can with salt. The can is sealed and retorted at 250° F (124° C) for approximately 45 to 50 minutes. DOD purchases red (sockeye), medium red (silver), and limited amounts of pink salmon.

(2) Fish portions or fish sticks. Raw, breaded fish portions and sticks are prepared from frozen fish blocks. Approximately 30 pounds of fillet are placed in a container, frozen under pressure, then tempered and cut into portions or sticks to a required size. These pieces are then battered, breaded, and refrozen. Breaded portions and sticks must contain at least 75 percent fish flesh. They may be processed from cod, pollock, haddock, or perch.

(3) Vacuum packing. The product is frozen, placed in a heavy plastic pouch. A vacuum removes the oxygen and the pouch is heat-sealed. Salmon steaks and halibut are examples of products marketed in this form.

(4) Freeze dehydration. In freeze dehydration, the moisture content is reduced to 2 percent. Examples are fish squares (procured for troop issue) and shrimp.

## 1-8. METHODS OF PRESERVATION

a. **General.** Most of the chemical changes in waterfoods can be controlled by proper preservation. There are several methods employed to extend the shelf life of the highly perishable waterfood products. Of these, there are six methods most commonly used for troop issue items.

b. **Icing.** Icing is the method used for whole fresh or eviscerated fish and fresh landed shell fish. The fish must be completely surrounded by ice and the container equipped with drainage for the melted ice. Fresh fish are stored in containers, ranging from 50-pound boxes to holds of fishing vessels with 10,000-pound plus capacity. A layer of ice is placed on the bottom, then a layer of fish, and so on until the container is filled and the last layer of fish is completely covered with ice. This is a short-term storage, normally 7 to 10 days. The inspector will encounter iced fish only when performing class 8 inspections for clubs and open messes and some limited commissary resale operations. There are several disadvantages to icing.

- (1) Spoilage bacteria will continue to reproduce at this temperature.
- (2) The water will affect (bleach) the color of the flesh.
- (3) Frequent reicing is necessary.

c. **Freezing.** Freezing is the primary method used for extended storage periods for practically all forms: eviscerated fillets, fish portions, steaks, and processed shellfish. Freezing provides a year-around supply of seasonal items. The major advantage to freezing is an extended storage period (long-term storage). Methods of freezing are conventional and quick frozen. If frozen rapidly, small ice crystals will develop, resulting in a small drip loss when thawed. If conventional freezing methods are used, large ice crystals will develop resulting in a large amount of drip loss.

- (1) Conventional. The internal temperature must be reduced to 0° F within 72 hours.
- (2) Quick frozen. The internal temperature must be reduced to 0° F within one hour. This method is the one most commonly used.

d. **Glazing.** Glazing is used on a variety of products such as steaks, fillets, eviscerated fish and practically all shellfish, though, for troop issue, primarily seen on Form IV fish steaks. The product is frozen to 0° F (-18° F) by one of the methods above and then dipped in cold water several times (at a temperature of 34° to 38° F) until a protective layer of ice completely covers all surfaces, forming a glaze. Since glazing is a method of preservation by the addition of another substance similar to packaging, a means of determining the amount of glaze is required. This method will be discussed in a subsequent part of this subcourse.

e. **Freeze Dehydration.** Freeze dehydration is a method used to preserve fish squares and shrimp. The moisture content is reduced to approximately 2%. The product is then placed in cans, nitrogen is used to remove the oxygen, and then the can is sealed. This method provides the longest safe storage time. However, freeze dehydration is expensive and is not used as often as other methods.

f. **Canning.** Canning is another method used for food preservation. Canning destroys spoilage bacteria through commercial sterilization and allows long-term storage without refrigeration. Canned salmon, tuna, and sardines are the three items procured for troop issue. However, numerous canned waterfoods may be found in the retail sales stores.

g. **Vacuum Pack.** Vacuum packing is a method that has become more common in waterfood preservation, especially in regard to frozen halibut and salmon steaks. The product is frozen, cut to a specified thickness, weighed, and then placed in a heavy plastic pouch. A vacuum is used to remove the oxygen and the pouch is heat sealed. The packaged product then passes through a steam chamber to shrink the pouch to the product. This eliminates the need to determine the amount of glaze and allows the inspector to examine the product for visual deteriorative conditions (for example, oxidation and freezer burn).

## 1-9. DETERIORATION

a. **General.** Deteriorative conditions are the result of bacteriological changes or chemical changes associated with storage. The most common are described below.

### b. Bacteriological Conditions.

(1) Microbial spoilage. Microbial spoilage is the major cause of deterioration of waterfoods. Fish are high in both water and protein, both necessary nutrients for the growth of the bacterial organisms that cause spoilage. The bacteria associated with fish are predominantly psychrophilic (cold-loving) and grow within temperatures of 32°-70° F. Psychrophilic bacterial contamination produces color changes (from a red to a slight green color), slime formation, and off odors.

(2) Honeycombing. Honeycombing is the formation of small pitted holes within the flesh and is the result of gas forming bacteria. The digestive enzymes, after destroying most of the digestive tract, penetrate the flesh adjacent to the poke. This condition is accompanied by a sharp taste and odor. Honeycombing is sometimes found in canned tuna and salmon. Gas is formed in the flesh by gas-producing bacteria present prior to canning. The inspector will see small pitted holes like pinholes in the surface flesh. A sharp, acid taste can be detected during a sensory examination. Proper sanitation and refrigeration can control microbial spoilage and retard its processes. Honeycombing may also be caused by refreezing; however, this will not affect the taste or odor.



c. **Chemical Changes Associated with Storage.**

(1) Oxidative rancidity. Oxidative rancidity is the result of oxygen combining with polyunsaturated fats of fish, producing a change in color, flavor, and odor. The change starts as a light yellow color, progressing through a golden yellow, to a light reddish brown. The fish has a bitter flavor and emits an odor similar to paint. This poses a problem with fish containing over 6% fat. The median superficial muscle will normally be affected more than the great lateral muscle. Proper glazing and air-tight packaging will prevent oxidative rancidity.

(2) Freezer burn. Freezer burn is a loss of moisture that leaves white dried fibrous areas on the surface of the product that resembles styrofoam. As the condition progresses, these areas become larger and deeper. The surface takes on a spongy texture. Proper glazing and air-tight packaging will prevent this condition.

(3) Storage breakdown. Storage breakdown, discussed in textbooks as protein denaturation (as there is loss of nutritional value), is the result of extended storage or less than adequate storage conditions. The protein breaks down resulting in a light brownish discoloration associated with a bland flavor and storage odor.

**1-10. NATURAL CHEMICAL CHANGES**

a. **General.** In order to understand the importance of handling fish properly, it is necessary to understand the changes through which they go from the time of catch and death until they are finally consumed. The flesh of all animals goes through three changes after death: rigor mortis, autolysis, and final spoilage or putrefaction. Quality in fish is more closely related to freshness than any other factor. Once fish are caught, deterioration immediately sets in and the spoilage process continues, even though the fish are iced down, until the product is no longer acceptable for food. The fact that fish are cold-blooded animals complicates retarding of deterioration. Enzymes and bacteria normally found in fish are accustomed to functioning at lower temperatures than those found in warm-blooded animals. For this reason, control of enzymes and bacteria in fish through chilling is not as effective as it is with red meats. The enzymes of these cold-blooded animals are as active at a temperature of 32° F as those of warm-blooded animals at 70° F.

b. **Rigor Mortis.** Rigor mortis is the first change that takes place in flesh after death. When present, it is an important sign of freshness and wholesomeness. Rigor mortis is caused by a breaking down of the glycogen of the muscle cell into lactic acid, resulting in a firming of the flesh. The body comes rigid. This condition lasts from a few hours to as much as 4 days. When pressure is applied, an indentation is left on the surface. However, once the pressure is removed, the area returns to its original shape. Since rigor mortis is a sign of freshness, it is important that steps be taken to prolong this condition. The slower the onset, the longer rigor mortis will continue. The quicker the onset, the sooner its disappearance. The following factors are directly related to rigor mortis.

(1) Temperature of the flesh. A rise in the temperature of the air and water hastens the onset of rigor mortis. As the temperature increases, the faster the fish will pass through this stage toward deterioration. Rapid cooling of fish immediately after catching slows the onset of rigor mortis and therefore prolongs freshness.

(2) Size. All other things being equal, the smaller the fish, the more rapid the onset of rigor mortis.

(3) Method of catch. Any method causing fish to struggle hastens the onset of rigor mortis. In the struggle, muscle cells convert the stored glycogen to energy causing a sudden release of lactic acid in the cell. During life, this lactic acid is normally carried away by the blood. If large amounts of lactic acid are present in the cell at death, there is an almost immediate onset of rigor mortis.

(4) Method of handling. Stunning the fish prevents a violent death struggle. Evisceration and packing the body cavity with ice immediately after catching will hasten chilling and delay rigor mortis.

c. **Autolysis.** Autolysis is the softening of the fish flesh caused by enzymes which are normally present in the body. It starts immediately following death and continues until final decomposition. Enzymes are chemical substances produced by living cells. They produce changes in other substances without being changed themselves. After death, the body systems that regulate enzyme action no longer function; however, enzyme action continues.

(1) Digestive enzymes. Fish, as with all living animals, derive essential nourishment from eating plants or other animals. To accomplish this, the animal must break down these complex foods into simple compounds that are capable of passing through the wall of the intestine into the blood stream where they can be assimilated by the animal's own body. This process, called digestion, is a chemical process performed by digestive juices containing enzymes. Each enzyme has a specific function; some break down protein contained in the food, others act on fats, and still others on carbohydrates. For example, a fish was eating just before it was caught. It has secreted digestive juices and enzymes to digest its food. However, since there are no body processes to control the functioning of the enzymes when the fish dies, the juices attack the intestinal walls and escape into the muscles of the belly walls where they continue to act.

(2) Body tissue enzymes. The enzymes present in the body tissue enable the body to draw upon stored body reserves for maintenance or energy supplying materials if food is not available to the body. Tissue enzymes are also essential in the healing process by dissolving the damaged cells so that they can be carried away in the blood. The old cells are then replaced by new cells to heal the injured part. Worn-out cells are similarly broken down by tissue enzymes and removed by the blood. Organs such as the pancreas and the stomach undergo self-digestion very rapidly due to the action of the enzymes they normally produce.

(3) Effect of death on enzymes. In the living, healthy animal, enzymes are held in proper balance by the processes of body maintenance. At death, this control ceases and the enzymes are free to attack any substance that they are capable of breaking down. Digestive enzymes are free to attack the intestinal wall and escape to the abdominal cavity where their action is continued. Tissue enzymes, normally found throughout the body, are freed to act on surrounding tissue. The chief effect of enzyme action is the softening of fish flesh. After death, effective preservation methods such as the use of heat, refrigeration, or dehydration must be used to control the rate and extent of enzyme action.

(4) Delay of autolytic action. Autolytic action shortens the duration of rigor mortis. However, autolytic action may be delayed by rapid cleaning and cooling of the fish. For all practical purposes, autolysis is stopped when fish are frozen.

d. **Putrefaction**. Putrefaction is the third chemical change and is evidenced by identifiable odors of deterioration. These odors range from mild to those that are obnoxious. When these odors are present, the fish are considered to be unacceptable for human consumption.

(1) Enzyme action. Bacteria causes spoilage by the enzymes they secrete. The unicellular bacteria can only live on food in a liquid state which can be absorbed through their cell membrane. Before bacteria can multiply on a solid food, they must secrete enzymes to break down the solids into simpler substances. Bitter flavors and unpleasant odors, characteristic of "spoiled" food, are derived from the breakdown substance not absorbed by the bacteria.

(2) Rapid growth of bacteria. Bacteria are present almost everywhere, including the water in which fish live. They are found in large numbers in the body slime, on the gills, and in the digestive tract. As long as the fish is healthy, they have little, if any, effect on the host. At death, however, the fish cease to maintain barriers to bacterial assault, and with the softening of the flesh by autolysis, the growth and spread of bacteria is facilitated.

(3) Factors related to bacterial deterioration. The rate and extent of bacterial deterioration is controlled by the following factors.

(a) The initial load of bacteria on the fish when taken from the water. A thorough washing of the fish to remove the slime eliminates large quantities of bacteria. Evisceration and removal of the gills aboard the ship remove large numbers of organisms before they can multiply.

(b) The temperature of the fish. Because bacteria multiply more rapidly at warm temperatures, fish caught in warm waters are more subject to spoilage than those caught in colder waters. Immediate icing aboard ship and care in packing the body cavity with ice hastens chilling. Freezing checks bacterial action as long as the product remains frozen.

(c) The lapse of time after death. Long voyages from the fishing grounds provide a longer time for bacterial growth.

(d) The type of sanitation practiced aboard ship and at processing and handling facilities. Bacterial build-up on the unclean surfaces of equipment can be tremendous and can contaminate an otherwise excellent product.

(e) Putrefaction can be retarded by thoroughly washing and gutting the fish and removing the gills. Freezing stops it entirely as long as the fish is frozen solid. Fish left whole, just as they come from the waters (Form I), are more liable to putrefaction than those gutted at sea.

(4) End products. The most frequent end product of decomposition is ammonia, a breakdown product of the protein nitrogen of the flesh. Ammonia is evolved rather slowly at first and may not be readily noticeable. In the advanced stages of decomposition, larger quantities are produced and a sharp odor of ammonia is noticeable. The most common odor of stale fish is trimethylamine. Trimethylamine (TMA) is produced by the action of bacteria on trimethylamine oxide which is present in the nitrogenous compounds of fish flesh. The odor of hydrogen sulfide (rotten egg) is not typical of spoilage of fish flesh.

## 1-11. FISH CLASSIFICATION

Based on the deteriorative condition, Table 1-1 provides a list of the characteristics that can be used to determine the condition of a fish product (fillet or steak). The three conditions are fresh, stale, and putrid.

## 1-12. PARASITES OF FISH

a. **Five Parasites.** There are many parasites in fish. Most do not cause diseases in humans and are killed by normal cooking temperature and freezing. There are only two that could cause a potential public health problem and three of commercial importance, because they affect the quality of fish flesh presented to consumers.

(1) European or broad tapeworm. The fish tapeworm (broad or European tapeworm) is identified by its segmented body and broad head. It is mostly found in the U.S. in pike and pickerel fish from midwestern or Canadian lakes. It is also found in some European freshwater fish. The tapeworm is found in cyst form in fish flesh. However, in man, it may grow to its adult size of 20 to 30 feet. Infection (called diphyllobothriasis) is the result of eating raw or inadequately-cooked fish containing the cyst of the *Diphyllobothrium latum*. Proper preparation will render the cyst harmless.

	FRESH	STALE	PUTRID
<b>APPEARANCE</b>	Bright bloom	Dull	Dull - dry
<b>ODOR</b>	Devoid of odor or odor is characteristic of species	Slight off-odor (fishy odor, trimethylamine)	Offensive odor (ammonia)
<b>EYES</b>	Bright, prominent, clear	Opaque, dull, sunken, red bordered	Greatly sunken, broken down, devoid of definition or color
<b>GILLS</b>	Red, free of odor	Reddish-gray, pale yellow, slight odor	Dark brown, offensive odor
<b>SCALES</b>	Glisten, firmly adherent	Dull, loose, easily removed	Dry, loose, come off in hand
<b>SURFACE SLIME</b>	Clear, odorless, or creamy white	Devoid of color or dark, viscous, slight odor	Dry and very sticky, offensive odor
<b>FLESH</b>	Firm, elastic, tight on bones, finger impressions do not remain	Soft, flabby, finger impressions remain	Withered, flabby, finger impressions remain
<b>BLOOD</b>	Bright red, no odor	Dark brown, slight odor	Dirty brown, offensive odor

Table 1-1. Condition classification: characteristics of fresh, stale, and putrid fish.

(2) Roundworm larvae. The roundworm larvae of the Anisakidae family are found in squid and saltwater fish from many parts of the world. For example, it is found in Pacific flat fish. Infected fish are common in U.S. markets and may cause acute gastrointestinal distress (anisakiasis). This is caused by ingestion of larval nematodes of the Anisakidae in raw or improperly prepared (salted, freezing, cooking, smoking) saltwater fish and squid. Heating at 140° F (normal cooking temperature) or freezing at -4° F for more than 60 hours kills the larvae.

**NOTE:** A trend to consume raw, fresh, and unfrozen fish will expose more individuals to parasites and may result in a significant public health problem.

(3) Copepod (sea lice). The copepod is a small crustacean commonly found on Atlantic Ocean perch and on the anal and pelvic fins of salmon. It has a claw-like appendage, which it attaches to the fish, causing areas of inflammation, and abscesses that are visible to the naked eye. Trimming of the affected area is necessary to improve appearance; however, the flesh may be consumed without harm.

(4) Flatworm. The flatworm is common in Pacific Ocean perch. Flatworms are small, discus-shaped parasites which form "nits" or cysts in the flesh 1/8 to 1/4 inch in length and appear as small yellowish-brown to black spots. They are not normally visible to the naked eye. These flatworms are harmless to humans, but are removed for commercial purposes.

(5) Codworm. The codworm is common to the cod family but also may be found in haddock, pollack, and lake and ocean perch. It is also found in the Pacific Ocean species. The codworm is the larval form of the roundworm of the seal and not harmful to humans. The seal must eat the fish for the worm to complete its life cycle. Codworms are small, snake-like parasites, white to light brown in color, which are imbedded in the flesh of the fish. If the fish are immediately processed and quick-frozen, the codworm will normally be coiled to a diameter of less than 1/4 inch. In conventional frozen fish, codworms tend to migrate towards the surface and can be detected by their light brown color in 1 1/2 inch lengths.

b. **Candling**. When required by contractual documents, fillets are candled to detect and remove parasites. Candling devices are constructed by placing a thick, clear plastic cutting board over a light. The fillets are placed on this plastic board, and, as the light passes through the flesh, parasites become visible and may be trimmed from the fillets. The Food and Drug Administration has established a standard for certain parasites in fish which changes from time to time.

## Section II. INSPECTION PROCEDURES FOR FISH

### 1-13. INTRODUCTION

The inspection of fish determines if the condition, identity, and quantity of the fish being received meets the requirements specified in the inspection data packet.

a. The final acceptance inspection at destination and surveillance inspections will be performed by the military veterinary service.

b. The veterinary food inspection specialist performs a visual, tactile, and olfactory inspection of the product in order to identify any abnormalities. The inspector should ensure that his hands are clean and that no abnormal smell is present on his hands before beginning the inspection.

### 1-14. INSPECTION STEPS AND PROCEDURES

a. **STEP 1** - Use the correct inspection data packet.

(1) For prime vendor deliveries, initially refer to the current 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.

(2) Deliveries to Defense Commissary Agency (DCA) facilities will be inspected in accordance with the Joint Food Receipt Inspection Manual (JFRIM). Requirements for these inspections will be in the Retail Ordering Agreement (ROA), blanket purchase agreement, Defense Support Center Philadelphia (DSCP) contract, or other purchasing tool.

(3) Food items inspected at Army and Air Force Exchange Service (AAFES) establishments will be inspected using Exchange Service Regulation (ESR) 1-2.

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

b. **STEP 2** - Inspect the conveyance or storage area, if necessary. (See Subcourse MD0717, Storage and Sanitation, for more information on inspecting a conveyance or storage areas.)

c. **STEP 3** - Select the samples IAW the inspection data packet.

(1) Sample size for prime vendor inspections is IAW local Standing Operating Procedures (SOP).

(2) Sample size for wholesale and retail activities (other than prime vendor) is IAW the JFRIM.

(3) Sample size for all surveillance inspections is IAW AR 40-656 or purchasing agency directives.

d. **STEP 4** - Determine the product approved source status or exempt status.

(1) Some contracts are awarded requiring "inspection at destination only" or for brand name items, e.g., Skipper's Ocean Perch Fillets. In either case, there is no origin inspection. Therefore, the veterinary food inspection specialist is required to inspect for all terms of the contract as stated in the contract. Normally, it is for identity and condition only; however, part of the identity is to determine if the product is from an approved source. To be an approved source, the plant must have been inspected and sanitarily approved and listed in one of the following publications.

(2) To verify the approved source listing or exempt status of the waterfood. (See Subcourse MD0694, Basic Food Inspection Procedures, for further instructions to determine whether a subsistence item is from an approved source.)

(3) Sources of waterfood may be listed in the USDC, "Approved List of Fish Establishments and Products" published by the USDC. Products originating from these establishments may contain on the primary container one of two types of inspection legends. See Figure 1-5. This document is the more important of the two for identity inspection because all waterfood products must be approved by the USDC. This publication is on the world wide web at: <http://seafood.nmfs.gov/publications.html>.

(4) Other water foods may be listed in the U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration's "Interstate Certified Shellfish Shippers List". This publication is on the world wide web at: <http://vm.cfsan.fda.gov/~ear/shellfis.html>.

(5) Other sources may be listed in VETCOM Circular 40-1, Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement.

(6) Exceptions to the above will be provided in the contract.

e. **STEP 5** - Determine compliance with the requirements for packing, packaging, marking, and labeling. The inspector compares information from the inspection data packet and the USDC Certificate of Inspection with the cases in the shipment. He observes:

(1) Packaging and packing of product.

(2) Item description.

(3) Official stamp impression on cases. (See Figure 1-5.)

(4) Dates, lot numbers, code numbers.

f. **STEP 6** - Determine compliance with the requirements for age at delivery and remaining shelf life.

(1) Contractual documents will state the product's maximum age at delivery and/or remaining shelf life requirement.

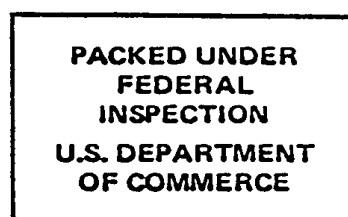
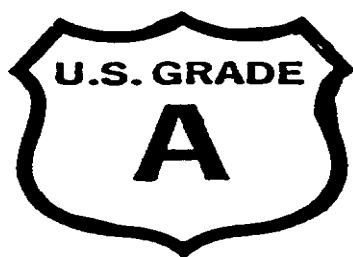
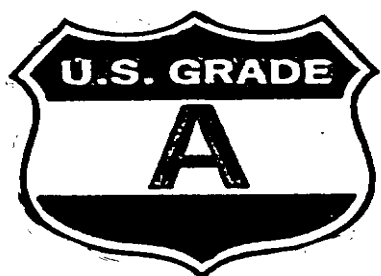
(2) The actual age at delivery (in days) is determined by subtracting the Julian date the product was manufactured from the Julian date the product was received.

(3) The actual remaining shelf life is determined by subtracting the Julian date of receipt from the Julian date of the product's expiration.

**NOTE:** Products labeled with "use by", "best if purchased by", or "best if used by" do not expire on that day. These products may be sold or consumed on that day. The



following day, these items expire and may not be issued or sold unless local command guidance permits shelf life extension.



**The "U.S. GRADE" mark signifies that:**

1. The product is clean, safe, and wholesome.
2. The product is of a specified quality, identified by the appropriate U.S. Grade designation, as determined by a Federal inspector in accordance with established requirements in U.S. Grade standards.
3. The product was produced in an acceptable establishment, with proper equipment and in an appropriate processing environment as required by food control authorities.
4. The product was processed under supervision by Federal food inspectors and packed by sanitary food handlers in accordance with specific Good Manufacturing Practice requirements.
5. The product is truthfully and accurately labeled as to common or usual name, optional ingredients, and quantity.

**The "PACKED UNDER FEDERAL INSPECTION" mark may be displayed:**

1. As an official mark or
2. As an official statement on the product label.

**The mark or statement signifies that:**

1. The properly labeled product is clean, safe, and wholesome.
2. The product has been produced in an acceptable establishment with appropriate equipment under the supervision of Federal inspectors.
3. The product has not been graded as to a specific quality level, rather, it is of an acceptable commercial quality as determined by Federal inspectors in accordance with approved standards or specifications.

Figure 1-5. USDC Inspection Legends

g. **STEP 7** - Determine compliance with the requirements for gross product identity.

(1) Inspection for identity determines if the product is actually what is specified in the contract, and, when inspected at origin, that it is the same product previously inspected. The country of origin must be clearly marked on the box. Inspection for identity may be accomplished by survey of inspection stamps, inspection reports, can codes, case codes, car numbers, invoices, manifests, and labels. (For example, the country of origin can be found in the export document and also is stamped on each box of product.) Cans or other primary containers may be opened for examination of the product.

(2) Next, the inspector opens sample cases to determine if product is that required by the contract. For example, if the contract requires fillets, do cases contain fillets?

(3) **Origin Inspection.** Origin inspection is performed on troop-issue items by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration of the United States Department of Commerce (USDC). (It is not performed by the Veterinary Service.) This inspection is performed on each lot produced by a processor to determine if it meets contractual requirements. When found to be conforming, it is certified and a certificate is issued. A USDC Certificate of Inspection that provides certain information accompanies each shipment received at destination. This information consists of: (See Figure 1-6.)

- (a) Product description, e.g., Fish Portion, Raw, Breaded, Frozen.
- (b) Lot numbers and code numbers and date for each lot produced.
- (c) Number of containers and pounds produced for each lot.
- (d) Stamp number for each lot.
- (e) Total cases and pounds for the shipment.
- (f) Date of shipment.
- (g) Official stamp impression that will be placed on each case.



i. **STEP 9** - Determine compliance with the requirements for obvious condition defects. This inspection is performed to determine if any deterioration is present in the product.

(1) Shipments are inspected to determine if the product is in the condition required by the contract (e.g., fresh or frozen), if the product is at the required temperature, and if the packaging (unit container) and packing (shipping container) are in such condition as to protect the product during storage and distribution.

(2) Perform a sensory evaluation to determine condition. Perform an open-package inspection. Examine fish to determine if it is free of microbial spoilage, oxidative rancidity, freezer burn, and parasites and to determine if it is fresh, not stale or putrid. On frozen items, it may be necessary to partially thaw a small sample to make this determination.

**NOTE:** Ensure products such as crab, lobster, and shellstock are alive if required by contract.

j. **STEP 10** - Report inspection findings.

(1) Report discrepancies to your supervisor.

(2) Document the samples that are destroyed during testing using the appropriate sample receipt.

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

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

(3) Report inspection findings on a DD Form 1232, unless otherwise directed.

## 1-15. QUANTITY

Inspection for quantity is a determination that the quantity (i.e., net weight or count per primary container or unit) is as specified in the inspection data packet.

## 1-16. DETERMINING QUANTITY

When the product has been glazed as a means of preservation, this glaze is not part of the net weight. The procedure below is a method of determining the amount of glaze and the net weight, which is the actual amount of fish flesh.

a. **Determining Percentage of Glaze.** The percentage of glaze is determined as follows:

(1) Determine weight of glaze units as follows:

(a) For small containers (2 lb or less), record the declared net weight.

(b) For larger containers, select a sample of three glazed units, weigh, and record the actual weight.

(2) Remove glaze.

(a) Adjust tap water to a flow rate of about 3 quarts per minute through an aerated faucet.

(b) Direct 50° F to 60° F (10° C to 16° C) tap water on sample while gently feeling and rubbing the surfaces with fingertips. If necessary, temperatures up to 80° F may be used but closer control is required.

(c) When all glaze is removed from cut flesh surface, as evidenced by absence of slick feel to fingers, remove sample from water.

(d) Rapidly remove the excess water before it has time to refreeze on the fish by applying a single paper towel, and flick off the residual skin glaze by knife or hand.

(e) Repeat steps (b), (c), and (d) above on each sample unit.

(f) Weigh and record weight of deglazed sample units.

(3) Calculate the percentage of glaze.

$$\frac{\text{Declared or actual weight} - \text{Deglazed weight}}{\text{Declared or actual weight}} \times 100 = \% \text{ of glaze}$$

b. **Example of Calculations (Percentage of Glaze of a Sample).** The following is an example to work from: Three fish steaks have been selected as a sample from a 50-pound container. The gross weight of the case is 56 pounds, and the tare of packaging and packing materials is 2.5 pounds. The weight of the glazed steaks (actual weight) is 22 ounces. After removal of the glaze, as described above, the deglazed weight is 20 ounces. Calculate the percent of glaze as in (3) above.

(1) To determine the weight of the glaze in the sample taken from the case of fish steaks, subtract the deglazed weight of the fish steaks (20 ounces) from the glazed weight of the fish steaks (22 ounces).



Percentage of glaze = 9.1%

Glazed weight of case of fish steaks = 53.50 pounds

Amount	53.50	
of glaze	<u>x .091</u>	
	5350	
	<u>48150</u>	
Total	= 4.86850	pounds

Rounded to hundredths = 4.87 pounds

Amount of glaze in case = 4.87 pounds

(3) To determine the amount of fish flesh that is really in the case of fish steaks, subtract the amount of glaze in the case in pounds (pounds of glaze) from the glazed weight of the case (actual weight), also in pounds. Round the results to the nearest quarter of a pound. The result is the amount of fish flesh in the case (net weight) in pounds.

Glazed weight of the case (actual weight) = 53.50 pounds

Amount of glaze in case = - 4.87 pounds

Amount of fish flesh in case (net weight) = 48.63 pounds

Rounded to nearest 1/4 pound = 48 3/4 pounds

d. **Noncompliances.** Report noncompliances to the supervisor.

e. **Disposition of Samples.** Determine disposition of samples as taught in Subcourse MD0694, Basic Food Inspection Procedures. All food samples must be accounted for, including unused portions. Unused portions should not be consumed.

***Continue with Exercises***

**EXERCISES, LESSON 1**

**INSTRUCTIONS.** 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.

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

1. The five major chemical components of fish are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.
- d. \_\_\_\_\_.
- e. \_\_\_\_\_.

**SPECIAL INSTRUCTIONS:** Use Figure 1 to answer exercises 2 through 7.

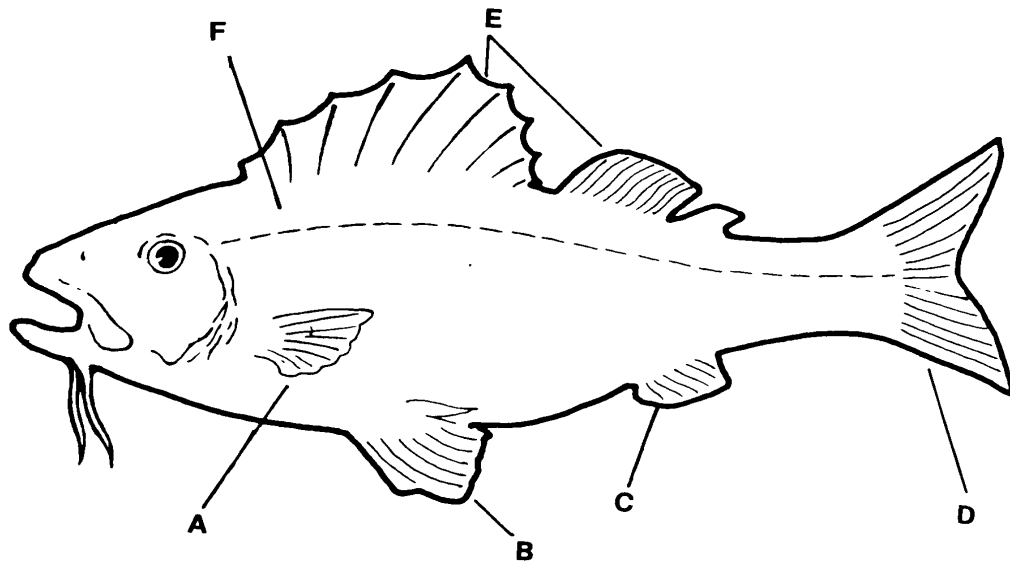


Figure 1. External features of fish.



2. Line A on Figure 1 is the:

- a. Pelvic fin.
- b. Caudal fin.
- c. Pectoral fin.
- d. Adipose fin.

3. Line E on Figure 1 is the:

- a. Adipose fin.
- b. Dorsal fin.
- c. Pectoral fin.
- d. Pelvic fin.

4. Line D on Figure 1 is the:

- a. Caudal fin.
- b. Anal fin.
- c. Pelvic fin.
- d. Dorsal fin.

5. Line F on Figure 1 is the:

- a. Maxillary.
- b. Gill cover.
- c. Mandible.
- d. Lateral line.

6. Line C on Figure 1 is the:

- a. Pelvic fin.
- b. Anal fin.
- c. Adipose fin.
- d. Caudal fin.

7. Line B on Figure 1 is the:

- a. Pectoral fin.
- b. Anal fin.
- c. Pelvic fin.
- d. Adipose fin.

8. Fish are inspected in order to determine if the product is that called for in the inspection data packet. When the veterinary food inspection specialist performs this inspection, he is inspecting for:

- a. Identity.
- b. Condition.
- c. Quantity.
- d. Quality.

9. Inspection of fish includes examination of the product for which of the following?

- a. Sterility, size, and identity.
- b. Size, identity, and condition.
- c. Identity, condition, and sterility.
- d. Identity, condition, and quantity.

10. Fish are inspected in order to determine whether any deterioration has taken place. When the veterinary food inspection specialist performs this inspection, he is inspecting for:

- a. Quality.
- b. Condition.

**SPECIAL INSTRUCTIONS.** Questions 11 through 14 are matching exercises. Match the method used to prepare a fish product for consumer use in Column B to the market form in Column A.

<u>Column A</u>	<u>Column B</u>
11. ___ Form I.	a. Dressed.
12. ___ Form II.	b. Steaks.
13. ___ Form III.	c. Whole.
14. ___ Form IV.	d. Fillets.

15. Four other market forms of fish (not Forms I, II, III, IV) are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.
- d. \_\_\_\_\_.

16. Six common methods used to preserve fish are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.
- d. \_\_\_\_\_.
- e. \_\_\_\_\_.
- f. \_\_\_\_\_.

17. The three changes that take place in fish after death are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.

18. Fish are classified into three conditions, which are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.

19. Five common parasites of fish are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.
- d. \_\_\_\_\_.
- e. \_\_\_\_\_.

20. The temperature of water used to remove glaze should be \_\_\_\_\_.

21. A fish is being inspected. The scales glisten and adhere firmly; the flesh is firm and elastic; the gills are red and free of odor; the surface slime is clear and odorless. The condition of the fish is:

- a. Stale.
- b. Putrid.
- c. Fresh.

22. A Form I fish is rigid. When pressure is applied, the surface can be dented, but once the pressure is removed, the area returns to its original shape. The chemical change that the fish is evidencing is:

- a. Rigor mortis.
- b. Autolysis.
- c. Putrefaction.

23. In order to determine whether there are parasites in fish fillets, the fillets are:

- a. Cut in half.
- b. Washed.
- c. Canded.
- d. Frozen.

24. For troop issue, glazing is used primarily on the \_\_\_\_ market form of fish.
- a. Form I.
  - b. Form II.
  - c. Form III.
  - d. Form IV.
25. The glazed weight of sample fish steaks (actual weight) is 30 ounces. The deglazed weight is 27 ounces. The percentage of glaze is:
- a. 11.12%
  - b. 6.67%
  - c. 11.11%
  - d. 10.00%
26. The gross weight of a case of fish steaks is 55 pounds. The tare of packaging and packing is 2.5 pounds. What is the glazed weight (actual weight) of the case of fish steaks?
- \_\_\_\_\_ pounds.
27. The glazed weight of a case of fish steaks (actual weight) is 53.4 pounds. The percentage of glaze of the sample is 11.1%. The amount of fish flesh in the case (net weight) is:
- \_\_\_\_\_ pounds.

28. You are ordered to perform a sensory evaluation to determine condition. You decide to perform an open-package inspection on a frozen item. Tell how you will perform the inspection and list five factors for which you will check.

How?

Five factors--check for:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.
- d. \_\_\_\_\_.
- e. \_\_\_\_\_.

29. Water constitutes the largest component of the edible flesh of waterfoods. It ranges from:

- a. 78 to 87 percent.
- b. 60 to 80 percent.
- c. 66 to 84 percent.

30. Finfish containing 6 percent lipid content are referred to as:

- a. "Fatty" fish.
- b. "Lean" fish.

31. Some species have two or three dorsal fins. The dorsal fin is toward the:

- a. Middle.
- b. Bellyline.
- c. Head area.
- d. Backline.
- e. Tail area.

32. Which of the following fish is considered a lean fish?
- a. Haddock.
  - b. Chinook salmon.
33. Sensitive nerve endings of fish are located underneath the:
- a. Pectoral fin.
  - b. Lateral line.
  - c. Gill cover.
  - d. Caudal fin.
34. Do fish oils contain a high level of water soluble vitamins?
- a. Yes.
  - b. No.
35. The most common point where deterioration begins is the:
- a. Kidney.
  - b. Air bladder.
  - c. Median superficial muscle.
  - d. Gills.
  - e. Mouth.
36. Both species and age of finfish can be determined by examination of the:
- a. Caudal peduncle.
  - b. Gills.
  - c. Patterns of the pigmented areas.
  - d. Pectoral or pelvic fins.
  - e. Scales.
37. Select the medial fin that, in some species, may contain needlelike bones that may be used as a means of protection.
- a. Adipose fin.
  - b. Anal fin.
  - c. Caudal fin.
  - d. Dorsal fin.
  - e. Pectoral fin.

38. Which fin is the main fin in movement?

- a. Anal fin.
- b. Caudal fin.
- c. Pelvic fin.
- d. Dorsal fin.
- e. Pectoral fin.

39. The adipose fin in a salmon is located near the:

- a. Pelvic fin.
- b. Anal fin.
- c. Dorsal fin.
- d. Gill cover.
- e. Nape.

40. Which fin (or fins) are located on the ventral border and correspond in position to human legs?

- a. Adipose fin.
- b. Caudal fin.
- c. Pectoral fin.
- d. Anal fin.
- e. Pelvic fin.

41. Which of the following fleshy portions of fish are usually darker in color and contain higher amounts of fat and blood pigments?

- a. Caudal peduncle.
- b. Great lateral muscle.
- c. Median superficial muscle.

42. The major muscle of fish, paralleling the body cavity and backbone from the nape to the caudal fin, is the:

- a. Great lateral muscle.
- b. Median superficial muscle.



43. Which fillet leaves some skin attached at the ventral border of the poke?
- a. Single fillet.
  - b. Butterfly fillet.
44. Raw, breaded fish portions and sticks must contain at least \_\_\_\_ fish flesh.
- a. 50%.
  - b. 65%.
  - c. 75%.
45. In which market form are crosscut sections cut perpendicular to the backbone?
- a. Form IV.
  - b. Form III
  - c. Form II.
46. Which method of preservation reduces the moisture content to approximately 2%?
- a. Freezing.
  - b. Vacuum packing.
  - c. Glazing.
  - d. Freeze dehydration.
47. Select the most common method used to preserve fish for short-term storage.
- a. Canning.
  - b. Icing.
  - c. Freezing.
  - d. Glazing.
  - e. Freeze dehydration.
48. A sharp acid taste detected during a sensory examination probably indicates:
- a. Honeycombing.
  - b. Slime formation.
  - c. Rigor mortis.
  - d. Refreezing.

49. " Approved List of Fish Establishments and Products " is published by:
- The Food and Drug Administration.
  - The U.S. Department of Commerce.
  - The U.S. Department of Agriculture.
  - The Office of the Surgeon General.
50. For fish to be from an approved source, the plant must have been inspected and sanitarily approved and listed in:
- Approved List of Fish Establishments and Products.
  - Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement.
  - Both of the above publications.
  - Either of the above publications.
51. Bacteria associated with the microbial spoilage of fish are predominantly:
- Halophilic.
  - Mesophilic.
  - Psychrophilic.
  - Thermophilic.
52. The softening of fish flesh caused by enzymes which are normally present in the body is:
- Rigor mortis.
  - Autolysis.
  - Putrefaction.
53. The breaking down of the glycogen of the muscle cell into lactic acid is:
- Rigor mortis.
  - Autolysis.
  - Putrefaction.

54. When the eyes of fish are red bordered, the gills are reddish-gray or pale yellow, and the slime surface is devoid of color, the condition classification is:

- a. Fresh.
- b. Stale.
- c. Putrid.

55. Acute intestinal distress from improperly prepared squid and saltwater fish is caused by:

- a. Diphyllbothriasis.
- b. Sea lice.
- c. Flatworms.
- d. Roundworm larvae.
- e. Codworms.

56. Which of the following parasites of fish is **NOT** considered harmful to humans?

- a. The larval form of the roundworm of the Anisakidae family.
- b. The cyst of the *Diphyllbothrium latum*.
- c. The larval form of the roundworm of the seal.

**Check Your Answers on Next Page**

**SOLUTIONS TO EXERCISES, LESSON 1**

1.
  - a. Water
  - b. Protein
  - c. Fats
  - d. Inorganic compounds
  - e. Vitamins and minerals. (para 1-2)
  
2. c (Figure 1-1)
  
3. b (Figure 1-1)
  
4. a (Figure 1-1)
  
5. d (Figure 1-1)
  
6. b (Figure 1-1)
  
7. c (Figure 1-1)
  
8. a (para 1-14g)
  
9. d (para 1-13)
  
10. b (para 1-14i)
  
11. c (para 1-7b(1))
  
12. a (para 1-7b(2))
  
13. d (para 1-7b(3))
  
14. b (para 1-7b(4))
  
15.
  - a. Canning
  - b. Fish portions/sticks
  - c. Vacuum packing
  - d. Freeze dehydration  
(para 1-7c)
  
16.
  - a. Icing
  - b. Freezing
  - c. Glazing
  - d. Freeze dehydration
  - e. Vacuum pack
  - f. Canning (para 1-8)

- 17. a. Rigor mortis  
b. Autolysis  
c. Final spoilage or putrefaction.  
(para 1-10a)
- 18. a. Fresh  
b. Stale  
c. Putrid (para 1-11)
- 19. a. Fish tapeworm (broad or European tapeworm)  
b. Roundworm larvae of the Anisakidae family  
c. Copepods  
d. Flatworms  
e. Codworms (para 1-12a)
- 20. 50°-60° F. (para 1-16a(2)(b))
- 21. c (para 1-11; Table 1-1)
- 22. a (para 1-10b)
- 23. c (para 1-12b)
- 24. d (para 1-8d)
- 25. d (para 1-16a,b)

$$\begin{array}{r} 30 \text{ ounces} = \text{Glazed weight} \\ - 27 \text{ ounces} = \text{Deglazed wt} \\ \hline 3 \text{ ounces} = \text{Wt of glaze} \end{array}$$

Divide weight of glaze in sample by glazed weight.

$$\frac{.100}{30/3.000} = 10.0\%$$

- 26. 52.5 lb. (para 1-16c(1))

$$\begin{array}{r} 55.0 \text{ pounds (gross wt)} \\ - 2.5 \text{ pounds (tare wt)} \\ \hline 52.5 \text{ pounds (actual wt)} \end{array}$$

27. 47 1/2 pounds.

(para 1-16c(2), (3))

53.40 pounds (glazed wt)  
x .111 (percent glaze)  
5.92740 = 5.93 pounds

53.40 pounds  
- 5.93 pounds glaze  
47.47 pounds (net wt) Rounded to nearest 1/4 pound = 47 1/2 pounds

28. Partially thaw small sample to determine condition.

- a. Microbial spoilage.
- b. Oxidative rancidity.
- c. Freezer burn.
- d. Parasites.
- e. Condition (fresh, stale, or putrid. (para 1-14i(2))

29. c (para 1-2a)

30. b (para 1-2c)

31. d (para 1-3b(3))

32. a (para 1-2c)

33. b (para 1-4e)

34. b (para 1-2e)

35. a (para 1-6e)

36. e (para 1-4d(2))

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

38. b (para 1-5b(3))

39. c (Figure 1-1)

40. e (para 1-5c(2))

41. c (para 1-6f(2))

42. a (para 1-6f(1))

- 43. b (para 1-7b(3))
- 44. c (para 1-7c(2))
- 45. a (para 1-7b(4))
- 46. d (para 1-8e)
- 47. b (para 1-8b)
- 48. a (para 1-9b(2))
- 49. b (para 1-14d(2))
- 50. d (para 1-14d(3), (5))
- 51. c (para 1-9b(1))
- 52. b (para 1-10c)
- 53. a (para 1-10b)
- 54. b (Table 1-1)
- 55. d (para 1-12a(2))
- 56. c (para 1-12a(5))

***End of Lesson 1***

## LESSON ASSIGNMENT

### LESSON 2

Inspection of Shellfish

### LESSON ASSIGNMENT

Paragraphs 2-1 through 2-22.

### LESSON OBJECTIVES

After completing this lesson, you should be able to:

- 2-1. Identify internal anatomical features of mollusks.
- 2-2. Identify internal and external anatomical features of crustaceans.
- 2-3. Identify deteriorative and unacceptable conditions of shellfish.
- 2-4. Identify inspection procedures for shellfish.
- 2-5. Determine number of shrimp per pound.
- 2-6. Compute percentage of shrimp flesh in breaded shrimp.

### SUGGESTION

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



## LESSON 2

### INSPECTION OF SHELLFISH

#### Section I. SHELLFISH: THEIR COMPOSITION, ANATOMY, AND DETERIORATION

##### 2-1. INTRODUCTION

Shellfish are differentiated from fish by their skeletal structure, which is exoskeletal. For the purpose of this subcourse, they are further divided into two types:

(1) mollusks: oysters, clams, and scallops; and (2) crustaceans: shrimps, crabs, and lobsters. Their chemical composition is basically the same as fish, with some exceptions. Although the amount of shellfish procured by the military is small poundage-wise, the dollar value is significant. A basic knowledge of their anatomical features is necessary to the inspector so that deteriorative conditions can be better understood.

##### 2-2. CHEMICAL COMPONENTS

The basic chemical components of shellfish that are of importance to the inspector are:

a. **Water.** Water is the largest component, averaging 80%. Some shellfish have a tendency to absorb water. Therefore, a water contact time has been established during processing. This is an origin inspection responsibility.

b. **Carbohydrates.** Shellfish contain a measurable amount of carbohydrates. Approximately 0.5% to 6% carbohydrates are found in shellfish. Most of this component is converted to lactic acid during bacterial growth. As a result, the pH value can be measured and is used as a quick quality indicator for freshness of oysters.

c. **Protein.** Shellfish flesh contains 10% to 16% protein, averaging 14%. It is like that found in fish. This protein contains amino acids required by man in his daily diet.

d. **Fat.** There is less than 2% fat; therefore, rancidity is not as much a problem as in fish.

e. **Minerals and Vitamins.** Combined, minerals and vitamins average approximately 2%. Practically every chemical element contained in sea water may be found in shellfish.

f. **Difference from Finfish.** The one difference in the chemical composition of shellfish and finfish is that some shellfish contain a measurable amount of carbohydrates while finfish do not.

## 2-3. INTRODUCTION TO MOLLUSKS

a. **General.** Mollusks are defined as shellfish having soft, unsegmented bodies commonly covered by a hard outer shell. Those with a shell of one piece are called univalves while those with shells of two pieces are bivalves. The shell of the bivalves open and close for normal body function. See Figure 2-1. Mollusks of interest to food inspectors include oysters, clams, and scallops. Mussels, abalone, and squid are of commercial importance, but they are not procured by DOD.

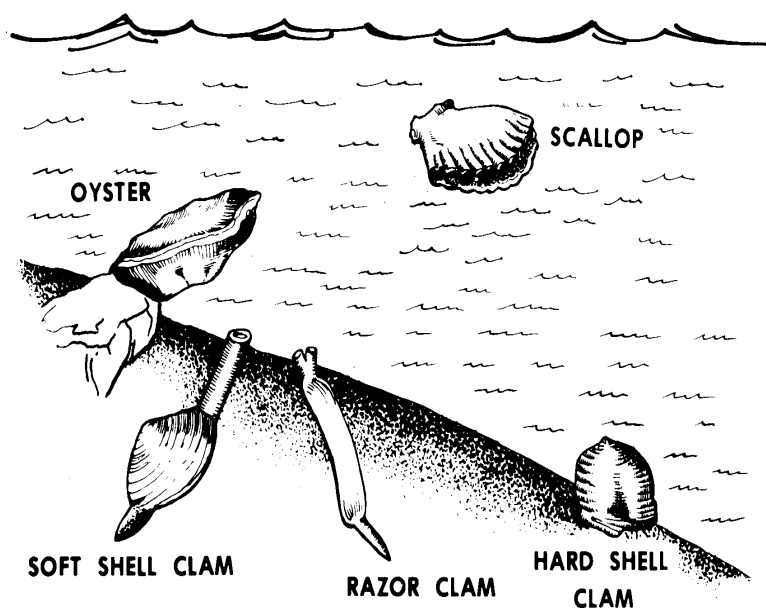


Figure 2-1. Mollusks

b. **Oysters.** Oysters are bivalve mollusks found in most coastal waters, except in the polar seas. They prefer tidal regions, particularly estuaries where the salinity of the sea water is reduced by fresh water rivers. Oysters cannot move about after they have attached themselves at the bottom of a tidal region.

c. **Clams.** Clams, like oysters, are bivalves. The term "clam" includes a number of different species found all over the world. Many clams are able to dig down into the bottom, and, to a certain extent, move around.

d. **Scallops.** Scallops are found in all seas of the world. They are free-swimming and propel themselves through the water by rapidly opening and closing their shell. Scallops are found in deep or shallow water. In the United States, there are only two species of commercial importance: the Bay scallop and the Deep Sea scallop.

## 2-4. ANATOMICAL FEATURES OF OYSTERS

a. **General.** Shortly after spawning, the small oyster is hatched from the larvae, and then swims until it attaches itself to a rocky surface where it remains for the rest of its life. Oysters are bivalves; the body is enclosed in two shells or valves. The shells are hinged at one end by a dark colored elastic ligament. This ligament is so placed that it tends to throw the free ends of the shells slightly apart when the large closing muscle is cut or relaxed. This narrow hinge end is the anterior (front) end of the oyster. The broad opposite end is the posterior (rear) end. The main structure of the body is shown in Figure 2-2. This figure shows an oyster lying in the left shell, which is deeper than the right one. Oysters normally grow upright in the water, the hinged end is down, and the broad posterior end up. The left shell is normally the one by which the oyster is attached to rocks.

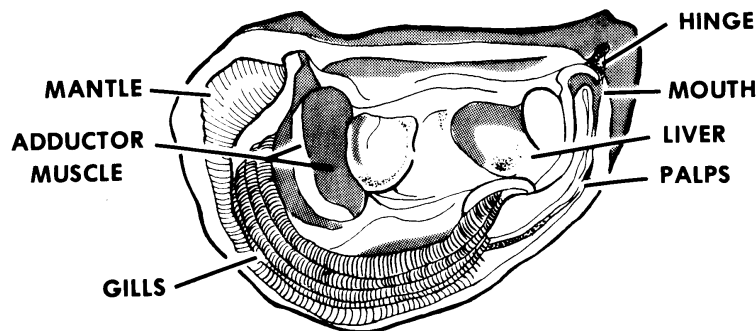


Figure 2-2. Internal Features of Oysters.

b. **Mantle and Shell.** Approximately 90% of the oyster's weight is shell. Each shell is lined with a thin membrane called the "mantle," which is fringed on the edge. The mantle is loosely attached to the shell and covers nearly all of its area. It is free along the margin. The shell, which is produced by the mantle, consists of three layers: (1) a dark, horny, outer layer which is often worn away; (2) a middle layer consisting largely of calcium carbonate deposits arranged perpendicular to the surface of the shell; and finally, (3) an innermost pearly layer made up chiefly of thin sheets of calcium carbonate laid parallel to the surface of the shell. The first two layers are secreted only by the edge of the mantle, and hence show the concentric markings of irregular growth periods. The inner, pearly layer is laid down by the whole surface of the mantle and has a smooth, lustrous surface. In most oysters, the fringed edge of the mantle is of a darker color due to melanin, a normal black pigment. Certain varieties in the southern coastal areas of the United States have a distinct black edge to the mantle and around the adductor muscle, which is considered normal.

c. **Adductor Muscle.** The large adductor muscle is located in approximately the center of the body. The contraction of this muscle closes the oyster shell. It consists of two parts. The inner part merely closes the shell. The white outer part acts as a locking mechanism, keeping the shells together. When the adductor muscle relaxes, the ligament at the hinge forces the shells apart. The main body of the oyster

lies between the two sides of the mantle and is attached to it and the adductor muscle. For shucking oysters, a specially designed knife is inserted between the shell halves to cut the muscle and thus allow the shell to be opened for removal of the oyster meat.

d. **Gills.** Four gills extend along the ventral border of the oyster. Gills are the breathing mechanism for extracting oxygen from the water and releasing carbon dioxide. At the anterior end, four lips or palps reach under the ends of the gills and extend forward toward the mouth. The gills are covered on both sides with very fine hairs (cilia) arranged in rows. These cilia beat back and forth causing a current of sea water to pass into the gills when the oyster has its shell open. There are small openings on the surfaces of the gills leading into "watertubes" inside. The beating of the cilia forces water through these holes and into the watertubes. As the water passes through the gills, the gills extract oxygen and give off carbon dioxide. Experiments have shown that one oyster can pump up to 12.7 gallons of water each hour in this fashion. When the temperature of the water drops to or below 40° F (4° C), the pumping is greatly reduced, or ceases completely, and the oyster goes into hibernation.

e. **Digesting Food.** Tiny food organisms in the water are trapped in slime on the gill surfaces as the water passes through the gills. When these particles become entangled in the slime, the cilia strike against them in such a way as to roll or slide them along the gills toward the mouth. Upon reaching the anterior ends of the gills, they are pushed off, falling between the palps. The palps are also covered with cilia which carry the particles forward until they slide into the mouth. The mouth too is lined with cilia which move the food into the stomach. In the stomach, the food is acted upon by the digestive juices secreted by the digestive gland (liver). The partially digested food is then passed to the intestine where the nutritive portion is absorbed and the indigestible portion passed out of the intestines.

f. **Spawning.** The reproductive organ consists of a mass made up of microscopic tubes and connective tissue lying between the folds of the intestine and investing it, as well as the stomach and the liver, in such a manner as to cover the visceral organs. The branched ducts on the surface over the digestive gland are easily seen when the oyster is spawning.

## 2-5. ANATOMICAL FEATURES OF CLAMS

a. **General.** Clams are moveable bivalves. A clam moves about the shallow beaches in search of food with assistance of its foot. It is normally covered with sand and obtains water into its body by extending the siphons above the sandy surface. Food is obtained in the "filter feeding" manner. The anatomical features are basically the same as the oyster, with some exceptions. See Figure 2-3.

b. **Adductor Muscles.** The clam has two adductor muscles, an anterior and a posterior. Both are used to open and close the shell. There is no locking device as found in the oyster.

c. **Foot.** The foot is a muscular organ the clam uses to move about and to dig. Once the shell is opened, the foot extends through the opening. The clam moves by attaching the foot to an object and then pulling its body towards the object.

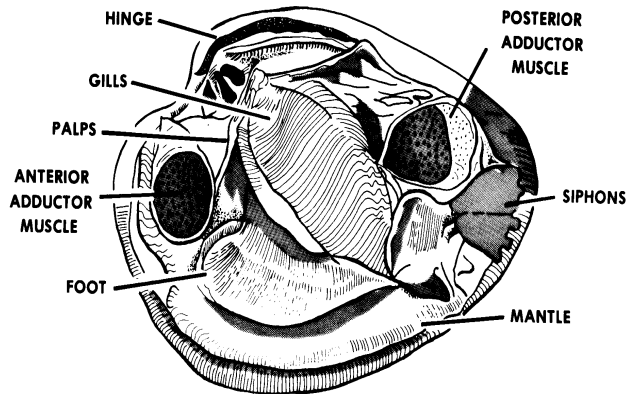


Figure 2-3. Internal Features of Clams

d. **Siphons.** There are two siphons, an incurrent and an excurrent. Water containing food particles is drawn in through the incurrent siphon across the gills and palps. Used water containing body wastes is removed by the excurrent siphon.

## 2-6. ANATOMICAL FEATURES OF SCALLOPS

A scallop is a moveable bivalve found in shallow coastal waters and in depths up to 150 fathoms. Figure 2-4 shows the entire internal anatomy, but the adductor muscle is the only part that is used as food. The scallop cannot close its shell as tightly as does the oyster and clam (it will not stay closed). Therefore, it is subject to rapid deterioration. For this reason, scallops are shucked at sea and all but the adductor muscle is discarded. The adductor muscle is creamy white to a light orange color. The food inspector needs to be aware that occasionally some vendor may try to substitute shark plugs for scallops.

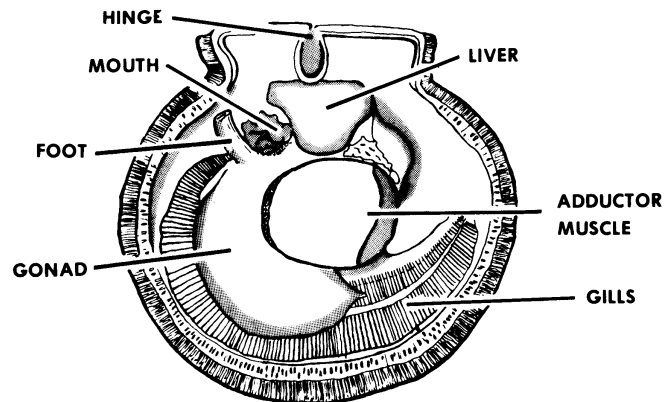


Figure 2-4. Internal Features of Scallops

## 2-7. IDENTIFICATION CHARACTERISTICS OF CRUSTACEANS

The crustaceans purchased for troop issue by DOD are defined as exoskeletal. The body is covered with a hard outer shell that is divided into segments that are joined together (for example, shrimp and spiny lobsters). Shrimp and spiny lobster have the same basic anatomical structure. It is important that the food inspector be knowledgeable of the anatomy of shellfish as each has a bearing on specification and product utilization. In the case of oysters, the entire body is eaten. Only the flesh of peeled and deveined shrimp is retained; the rest is discarded. More shrimp are bought by the military services than any other of the shellfish.

## 2-8. ANATOMICAL FEATURES OF SHRIMP

a. **External Features of Shrimp.** The external features of a shrimp consist of two major parts--the head, which is discarded, and the tail, which is saved. See Figure 2-5.

(1) The head. The head contains the antennae, horn, eyes, and walking legs. The head section is inedible because it contains 75 percent of the natural bacteria. Since heads have no food value, they are usually removed at sea and discarded.

(a) Antennae. Antennae are sensory organs much like the nerve endings under the lateral line of fish.

(b) Rostrum. The rostrum is a horn-like structure above the eyes that has no particular function.

(c) Walking legs. The walking legs are used for movement on the ocean floor.

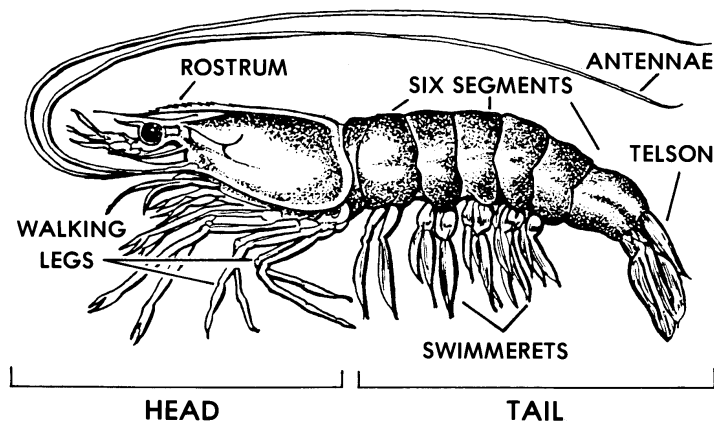


Figure 2-5. External Features of Shrimp.

(2) The tail. The tail is comprised of six segments that contain the edible flesh. The tail also includes swimmerets and the telson.

(a) Swimmerets. Swimmerets function similarly to paddles. They assist the shrimp in swimming.

(b) Telson. The telson, which is the fan-shaped tail of the shrimp, is sometimes called the tail or fan. It is the primary organ used for swimming.

b. **Internal Features of Shrimp.** The internal organs have two features important to the food inspector. See Figure 2-6.

(1) Alimentary canal. The alimentary canal is commonly called the sand vein. Body wastes which contain sand pass through this canal.

(2) Blood vessel. This vessel is not easily seen since the blood of the shrimp is clear.

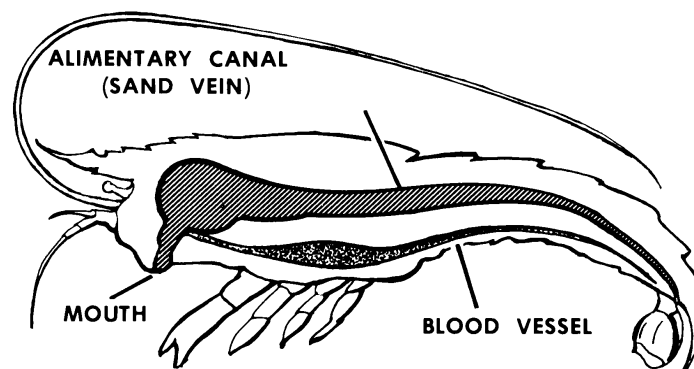


Figure 2-6. Internal Features of Shrimp.

c. **Species of Shrimp.** There are three species of shrimp that are procured for the military services -- white or common, pink grooved, and brown grooved. These can best be distinguished by color and the presence or absence of the groove on the tail segment just posterior of the tail. See Figure 2-7. Colors described pertain to the shell only. The flesh of all shrimp is white. (It is interesting to note that shrimp farming now supplies one-quarter of the world's market.)

(1) White or common shrimp. The shell is a light grayish white to a light gray. The tail segment is not grooved. See Figure 2-7.



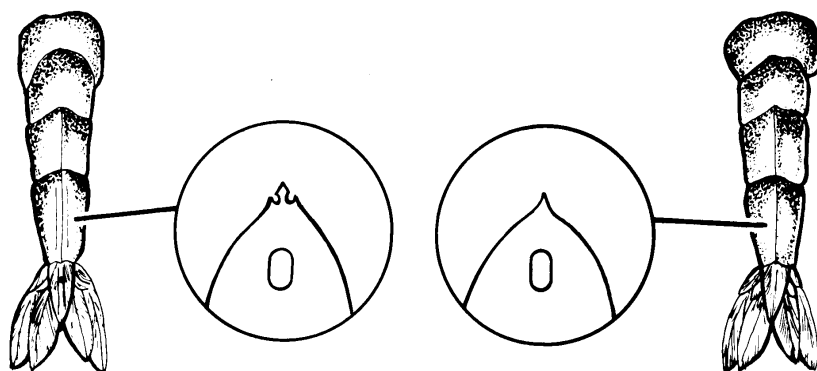


Figure 2-7. Shrimp tails, grooved and not grooved.

(2) Pink grooved shrimp. The shell is a light pinkish brown to a very light reddish brown. On the third tail segment from the head, there is a small pink spot approximately 1/4 inch in diameter. There is a groove on each side of the dorsal ridge of the last tail segment. The scientific name is *Penaeus duorarum*. See Figure 2-8.

(3) Brown grooved shrimp. The shell is a light reddish brown, almost the same as pink. They are grooved but minus the pink spot on the third segment. The scientific name is *Penaeus aztecus*. See Figure 2-9.

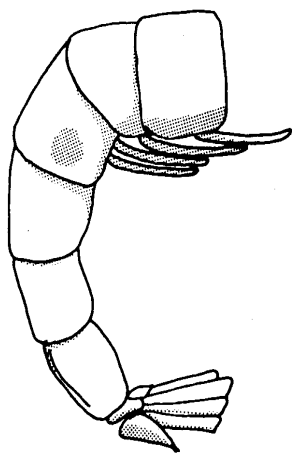


Figure 2-8. Pink grooved shrimp tail.

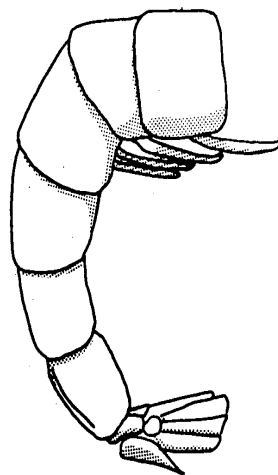


Figure 2-9. Brown grooved shrimp tail.

## 2-9. ANATOMICAL FEATURES OF LOBSTERS

Lobsters are by far the most expensive shellfish item purchased by the military services. Those found within the supply system are the "true Maine lobster" and the "spiny lobster." The anatomy and functions of the lobster are the same as the shrimp except that lobsters have claws on their first walking legs.



a. **Maine Lobster.** The Maine lobster (*Homarus americanus*) is a bluish-green to olive brown color with darker spots.

(1) It has claws on the first four walking legs.

(2) It does not have horns above the eyes.

b. **Spiny Lobster.** The spiny lobster is a greenish color but can contain many varieties of coloration and spots. See Figure 2-10. There are many varieties of spiny lobster (genus *Panulirus*). Most come from the coasts of Florida, Central America, South America, and Australia. The anatomy of the spiny lobster is practically the same as shrimp.

(1) It has no claws.

(2) It has a pair of horns above each eye.

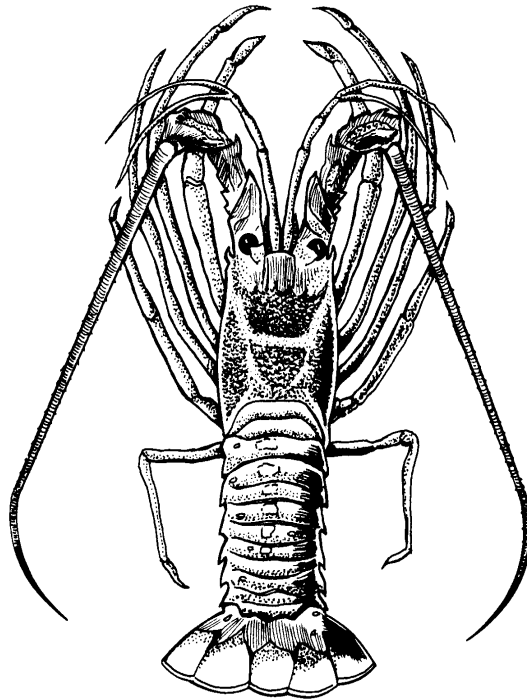


Figure 2-10. The spiny lobster.

c. **Marketing.**

(1) True Maine lobsters are not procured for troop issue. Frozen tails, however, may be found in retail sales. In some cases, the true Maine lobster is available in live tanks. The Maine lobster is sold mainly in the fresh, live state for restaurant use. The inspector will most likely see them on a class 8 inspection.

(2) The spiny lobster may be procured as a troop-issue item. In this case, only the tail will be frozen, glazed, and packaged, as required by contract.

## 2-10. ANATOMICAL FEATURES OF CRABS

Crabs are the last crustaceans to be discussed. Like Maine lobsters, crabs will only be seen on class 8 inspections and limited commissary resale. The external anatomy varies greatly from shrimp. Most of the edible flesh comes from the legs and shoulders. Identification and inspection procedures are governed by local SOP. The most common species are King, Snow, Dungeness, and Blue crabs.

a. **Blue Crabs.** Blue crabs are found on the Atlantic and Gulf Coasts. See Figure 2-11. They are easily distinguished by their blue-green colors and by the shape of the shell, which is drawn out to form a spike on each side. The market size is from approximately 4 to 7 inches in diameter.

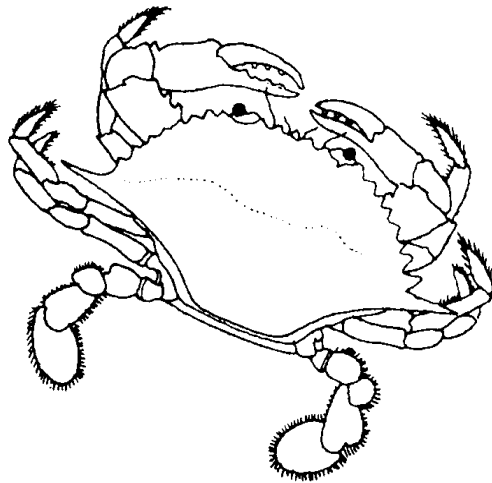


Figure 2-11. Blue crab.

b. **Dungeness Crabs.** Dungeness crabs are found along the Pacific Northwest coast. They are brownish in color. When marketed, they are 6 inches or more at the widest part of the shell.

c. **King Crabs.** King crabs are the largest crustaceans harvested by the United States fisheries. They are found in the northern Pacific off the Alaskan coast. They average about 12 pounds in weight and measure from 2 to 3 feet from tip to tip of the legs. The body is small, compared to the length of the legs. The king crab is by far the most expensive species of the crab. The king crab has a nutty taste.

d. **Snow Crabs.** Snow crabs (opilio crab) are found in the northern Pacific Ocean off the Alaskan coast. Snow crab flesh is less expensive than king crab. When marketed, the edible flesh comes from the legs. The snow crab has a bland taste.

## 2-11. DETERIORATIVE AND UNACCEPTABLE CONDITIONS--INTRODUCTION

a. **General.** Like fish, shellfish are highly perishable, and due to their filtering mechanisms, unacceptable conditions may be present. As previously stated, mollusks obtain their food and oxygen by forcing water across their gills. As plankton and other microscopic organisms are trapped by the cilia, any undesirable organisms present may be trapped, ingested, or retained in the gills, producing unacceptable or possibly toxic conditions. In paragraphs 2-12 through 2-14, these conditions are discussed by species.

b. **Shellfish Poisoning.** Paralytic shellfish poisoning results from eating mollusk that contains saxitoxin. Some shellfish growing areas are normally contaminated with a microscopic plant named *Gonyaulax catanella*, from the order Dinoflagellata. These small plants lay dormant until climatic conditions develop that induce reproduction. Reproduction may reach levels that give the water a reddish cast, referred to as the "red tide." The consumption of these plants by mollusk results in a buildup of saxitoxin. This in turn produces paralytic shellfish poisoning in humans that may result in illness or even death.

## 2-12. DETERIORATIVE AND UNACCEPTABLE CONDITIONS OF OYSTERS

a. **Spawny Oysters.** Spawny oysters can be identified by the presence of a translucent, milky-colored material. When moderate pressure is applied to the body of a shucked oyster, this fluid is released from within the oyster. The condition develops when the water approaches 50° to 70° F (10° to 21° C) during late spring and early fall. As the waters on the Pacific coast seldom reach 50° F, there is a tendency for spawning to continue throughout the summer months. Since 2 to 5 percent of the Pacific coast oysters are spawny by this definition, a tolerance of one spawny oyster per pint has been established for each shipment of oysters.

b. **Undernourished, Elongated Gills.** Undernourished, elongated gills are a condition that may develop in oysters after the heavy spawning periods and normally occurs in late spring or early fall. The gills become thin, watery, and brownish in color. The body is thin and somewhat brownish, not whitish, the color that would indicate a fat oyster of high quality. There are many other factors that may produce this condition, for example, salinity of the water, lack of food, and turbidity of the water.

c. **Pink or Red Oysters.** Pink or red color is a condition that develops in oysters subsequent to shucking and packing (caused by poor plant sanitation). The condition is normally caused by a yeast growth that can develop at temperatures as low as 0°F. On frozen oysters, it appears as small pink or red pinpoint specks; however, in the chilled or thawed state, the discoloration diffuses into the oyster liquor. The inspector will check for this condition at destination inspection and at cold storage sites. Slicing oyster samples and holding them for 24 hours can detect this condition.

d. **Green-Gilled Oysters.** Green-gilled oysters are caused by the accumulation in the gills and mantle of a bluish or greenish pigment derived from certain types of algae and diatoms. The pigments are temporarily stored in the blood cells, filling up the blood vessels of the gills and mantle. The color will be more internal in the gills than in any other area of the body. This condition is not harmful if the oysters are consumed. However, the condition lessens the quality of the oyster. It is not to be confused with natural greenish color sometimes found in the stomach area and caused by excess copper in the blood cells.

e. **Gaper.** A gaper is a dead oyster, one in which the valves are parted and will not close when the oyster is disturbed. A gaper should not be included in a production lot. Since the time of death is not known and the degree of deterioration is also unknown, contamination to the balance of the lot could result.

f. **Measuring the pH Level.** Measuring the acid value of oyster liquor is a fairly accurate quality indicator since glycogen is converted to acid at a standard rate. At origin, the oyster should have a 6.2 pH level, 6.0 at destination, and during surveillance 5.9 or 5.8.

## 2-13. DETERIORATIVE AND UNACCEPTABLE CONDITIONS OF SCALLOPS

a. **Dark Gray or Black Scallops.** Dark gray or black scallop is a condition that develops when the scallops are not iced immediately after being caught. (Scallops are normally shucked at sea with only the adductor muscle being retained, packed in cloth bags, and then thoroughly iced.) This condition can also develop when the scallop is held in a chill state for a long time prior to freezing. The condition starts as a light grayish discoloration on the outside surfaces, becoming darker and penetrating inward. Light gray scallops may be accepted by the inspector.

b. **Diseased Scallops.** Diseased scallops is a condition where small pink nodules, approximately one-fourth inch in diameter, develop within the adductor muscle. The nodules contain a pus-like fluid. The condition is not necessarily confined to the surface. The cause of this condition is unknown. Any lot of scallops with evidence of this disease is rejected.

c. **Yellow-Tinged Scallops.** Yellow tinges around the edges of scallops indicate rancidity.

## 2-14. DETERIORATIVE AND UNACCEPTABLE CONDITIONS OF SHRIMP

a. **Black Spot or "Tigering."** Black spot or "tigering" is a condition caused in shrimp by enzyme reactions in the presence of oxygen. This black discoloration develops where the segmented sections of the shell join together. There is a blackening of melanin pigments in the shell membranes. The blackening appears as black bands where shell segments overlap, giving the tail a banded (zebra or tiger) appearance. This leaves a tigering appearance. This condition when confined to the

shell is not serious, but when it penetrates into the flesh beneath the shell, it is unacceptable. Aboard fishing vessels, chemicals such as sodium bisulfite are added to the shrimp when iced to inhibit this development.

b. **Fever Shrimp.** Fever shrimp is a reddish discoloration of the muscle tissue under the shell of shrimp and other crustaceans. It is the result of improper chilling (icing) after the catch. It is more noticeable in white shrimp. The inspector must not confuse fever shrimp with the normal red membrane that separates the muscle tissue from the shell.

c. **Cotton or Milky Shrimp.** Cotton or milky shrimp is a condition that results in the muscle tissue turning to a gelatinous mass (like jello). The tissue remains soft and mushy even after cooking. The condition is caused by a microscopic parasite that attaches itself to shrimp at some time during the shrimp's life cycle. It causes the flesh to become soft and gelatinous with a cotton or cottage- cheese texture.

d. **Iodoform Shrimp.** Iodoform odor in shrimp is the result of excessive feeding on certain types of seaweed. There is a strong medicine odor and taste in iodoform shrimp. It is common for brown shrimp to have an iodoform taste and odor. However, a pronounced condition is unacceptable as it reduces the palatability for institutional type feeding.

## **2-15. FREEZER BURN/DEHYDRATION AND RANCIDITY**

Freezer burn/dehydration and rancidity are generally a limited problem in shellfish due to the packaging/packing methods. Dehydration affects bagged shrimp more than other shellfish. When observed, chemical changes associated with storage are treated the same as with any other product.

## **Section II. INSPECTION PROCEDURES FOR SHELLFISH**

### **2-16. INTRODUCTION**

The purpose of inspecting shellfish is to determine if the shellfish being received meets the requirements specified in the inspection data packet. These requirements and inspections are for identity, condition, and quantity. This section provides additional information used to evaluate the identity, condition and quantity of shellfish. When performing a receipt or surveillance inspection of shellfish, follow the inspection procedures from Section II of Lesson 1.

### **2-17. IDENTITY**

Inspection for identity is a determination that the product is that specified in the contract; and, if inspected at origin, is the same product. This inspection may be

accomplished by survey of inspection stamps, inspection reports, can codes, case codes, car numbers, invoices, manifests, and labels. (For example, the country of origin can be found in the export document and also is stamped on each box of product.) Cans or other primary containers may be opened for examination of the product.

## 2-18. DETERMINE IDENTITY

a. **Origin Inspection.** Origin inspection is performed on troop issue items by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration of the United States Department of Commerce (USDC). This inspection is performed on each lot produced by a processor to determine if it meets contractual requirements. When found to be conforming, it is certified and a certificate is issued. Each shipment received at destination is accompanied by a USDC Certificate (see Figure 1-6) which provides certain information. This information consists of:

- (1) Product description, e.g., Shrimp, Raw, Breaded, Frozen.
- (2) Lot numbers and code numbers and date for each lot produced.
- (3) Number of containers and pounds produced for each lot.
- (4) Stamp number.
- (5) Total cases and pounds for the shipment.
- (6) Date of shipment.
- (7) Official stamp impression that will be placed on each case.

b. **Other Inspections.** Some contracts are awarded requiring "inspection at destination only" and some for brand name items, such as Skipper's Deep Sea Scallops. In either case, there is no origin inspection. Therefore, the veterinary food inspection specialist is required to inspect for all terms of the contract as stated in the contract. Normally, it is for identity and condition only; however, part of the identity is to determine if the product is from an approved source.

(1) Approved sources for crustaceans. For crustaceans to be from an approved source, the plant must have been inspected and sanitarily approved and listed in one of the following two publications:

(a) VETCOM Circular 40-1 "Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement," published by the US Army Veterinary Command (VETCOM) in CONUS and by major commands overseas.

(b) "Approved List of Fish Establishments and Plants," published by the United States Department of Commerce (USDC). Products originating from these

establishments may contain an inspection legend (see Figure 1-5) on the primary container.

(2) Approved sources for mollusks. For mollusks to be from an approved source, they must have been shucked, packed, and processed in a plant that has been inspected and that has been sanitarily approved and listed in the "Interstate Certified Shellfish Shipper's List," published monthly by Public Health Service, Food and Drug Administration (FDA).

## **2-19. CONDITION**

Shipments are inspected to determine if the product is in the condition required by the contract (e.g., fresh or frozen), if the product is at the required temperature, and if the packaging (unit container) and packing (shipping container) are in such condition so as to protect the product during storage and distribution.

## **2-20. DETERMINING CONDITION**

The veterinary food inspection specialist inspects the product to determine if the product is in less than excellent condition. Excellent condition is a subjective term described as being free of any deteriorative conditions discussed in paragraphs 2-11 through 2-15. Using the sample cases selected for determining identity, the inspector continues as follows:

a. Perform a sensory evaluation to determine condition. Perform an open-package inspection. Examine shellfish to determine if they are free of deteriorative or unacceptable conditions, free of oxidative rancidity or freezer burn, and fresh. On frozen items, it may be necessary to partially thaw a small sample to make this determination.

b. Report noncompliances to the supervisor.

## **2-21. QUANTITY**

Inspection for quantity is a determination that the quantity (i.e., net weight or count per primary container or unit) is as specified in the inspection data packet.

## **2-22. DETERMINING QUANTITY**

a. **General.** The veterinary food inspection specialist determines actual net weight when required by contractual documents or at the request of the accountable officer. In the case of shrimp, shrimp are purchased on count per pound, "the larger the shrimp, the higher the price." For that reason, breaded shrimp are inspected to determine count per pound. Shrimp are graded for quality by USDC and the military inspector IAW CFR 50 Part 265. Size has no bearing on quality. Flavor, odor, and physical defect determine grade.



**b. Determining Count Per Pound (Breaded Shrimp).**

(1) Requirements. The inspection documents are reviewed to determine the number of shrimp per pound required by the contract. The numbers depend on the size of the shrimp and are in four categories: 17 shrimp or less per pound, 20 shrimp or less, 23 or less, and 28 or less per pound.

(2) Procedure.

(a) Remove shrimp from container. Discard shrimp containing less than five segments.

(b) Count number of whole shrimp. Weigh and record total weight.

(c) Divide number of shrimp by weight. Round to the nearest whole shrimp.

(d) Compare results with the contract requirement.

**c. Determining Percentage of Shrimp Flesh (Breaded Shrimp).**

(1) Procedure.

(a) Weigh a specified number of breaded shrimp and record the weight.

(b) Place the shrimp in a large container of water for 15 minutes. Gently agitate by hand until the breading softens and starts to slough off.

(c) Pour shrimp and water through stacked sieves. The top sieve should be #8 x 8 in diameter, the bottom #20 x 8 in diameter.

(d) Hold the shrimp in the stacked sieves under a gentle spray of water. Gently remove the balance of the breading, avoiding removal of shrimp flesh.

(e) After removal of the breading, remove the #8 sieve containing shrimp and let it set for 2 minutes at a 45 degree angle.

(f) Weigh debreaded shrimp.

(g) Determine percentage of shrimp flesh. Divide the weight of the debreaded shrimp by the weight of the breaded shrimp and multiply by 100. Round to the nearest tenth. Then, add plus 2% for moisture migration.



(h) Compare results with the requirement. Breaded shrimp must have at least 50% shrimp flesh and lightly breaded shrimp must have at least 65% shrimp flesh.

(2) Example of calculations. In this example, there are 20 breaded shrimp weighing 14 ounces. Debreaded they weighed 7.5 ounces.

$$7.5 \div 14 \times 100 = 53.6\%$$

$$53.6\% + 2\% = 55.6\%$$

<u>.5357</u>	<u>.5357</u>
14/ 7.5000	<u>x 100</u>
<u>70</u>	53.5700 or 53.6%
50	
<u>42</u>	53.6% + 2.0% = 55.6%
80	
<u>70</u>	Percentage of
100	shrimp flesh = 55.6%
<u>98</u>	(Breaded shrimp)
2	

d. **Net Weight of Glazed Shrimp.** When the product has been glazed as a means of preservation, this glaze is not part of the net weight. The procedure below is a method of determining the unglazed weight of a box of frozen shrimp.

(1) Weigh glazed shrimp and record the weight of the sample unit within the bag or carton.

(2) Place sample unit into 4 gallon container or a larger container.

(3) Using a 75° to 87° F water source, introduce water from the bottom of the container through a hose at 6 gallon per minute flow rate.

(4) After glaze has melted (been removed) and shrimp have separated, empty the container into a tared (preweighed) No. 8 sieve, 12 inches in diameter.

(5) Tilt sieve at a 45° angle and let drain for two minutes.

(6) Weigh both sieve and shrimp.

(7) Determine net weight of unglazed shrimp by subtracting tare weight of sieve from the total weight determined in (6) above.

(8) Compare net (unglazed) weight to the marked net weight on the container.

**e. Final Actions.**

- (1) Report noncompliances to the supervisor.
- (2) Determine disposition of samples. (See Subcourse MD0694.) All food samples must be accounted for, including unused portions. Unused portions should not be consumed.

***Continue with Exercises***

**EXERCISES, LESSON 2**

**INSTRUCTIONS.** 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.

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

1. Shellfish are differentiated from fish by their \_\_\_\_\_.
  
2. The three most common mollusks procured by the military are:
  - a. \_\_\_\_\_.
  - b. \_\_\_\_\_.
  - c. \_\_\_\_\_.
  
3. The three most common crustaceans procured by the military are:
  - a. \_\_\_\_\_.
  - b. \_\_\_\_\_.
  - c. \_\_\_\_\_.
  
4. The basic chemical components of shellfish are:
  - a. \_\_\_\_\_.
  - b. \_\_\_\_\_.
  - c. \_\_\_\_\_.
  - d. \_\_\_\_\_.
  - e. \_\_\_\_\_.

5. The three species of shrimp that are procured for military use are:

- a. \_\_\_\_\_.
- b. \_\_\_\_\_.
- c. \_\_\_\_\_.

**SPECIAL INSTRUCTIONS:** Use Figure 1 to answer exercises 6 through 8.

6. Line A in figure 1 is the:

- a. Mantle.
- b. Adductor muscle.
- c. Gills.
- d. Hinge.

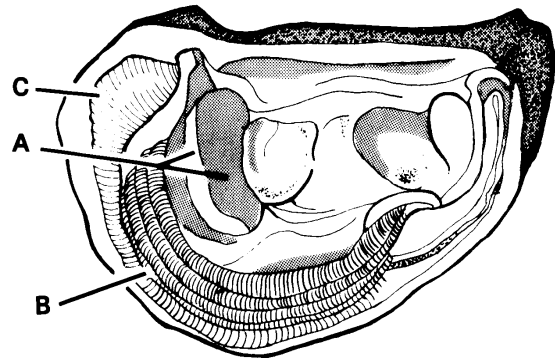


Figure 1. Internal features of oysters.

7. Line C in figure 1 is the:

- a. Mantle.
- b. Adductor muscle.
- c. Gills.
- d. Hinge.

8. Line B in figure 1 is the:

- a. Mantle.
- b. Adductor muscle.
- c. Gills.
- d. Hinge.

9. Shellfish are inspected upon receipt at destination for \_\_\_\_\_, \_\_\_\_\_, and quantity.

**SPECIAL INSTRUCTIONS:** Use Figure 2 to answer exercises 10 through 13.

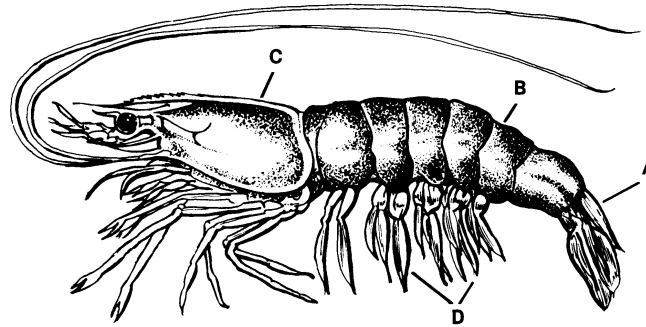


Figure 2. External features of shrimp.

10. Line A in figure 2 is the:

- a. Rostrum.
- b. Antennae.
- c. Telson.
- d. Swimmerets.

11. Line C in figure 2 is the:

- a. Rostrum.
- b. Head.
- c. Antennae.
- d. Tail.

12. Line B in figure 2 is the:

- a. Swimmerets.
- b. Telson.
- c. Tail.
- d. Rostrum.

13. Line D in figure 2 is the:

- a. Swimmerets.
- b. Rostrum.
- c. Walking legs.
- d. Telson.

14. The spiny lobster has claws on the first four walking legs.
- True.
  - False.
15. The most common species of crabs are:
- \_\_\_\_\_.
  - \_\_\_\_\_.
  - \_\_\_\_\_.
  - \_\_\_\_\_.
16. Pink or red-colored oysters are caused by a \_\_\_\_\_.
17. Fever shrimp are caused by \_\_\_\_\_.
18. For mollusks to be from an approved source, they must have been shucked in a plant that has been inspected and that has been sanitarily approved and listed in one of which two publications?
- \_\_\_\_\_.
  - \_\_\_\_\_.
19. To determine the unglazed weight (net weight) of shrimp, the glaze is \_\_\_\_\_, the shrimp are \_\_\_\_\_, the container is emptied into a preweighed \_\_\_\_\_, 12 inches in diameter, and both the sieve and the shrimp are \_\_\_\_\_.
20. The National Marine Fisheries Service, USDC, performs origin inspection on troop issue items.
- True.
  - False.

21. Shellfish are inspected in order to determine count per container. When the veterinary food inspection specialist performs this inspection, he is inspecting for:
  - a. Identity.
  - b. Condition.
  - c. Quantity.
  - d. Quality.
  
22. Shipments of Skipper's Deep Sea Scallops (a brand name item) are inspected at destination only for conformance to all terms of the contract.
  - a. True.
  - b. False.
  
23. For destination inspection, a USDA Certificate provides essential information for Veterinary Service personnel.
  - a. True.
  - b. False.
  
24. A contract requires 17 shrimp or less per pound. In your inspection, you have emptied the container and removed all shrimp (tails) with less than 5 segments. The number of shrimp in the container is 343. The weight of the shrimp is 20.8 pounds. What is the number of whole shrimp per pound?
  - a. 18.
  - b. 17.
  - c. 16.
  - d. 15.
  
25. Determine whether the percentage of shrimp flesh meets the requirement. In the sample selected, there are 20 breaded shrimp weighing 16 ounces. When they are debreaded, they weigh 7.7 ounces. Does the sample meet the requirement?
  - a. Yes.
  - b. No.

26. What percentage of carbohydrates are found in shellfish?
- a. Less than 2 percent.
  - b. 10 to 16 percent.
  - c. 0.8 to 2 percent.
  - d. 0.5 to 6 percent.
  - e. 1 to 28 percent.
27. Do oysters move about after they have attached themselves at the bottom of a tidal region?
- a. Yes.
  - b. No.
28. Which of the following mollusks are found in deep water?
- a. Oysters.
  - b. Lobsters.
  - c. Clams.
  - d. Scallops.
29. Which of the following are not procured by DOD?
- a. Crab.
  - b. Clams.
  - c. Squid.
  - d. Oysters.
30. Which "end" of the oyster is upright in the water?
- a. Broad posterior end.
  - b. Narrow hinged end.
31. How many palps does an oyster have?
- a. 2.
  - b. 3.
  - c. 4.



32. Which mollusk procured by DOD has two adductor muscles?
- a. Scallops.
  - b. Oysters.
  - c. Abalone.
  - d. Clams.
33. Which mollusk procured by DOD has siphons to draw in food and to expel wastes?
- a. Mussels.
  - b. Clams.
  - c. Scallops.
  - d. Oysters.
34. What is the color of the part of the scallop that is not discarded?
- a. Light pink.
  - b. Plain white.
  - c. Creamy white.
  - d. Light orange.
  - e. Either "c" or "d."
35. Select a shellfish that is **NOT** exoskeletal.
- a. Spiny lobster.
  - b. Shrimp.
  - c. Oyster.
  - d. Blue crab.
36. Which of the following parts of a shrimp contains 75% of the natural bacteria found in shrimp?
- a. The tail.
  - b. The head.
37. Which of the following is the primary organ used by shrimp for swimming?
- a. The telson.
  - b. The swimmerets.
  - c. The rostrum.
  - d. The antennae.

38. The sand vein on shrimp is the:
- Siphon.
  - Main blood vessel.
  - Watertube.
  - Alimentary canal.
39. Which species of shrimp has a small pink spot on the third tail segment from the head?
- Penaeus aztecus*.
  - Penaeus duorarum*.
40. Select the lobster with a color that is a bluish green to olive brown, with dark spots.
- Homarus americanus*.
  - Genus *Panulirus*.
41. Which crab has a market size approximately 4 to 7 inches in diameter?
- Snow crabs.
  - Dungeness crabs.
  - Blue crabs.
42. Which crab, when sampled, has a bland taste?
- King crab.
  - Dungeness crab.
  - Blue crab.
  - Snow crab.
43. The "red tide" produces paralytic shellfish poisoning in mollusks. It is produced by:
- Dinoflagellata.
  - Saxitoxin.
  - Diphyllobothriasis.
  - Anisakiasis.

44. When growing areas are contaminated with a microscopic plant named *Gonyaulax catanella*, what might happen if mollusks from the area are eaten?
- Dysentery.
  - A tingling, burning sensation.
  - Paralytic poisoning.
45. Which of the following unacceptable conditions for oysters develops after shucking and packing and is caused by a yeast growth that can develop at temperatures as low as 0° F?
- Green-gilled oysters.
  - Gaper.
  - Spawny oysters.
  - Pink or red oysters.
46. If the gills and mantle of oysters have a bluish or greenish color, will this condition be harmful if the oysters are consumed?
- Yes.
  - No.
47. Which of the following is an acceptable condition for scallops?
- Yellow tinges around the edges.
  - Small pink nodules 1/4 inch in diameter.
  - Dark gray scallops.
  - Light gray scallops.
48. When there is excessive feeding on certain types of seaweed, shrimp have a strong medicine odor and taste. If pronounced, this condition is unacceptable. It is called:
- Cotton shrimp.
  - Fever shrimp.
  - Iodoform shrimp.
  - Milky shrimp.

49. Which of the following unacceptable conditions of the muscle tissue of shrimp is the result of improper chilling (icing) after the catch?
- a. Fever shrimp.
  - b. Milky shrimp.
  - c. Iodoform shrimp.
  - d. Black spot.
  - e. Cotton shrimp.
50. For crustaceans to be from an approved source, the plant must have been inspected and sanitarily approved and listed in:
- a. Approved list, Sanitarily Inspected Fish Establishments.
  - b. Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement.
  - c. Both of the above publications.
  - d. Either one of the two publications above.
51. For mollusks to be from an approved source, they must have been shucked, packed, and processed in a plant that has been inspected and that has been sanitarily approved and listed in:
- a. Interstate Certified Shellfish Shipper's List.
  - b. Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement.
  - c. Both of the above publications.
  - d. Either one of the two publications above.
52. The number of breaded shrimp per pound required by a contract are in four categories. Which of the following is **NOT** one of the categories?
- a. 14 shrimp or less per pound.
  - b. 17 shrimp or less per pound.
  - c. 20 shrimp or less per pound.
  - d. 23 shrimp or less per pound.
  - e. 28 shrimp or less per pound.

53. When the glaze has been removed from glazed shrimp, the shrimp are placed in a preweighed sieve. What is the number and diameter of the sieve?
- a. No. 8, 8 inches.
  - b. No. 20, 8 inches.
  - c. No. 8, 12 inches.
  - d. No. 20, 12 inches.
54. Breaded shrimp must have at least \_\_\_\_ shrimp flesh.
- a. 50%.
  - b. 65%.
  - c. 75%.
55. When glaze is removed from shrimp, the water source temperature should be:
- a. 50° to 60° F.
  - b. 62° to 72° F.
  - c. 75° to 87° F.

***Check Your Answers on Next Page***

**SOLUTIONS TO EXERCISES, LESSON 2**

1. Skeletal structure. ([para 2-1](#))
2. Oysters, clams, and scallops. ([para 2-1](#))
3. Shrimp, crab, and lobster. ([para 2-1](#))
4. Water, carbohydrates, protein, fat, and minerals and vitamins. ([para 2-2](#))
5. White or common shrimp, pink grooved shrimp, and brown grooved shrimp. ([para 2-8c](#))
6. b ([Figure 2-2](#))
7. a ([Figure 2-2](#))
8. c ([Figure 2-2](#))
9. Identity, condition. ([para 2-16](#))
10. c ([Figure 2-5](#))
11. b ([Figure 2-5](#))
12. c ([Figure 2-5](#))
13. a ([Figure 2-5](#))
14. b ([para 2-9b\(1\)](#))
15. a. Blue crabs  
b. Dungeness crabs  
c. King crabs  
d. Snow crabs  
([para 2-10](#))
16. Yeast growth. ([para 2-12c](#))
17. Improper icing or chilling. ([para 2-14b](#))
18. "Interstate Certified Shellfish Shipper's List," and "Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement." ([para 2-18b\(1\)\(a\), \(b\)](#))

19. Melted,  
Separated,  
Sieve  
Weighed.  
(paras 2-22d(4)-(6))

20. a (para 2-18a)

21. c (para 2-21)

22. a (para 2-18b)

23. b (para 2-18b(1), (2))

24. c (para 2-22b(2))

Number of shrimp in the container divided by total weight of the shrimp.  
Round result to the nearest whole number. Result is the number of whole shrimp per pound.

$$343 \div 20.8 = 16.489 \text{ (rounds to } \underline{16})$$

16 whole shrimp per pound

25. a (para 2-22c)

Weight of debreaded shrimp divided by weight of breaded shrimp.  
Multiply quotient by 100 (convert to percent)  
Round to nearest tenth  
Add 2% to result to get total (Percentage of shrimp flesh)

$$7.7 \text{ ounces} \div 16 \text{ ounces} = 0.48125$$

$$0.48125 \times 100 = 48.125\%$$

Round to 48.1%

$$48.1\% + 2.0\% = \underline{50.1\%}$$

(Percentage of shrimp flesh = 50.1%)

26. d (para 2-2b)

27. b (para 2-3b)

28. d (para 2-3d)

29. c (para 2-3a)

- 30. a (para 2-4a)
- 31. c (para 2-4d)
- 32. d (para 2-5b)
- 33. b (para 2-5d)
- 34. e (para 2-6)
- 35. c (para 2-7)
- 36. b (para 2-8a(1))
- 37. a (para 2-8a(2)(b))
- 38. d (para 2-8b(1))
- 39. b (para 2-8c(2))
- 40. a (para 2-9a)
- 41. c (para 2-10a)
- 42. d (para 2-10d)
- 43. a (para 2-11b)
- 44. c (para 2-11b)
- 45. d (para 2-12c)
- 46. b (para 2-12d)
- 47. d (para 2-13a)
- 48. c (para 2-14d)
- 49. a (para 2-14b)
- 50. d (para 2-18b(1))
- 51. d (para 2-18b(2))
- 52. a (para 2-22b(1))



53. c (para 2-22d(4))

54. a (para 2-22c(1)(h))

55. c (para 2-22d(3))

***End of Lesson 2***

COMMENT SHEET

SUBCOURSE MD0711 Waterfoods

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.

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- 2. List any errors.

paragraph error correction

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

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- 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.