Plant Familiarization: Characteristics and Manufacturing Processes – Livestock Slaughter

Objective

After completing this module, participants will be able to describe the characteristics of the regulated industry, the processes used, and manufacturing principles related to the meat industry.

Introduction

The purpose of this module is to give you a brief introduction to the meat industry. We will not be covering the details of how we regulate the meat industry. Your regulatory responsibilities will be addressed in other modules. This module will give you an overview of the processes used and the products produced by the industries that we regulate. We will be discussing some of the slaughter and processing operations as examples, not as standards. Each plant is unique, and the production processes used by plants in your assignment are likely to differ in detail from the ones we present in this module. There are a wide variety of products produced and a number of different activities conducted by regulated establishments. The industry as a whole is dynamic, in that over time, production of products that are not favored by consumers are decreased or discontinued, and new products are created to meet consumer needs.

This section of training is about the nature of the regulated business. As regulators, we must have a general knowledge about the processes that the industry uses to produce products. There are many different types of equipment, processes, and products that might be produced in processing plants. We are going to familiarize you with some of this information. This information is important because it has an impact on some of the establishment's decisions when designing food safety systems. Having this knowledge will help you understand how to perform inspection procedures as an on-line inspector. We will cover some information about the technical aspects of the processes covered by this training. We will also cover some information about the science, especially as it applies to food safety.

We have organized these materials by ***processing categories***. These processing categories are addressed and defined in the Pathogen Reduction/Hazard Analysis and Critical Control Points (PR/HACCP) regulations, 9 CFR 417.2 (b). The 9 different processes include the following:

- Slaughter
- Raw product - intact
- Raw product – non intact
- Heat treated but not fully cooked - not shelf stable
- Fully cooked - not shelf stable
- Product with secondary inhibitors - not shelf stable
- Not heat treated - shelf stable
- Heat treated - shelf stable
- Thermally processed - commercially sterile

The focus of this module will be on the processing categories that are covered in the slaughter process: slaughter, raw product-intact and raw product non-intact. Every federally inspected establishment must develop a Hazard Analysis. When the establishment finds hazards reasonably likely to occur, the product must be produced according to a written ***HACCP*** plan. Many different products may be grouped within a single processing category, as long as the food safety hazards, critical control points, and critical limits are essentially the same.

In this module, we will discuss both quality and safety issues. Both of these issues are important to both the agency and the industry. There are many quality issues, sometimes referred to as ***non-food safety other consumer protection***. Some examples are products with low net weights or with water added above allowed limits. ***Food safety*** issues are given an extremely high priority because of the potential to cause food-borne disease outbreaks. The most common hazard to public health is the presence of harmful bacteria (or pathogenic bacteria). Throughout this module we will point out processes where quality or safety issues are important.

Slaughter Process

Slaughter is the process whereby healthy, live animals are humanely stunned, bled, dehided, dehaired, and eviscerated. The resulting carcass may be split and/or fabricated in some fashion. During this process, inedible and products (e.g., products not used for human food such as the hides) are produced. Edible byproducts (e.g., livers and hearts) are also produced. The establishment must keep inedible materials separate from edible ones. We will cover byproducts when discussing another processing category.

SLAUGHTER - includes all amenable livestock species. Some examples are beef and pork carcasses. Some of the products, such as steaks or ribs, will be distributed for sale following the slaughter process. However, most products go for further processing.

Beef Slaughter Process

Look at the ***process flow diagram*** (at the back of this handout) for the beef slaughter process. This is only an **example** of the slaughter process. These processes will vary from plant to plant. The examples we use are more typical of large plants. Large plants (large volume/many employees) are typically highly mechanized and may process thousands of carcasses daily. Smaller plants follow many of the same steps, but with fewer employees and less automatic equipment.

Beef slaughter covers all market classes of cattle. Class is determined based on maturity and sex of the animal at the time of slaughter. The ***classes*** of beef carcasses are calves, steers, bulls, heifers and cows. There are a number of quality issues that are of concern to the producer, such as marbling, color, and texture of the meat, that do not affect the slaughter process.

Cattle are received, unloaded from trucks, and held in pens. Prior to slaughter, packers will usually require that animals be kept off feed to facilitate the dressing procedures. The amount of time animals are kept off feed will vary by establishment. The animals must have access to water at all times. This is a requirement of the Humane Slaughter Act.

Animal pathology evaluation before death is called ***ante mortem inspection***. The inspection is to identify any disease conditions in the cattle. Some disease conditions are unacceptable because they may affect human health. Others are unacceptable from a quality standpoint.

Stunning is the first step in the slaughter procedure. This must be done in a way that complies with the Humane Slaughter Act. Most establishments use a mechanical method, such as a captive bolt, to render each animal completely unconscious with a minimum of excitement and discomfort.

Sticking causes death, resulting from the rapid loss of blood (***exsanguination***). A sharp blade is inserted into the neck, severing the carotid arteries and jugular vein. Typically, this is done while the animal is hanging head down from the rail. These overhead rails or tracks move at a controlled speed so that the carcass advances through the various slaughter processing steps.

The next step is ***removing the hide***. This may be achieved through various methods, either using mechanical equipment or by hand (at small operations).

After the head and hide are removed, many establishments use ***anti-microbial interventions*** (refer to “Beef Slaughter Intervention” section, page 4). The industry uses organic acid (such as lactic acid or acetic acid) carcass washes that help reduce and eliminate bacterial contamination. Another innovation is the steam vacuuming system, which is done to the dehided carcass, either before or after evisceration, to remove contamination.

Bunging happens prior to evisceration, when the rectum (bung), is secured to prevent contaminating the carcass with fecal material.

Evisceration is done to separate the internal organs from the carcass. Even in highly mechanized plants, this is still done by hand. It is important that evisceration is done properly, to prevent ***contaminating*** the carcass with the contents of organs such as the stomach or intestines. Fecal material or stomach contents ***(ingesta)*** will contain many bacteria, and may possibly harbor certain harmful bacteria ***(pathogens)*** like *E. coli* O157:H7 and *Salmonella*.

At this point the carcass receives ***post mortem inspection***. Similar to ante mortem inspection, the carcass is examined for disease conditions that cause the carcass or parts to be unacceptable for human consumption.

Next the carcass is ***split*** with a saw. At the trim rail, an inspection reveals whether the carcass is free from contamination or quality concerns that can be removed by ***trimming***.

In the next step, the carcasses are weighed, ***marked*** with an official USDA inspected and passed brand, and washed. They move to a chill box or cooler and are ***chilled*** to a specified temperature. The chilling step helps inhibit the growth of microorganism. There are various methods and equipment used for chilling the carcass.

Carcasses are typically ***stored*** in large refrigerated warehouses called coolers until they are shipped. It is important that an appropriate temperature, humidity, and air flow be maintained in coolers. Generally, the colder the temperature in the cooler, the slower the bacteria grow. Proper temperature is essential for preserving the quality and maintaining the safety of the product.

From this point, the carcass halves are ready to be ***fabricated***, which means cut into parts. This ***further processing*** may happen at the slaughter facility in a processing or fabrication department, or the carcasses may be shipped to another plant.

Edible and inedible byproducts will be covered when we discuss the Raw Product – Intact processing category. (Some establishments may include edible and inedible byproducts in their Slaughter HACCP plan.)

Beef Slaughter Interventions

Knife trimming and carcass washing with plain water were historically the primary means by which the industry addressed meat contaminants. However, the occurrence of food borne disease outbreaks and scientific advances over the years have shown that trimming and washing alone will not achieve the level of food safety that regulators and consumers expect from meat products. In response to food safety concerns, the industry and scientific community, with encouragement from FSIS, have introduced numerous antimicrobial interventions to the beef slaughter process.

Steam Vacuum System

Steam vacuum systems are designed to remove small visible spots of contamination from carcass surfaces. The system is a hand-held apparatus that uses a hot water spray (185º F) in a vacuum nozzle, with steam sprayed above and below the vacuum head. The hot water sprayed onto a carcass kills 90% or more of the bacteria and detaches contamination such as ingesta or feces, which is then vacuumed off. Many establishments utilize the steam vacuum system at multiple points in the slaughter process. For example, there may be a steam vacuum location after each of the carcass parts is skinned.

The following items may be considered as guidelines for the use of the steam vacuum system. Establishments may develop alternate parameters and should have supporting documentation to validate the use of such parameters.

- Fecal and ingesta contamination ***less than one inch*** in its greatest dimension may be removed by the steam vacuum system; however, contamination *one inch or greater* in its greatest dimension should be trimmed by a knife.
- Accurate temperature and vacuum readings should be provided.
- Water or steam temperatures should be maintained at a minimum of 180º F.
- The vacuum pressure at the carcass surface should be sufficient to remove the steam and water from the vacuum area to prevent dripping.
- The outer surface of the vacuum head should be continuously sanitized (180º F minimum steam) during its use.

Carcass Washes Followed by Organic Acid Rinses

After hide removal, the carcass may be subjected to a pre-evisceration wash and subsequent organic acid rinse. The use of a carcass spray immediately after hide removal serves to remove

bacteria before they have the opportunity to attach themselves to the carcass surface and begin growing. The subsequent organic acid rinse then provides a significant kill step for any bacteria that remain on the carcass surface. This intervention is also commonly applied after the slaughter process is complete and before the carcasses enter the cooler. The organic acids commonly used are *acetic* and *lactic*, although *citric* acid is also approved for this purpose. The concentration of the organic acid is between 1.5% and 2.5% and it may be applied as a mist, fog, or a small droplet rinse. (The establishment may use a concentration greater than 2.5% with supporting documentation.) Studies have shown that washing followed by an organic acid rinse is significantly more effective in reducing bacterial numbers than washing alone.

Other Antimicrobial Chemicals

Some other chemicals utilized as an antimicrobial rinse in beef slaughter include the following:

Acidified Sodium Chlorite (Sanova®)—has been shown to have a significant kill rate for *E. coli* O157:H7*, Listeria, Campylobacter, Salmonella*, and other bacteria. Applied at ambient temperature by spray at 500-1200 ppm, it is being used in several establishments across the country.

Lactoferrin—Applied as a spray in a 1% solution as the final step of the slaughter process. Lactoferrin (which is an allergen) has been shown to be effective against more than 30 food borne pathogens, including *E. coli* O157:H7*, Salmonella,* and *Listeria.*

Hot Water Rinses

High temperature water (>160º F) sprayed on the carcass as the last step prior to chilling has been shown to be effective in substantially reducing the numbers of *E. coli* O157:H7 and *Salmonella.*

Steam Pasteurization

Steam pasteurization is a process in which the carcasses are placed in a slightly pressurized, closed chamber at room temperature and sprayed with steam that blankets and condenses over the entire carcass, raising the surface temperature to 185º F and killing 95-99% of all bacteria. Carcasses are then sprayed with cold water.

Multiple Hurdle Approach

Studies have shown that, rather than rely on any one intervention, it is more effective to use the “multiple hurdle” approach to pathogen control. In using this approach, an establishment will utilize multiple interventions at various steps of the process to achieve the maximum reduction in bacterial numbers on the carcass. For example, a beef slaughter establishment may utilize the steam vacuum at multiple locations as the carcass is dehided, rinse the carcass at pre-evisceration with water followed by an antimicrobial spray, then wash with water, steam pasteurize, and rinse again with an antimicrobial spray prior to chilling.

Some commercial applications have combined these different interventions to provide an enhanced antibacterial effect. For example, a beef slaughter establishment may use a process called Thermal Organic Rinse (TOR) which utilizes organic acid heated to 131 ºF to provide greater bacterial reductions. Other systems utilize a hot water wash followed immediately by an organic acid spray.

Pork Slaughter Process

Now, let's look at the process flow diagram for pork slaughter. We will discuss the process for the skin-on pork carcass, which is most common. There are other pork slaughter processes, such as skinned, or hot boned.

Hog slaughter is somewhat similar to beef slaughter, but there are some major differences. We will highlight only the differences, rather than repeating information that is the same.

Hogs are usually stunned with an electrical shock or by the use of carbon dioxide that renders them unconscious and insensible to pain.

Sometimes hogs will be hanging during the sticking and bleeding step. However, sticking and bleeding can also be done while the hog is lying on its side or being held on its back.

Instead of removing the hide, usually hogs are scalded and ***dehaired***. Then, they are quickly singed with a flame to remove any remaining hairs.

The step called "***gambrelling***" refers to slicing the tendons on the back of the hock so that the carcass can be hung on a gambrel, or special type of hook.

Raw Product – Intact

The Raw Product –Intact HACCP processing category applies to product that is further processed directly following the slaughter processing steps or after receiving raw products. The processing steps at the establishment include the meat fabrication. Beef manufacturing trimmings (e.g., pieces of meat remaining after steaks, roasts, and other intact cuts) is also an example of intact raw beef product. FSIS considers raw products to be intact unless they have undergone any of the processes associated with the non-intact HACCP processing category.

Notice that the first step is Carcass Receiving. Carcasses are chilled after slaughter for a specified period allowing them to become firm to facilitate a neat job of cutting.

Fabrication

Fabrication refers to creating the various cuts from the carcass to produce particular types of product. ***Primal*** or ***wholesale*** cuts are made first. Their names usually identify where the meat comes from on the animal, such as the loin, the shoulder, etc. The plant typically uses large mechanized saws to fabricate the carcass into primal cuts. Retail cuts tell what part of the primal cut the meat comes from, for example, rib roast or round steak. Retail cuts may be made with a saw, especially if they include bone. Often, primal parts are boned before cutting into retail cuts, in order to produce boneless items. Establishments that produce portion controlled retail cuts for hotels, restaurants, and institutions are often called ***HRI*** operations.

Packaging

Packaging materials, such as wax treated paper or plastic film, protect the product from damage during refrigeration or frozen storage. The final step is distribution, either to other departments in the same plant, other plants, or to retail markets.

Byproducts

The processing category of Raw Product-Intact includes edible byproducts. Consumer demand has had an effect on production levels of various byproducts.

Edible Byproducts

Some of the edible byproducts include tongues, brains, sweetbreads, hearts, livers, and kidneys. They may be sold as fresh or frozen items, or used to make other processed foods. BSE is a progressive neurological disorder of cattle. The highest food safety risk is in the Central Nervous System of cattle. High-risk tissues for BSE contamination, known as **Specified Risk Materials (SRM)**, include tonsils and distal ileum for cattle of all ages. For cattle 30 months of age or older, additional SRMs include the cattle's skull, brain, eyes, spinal cord, dorsal root ganglia, trigeminal ganglia, and sometimes the vertebral column. SRM are inedible and prohibited for use as human food.

Mechanically Separated Product

Often, the industry searches for ways to yield the maximum edible, wholesome product from the meat or poultry carcass. The mechanical separation process is a way to obtain more usable product from bones from which the muscle has been removed. Often, you will see these products referred to as ***"mechanically separated (species) or MS (species)".*** Any species can be used: beef, veal, lamb, or pork. As per 9 CFR 319.5(b) mechanically separated beef is prohibited for use as human food.

The process begins with bones. Bones for this process have usually already had most of the muscle tissues removed by hand boning, or they are bones, like neck bones, which are difficult to process. The bones are ground up, and the resulting mass is forced through a sieve. The softer muscle particles are thus separated from the hard bone particles, which remain behind the sieve. The resulting product has a paste-like consistency.

Great pressure is used to force the product through the sieve, and this result in a temperature rise in the product. Therefore, product must be processed quickly and the temperature immediately reduced, in order to prevent oxidation and microbial degradation of the product. Even with these precautions, this product will deteriorate quickly. Although mechanically separated product has many of the characteristics of meat and may be used as a meat ingredient in the formulation of quality meat food products, it is not meat, as defined in the regulations. In particular, the consistency of mechanically separated livestock product and its mineral content are materially different from those of meat. The bone marrow, spinal cord, and a certain amount of fine bone particles are included in the finished product. However, there are specific limits on the quantity and size of the bone particles included in the final product. There are also limits on how much of the mechanically separated product that can be used in meat products, and it must be identified in the ingredients statement of the label.

Advanced Meat Recovery (AMR)

This process obtains the meat tissues from the bones without including materials that are not normally expected in meat. The resulting product consists of distinct particles of meat, with the typical color and texture of the species used. Regulation 9 CFR 318.24 prohibits the use of skulls or vertebral columns (excluding the vertebrae of the tail, transverse processes of the thoracic and lumbar vertebrae, and wings of the sacrum bones) of cattle 30 months of age and older from use in an AMR system.

Raw Product Non-Intact

This HACCP processing category applies to establishments that further process by using processing steps such as grinding, comminuting, injecting product with solutions, or mechanical tenderization by needling, cubing, pounding devices or other means of creating non-intact product. Examples of finished products in this category include raw products reconstructed into formed entrees, mechanically separated species and advanced meat recovery product. If the establishment produces bench trim or pieces of meat produced from non-intact meat, then the bench trim or pieces are also considered non-intact.

Some of the common products are ground beef, hamburger, ground beef patties, ground pork, fresh sausage, and Italian sausage. Beef, pork, veal, and lamb can all be ground and sold or used in other products. One of the favorite products served in this country is the hamburger patty, which is the example we will use in this section. However, the processing steps that are used to produce hamburger patties are also used for other products. Establishments differ in how they design their production processes, and you may see many variations of the basic processes that we illustrate.

Tenderization

Tenderization is another procedure used in some plants. All cuts can be tenderized, but this is typically used on cuts from lower quality grades and less tender cuts of higher graded carcasses. There are several methods for tenderizing meat. They include aging, use of enzyme solutions, and use of mechanical tenderizers. Mechanical tenderizers typically press many thin blades through the meat pieces, cutting the muscle fibers.

Non-meat Ingredients

Sometimes ground products contain non-meat ingredients. Ground products are often seasoned with salt, sugar, spices, or other flavorings. Depending on the product being made, water may be added, and some product formulations include binders and extenders such as soy flour or nonfat dry milk.

Establishments use a specified recipe, called a ***formulation***, to create a consistent product batch after batch. The formula lists the weights or percentages of ingredients to be used. Meats and other ingredients are weighed before use to ensure that the proper amount of each is added to the batch.

Non-meat ingredients and packaging materials will come from outside suppliers. Many establishments use a combination of suppliers, depending on the cost and type of product available from each. Dry ingredients and packaging materials are also received and stored prior to use.

Raw Materials

Raw materials for non-intact products include boneless meat, ***trimmings*** of different fat content (***trimmings*** are the unwanted pieces that are removed from carcasses while producing higher quality retail cuts of meat), meat from older animals, head meat, cheek meat, diaphragm meat, esophagus, and advanced meat recovery products. Grinding is a way that establishments can use lower quality products that would not be saleable to a retail consumer. In addition to beef trimmings, ground beef is also commonly made from flanks, short plates, shank meat, briskets, and chucks. Meat ingredients used may be fresh or frozen, or a combination.

Some of these raw materials have undergone several processing steps already and have the potential to have become contaminated. Grinders are dependent on their suppliers to eliminate or reduce microbial hazards because antimicrobial treatments and interventions are most practical when the product is still intact.

Meat for use in non-intact products may come into the establishment from outside suppliers, or it may be produced within the establishment during fabrication and boning operations. ***Written purchase specifications*** are developed by some establishments to ensure that a consistent product is received. Specifications are formal agreements between the supplier and the purchaser, and may include quality aspects, such as portions of lean and fat, and safety factors such as laboratory testing for pathogens.

After meat ingredients are received, they are stored in freezers or coolers until use. Meat products must be maintained at refrigeration temperatures adequate to prevent spoilage and growth of pathogens.

Refrigeration achieves several purposes. It slows the growth of microorganisms, including spoilage bacteria and pathogens. It slows down metabolic and enzymatic activities within the meat tissues that would lead to product deterioration. It also reduces moisture loss from the product.

Chiller or cooler temperatures in the range of 38° F - 45° F will substantially retard most pathogen growth. Chiller storage is temporary, however, because even at these temperatures, the spoilage organisms will continue to grow, although at a very slow rate. Freezers, generally maintained at -10° F or below, suppress the growth of all bacteria. Product kept at these temperatures will maintain safety and quality for longer periods of time.

Reduction of Particle Size

Comminution is the process of reducing the particle size of meats. Several different machines are used, including the flaker, the grinder, and the bowl chopper. Some producers use a combination of several of these in the production of a product.

The ***grinder*** consists of a hopper into which the meat chunks are placed. The meat then moves along an auger or screw, through a cylinder, at the end of which is a grinding plate and a knife.

As the meat is pressed up against the plate the knife turns and cuts off small bits of the meat. The size of meat particle produced is determined by the size of the holes in the grinding plate.

Another method of reducing particle size is the ***bowl chopper***. This machine consists of a metal bowl that revolves and a metal knife that rotates, cutting through the meat pieces in the bowl. The bowl chopper also mixes product as it chops it.

The ***flaker*** is used on large frozen blocks of meat or meat trimmings. Product is pressed against the knife blades, which shave off pieces of the still-frozen meat, enabling it to be used in formulation without thawing.

Sometimes meat ingredients go through several grinding processes. Often, fat and lean meat ingredients are ground separately and then combined.

After comminuting, products are mixed thoroughly. Often product is transferred to a separate piece of equipment, called a mixer or blender, in order to mix it. The ***mixer*** consists of a chamber that the ingredients are placed into, and blades or paddles that turn and mix the product, resulting in a uniform distribution of fat and lean particles. Non-meat ingredients, if used, are added at this stage.

After comminuting and mixing, the ground meat mixture is often ***shaped*** into different forms. Fresh sausage may be extruded into a casing. Hamburger or ground beef is often shaped into patties using a patty machine. After formation, the patties may be frozen.

Because of the moving metal parts common in these operations, there is a possibility of metal chipping or breaking. Proper maintenance of equipment is essential to reduce this possibility. Some establishments use a ***metal detector*** to identify product that may be contaminated with metal fragments.

Testing: Many companies now routinely test their product, such as testing raw ground beef for *E. coli* O157:H7.

The final step for ground products at the processing establishment is ***packaging and labeling***. Product may be packaged into retail size packages, into larger containers for institutional use, or into bulk containers for sale to other establishments for further processing. Although there are many different combinations of packaging materials in use, plastic liners and cardboard boxes are some of the materials commonly used. Labels must accurately reflect the product.

Trace Back and Trace Forward

Although the grinding establishment may not have access to records of the farm sources of their raw material, or records maintained by the plants that slaughter, dress, and bone their raw materials, they should purchase raw materials from suppliers that maintain such records. Establishments should also maintain records of distribution of products. These records can facilitate trace back and trace forward in the case of a recall or of an outbreak of foodborne illness.

Some establishments have developed a production coding system for tracking purposes. These systems enable the establishment to track the product from the raw material source up to the finished product.

Rework

Rework is sound finished product that is reincorporated into a batch of fresh ingredients prepared to make similar finished product. Establishments also sometimes choose to develop a rework tracking system to reduce the amount of product that would be implicated in a recall. Some establishments include all rework at the end of the production day, or divert it to cooked product processing departments.

There have been instances where a product recall was greatly affected by the establishment's ability to track the use of rework. In one example, an establishment recalled a large amount of product due to the presence of *E. coli* O157:H7, found during the investigation of an outbreak of food borne illness. Review of the establishment's production practices revealed that some of the production lot that was recalled had been used as rework in subsequent days' production. As a result, the recall was expanded to include the entire amount of production that may have included the rework. This recall eventually involved over 25 million pounds of product.

Processing Categories

9 CFR 417.2(b) requires establishments to develop and implement a written HACCP plan covering each product produced by that establishment whenever a hazard analysis reveals one or more food safety hazards that are reasonably likely to occur. The regulation lists processing categories that group products by major processing parameters.

A single HACCP plan may be written for **multiple products** within a single processing category, as long as the hazards, critical control point, critical limits, and other HACCP regulatory requirements are essentially the same.

Some products can fall into more than one processing category. For example, one establishment may have a HACCP plan for beef carcasses, another for byproducts and a third for fabrication of primal parts. Another establishment might group all of these products into one HACCP plan.

Examples Of Products In Each Process Category		
Slaughter	**Raw Product - Intact**	**Raw Product - Non Intact**
Beef carcass	Beef forequarter	Ground beef /pork/lamb
Veal carcass	Veal shanks	Ground beef patties
Pork carcass	Pork loin, boneless	Hamburger
Sheep/Lamb carcass	Lamb rib chops	Beef patty mix
Goat carcass	Beef trimmings	Beef steaks, tenderized with enzyme solution

WORKSHOP

Instructions: For each product listed below, identify the appropriate processing category.

Product	Processing category
1. Beef liver	
2. Bob veal carcass	
3. Pork chops	
4. Minute steak	
5. Lamb shank	
6. Ground beef patties	
7. AMR pork	

Define the following industry terms:

Stunning

Pathogens

Sticking

Trimmings

Comminution

Formulation

What is the food safety significance of the following procedures?

Chilling

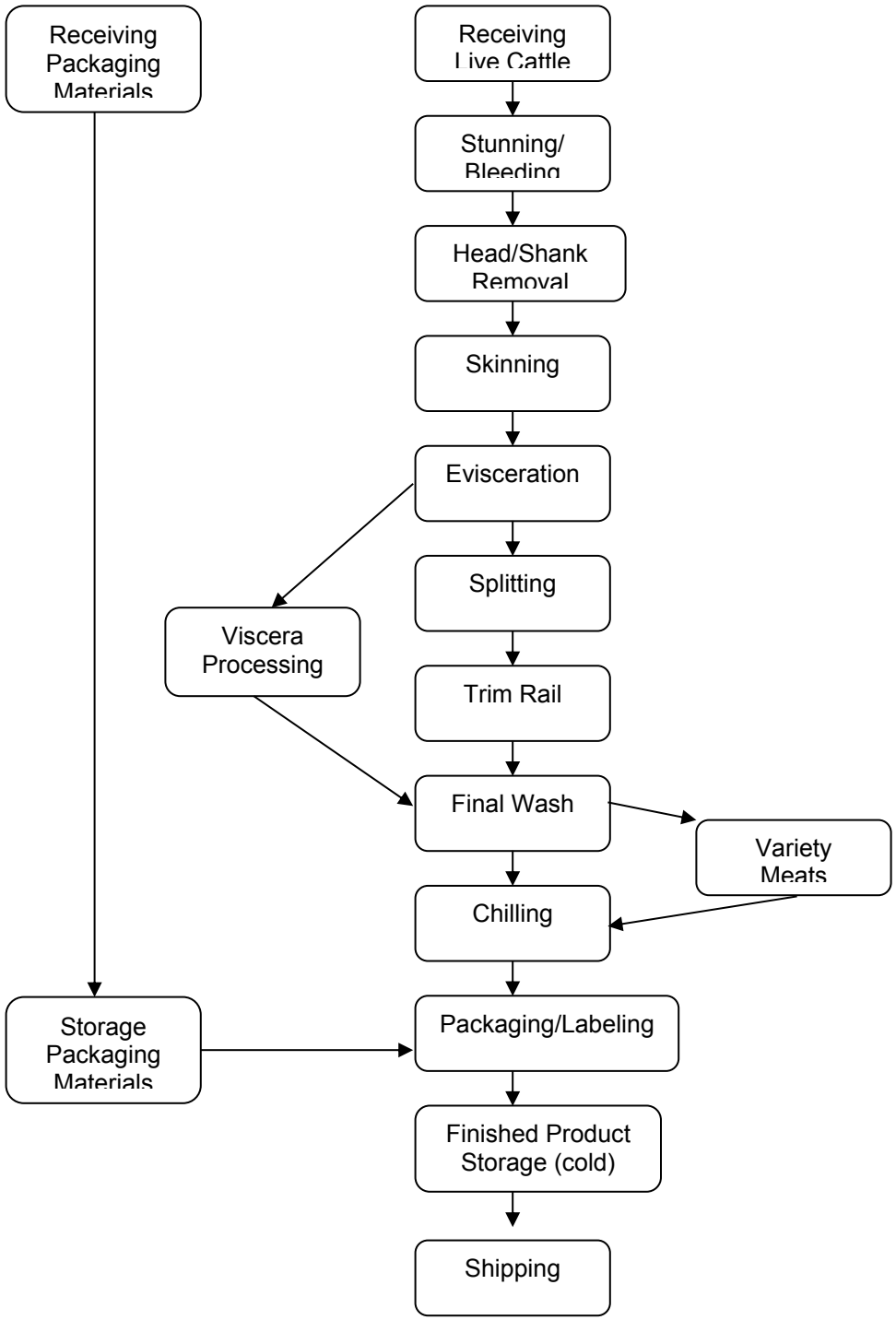
Evisceration

Grinding

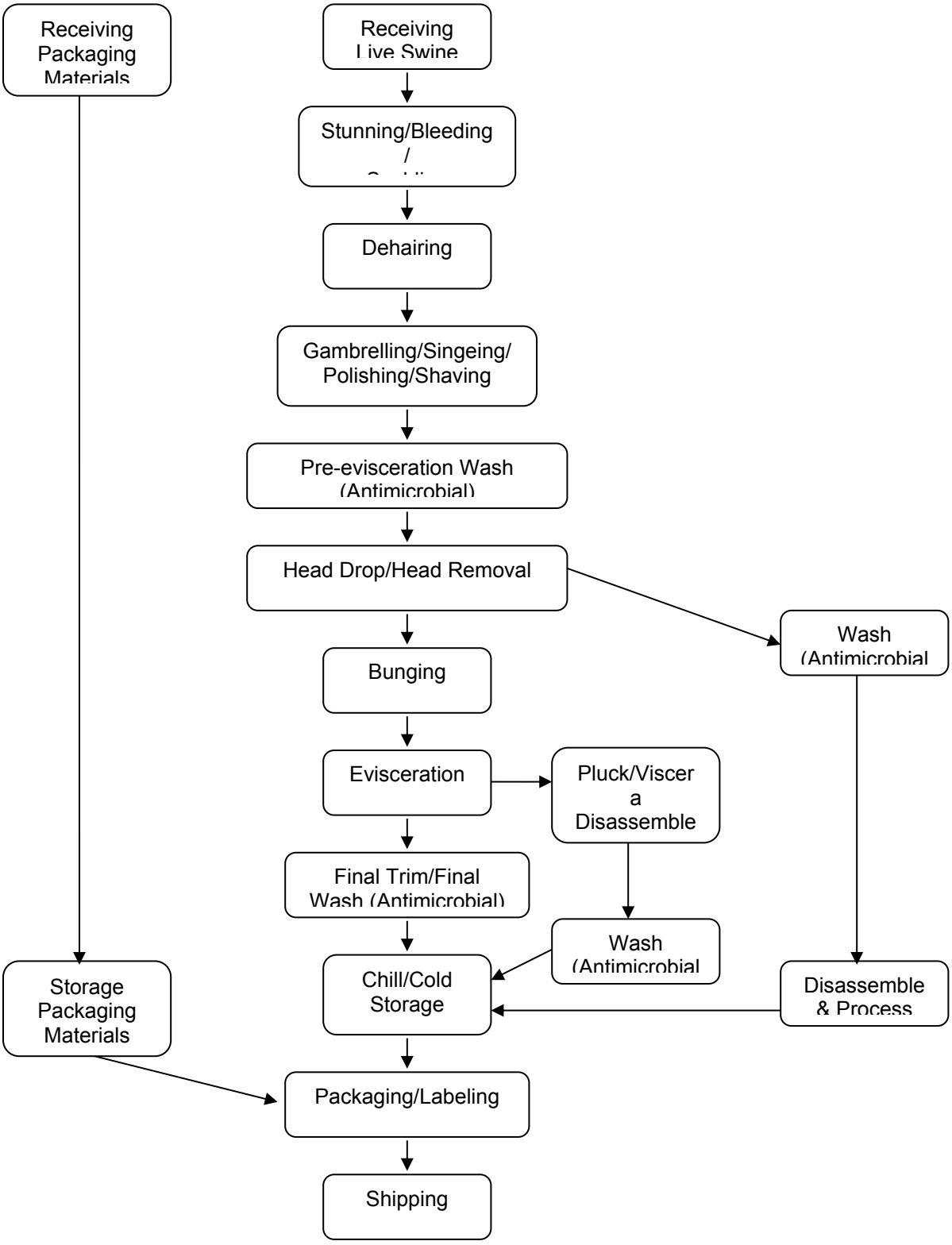
PROCESS FLOW DIAGRAMS

The following process flow diagrams are ***examples*** of the variety of formats that you will see in use by the industry. Please keep in mind that these are to be used as a classroom aid only.

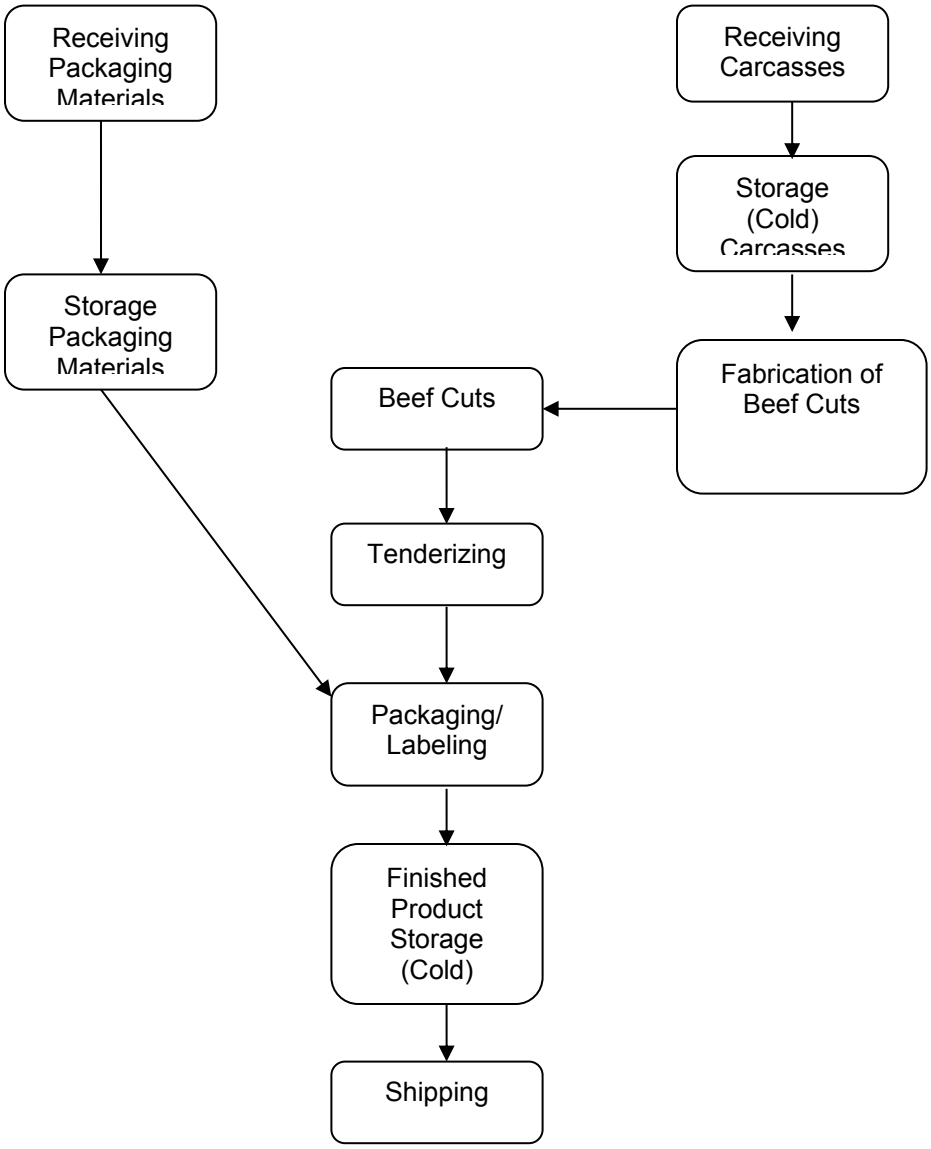
SLAUGHTER Example product: **Beef (carcasses)**



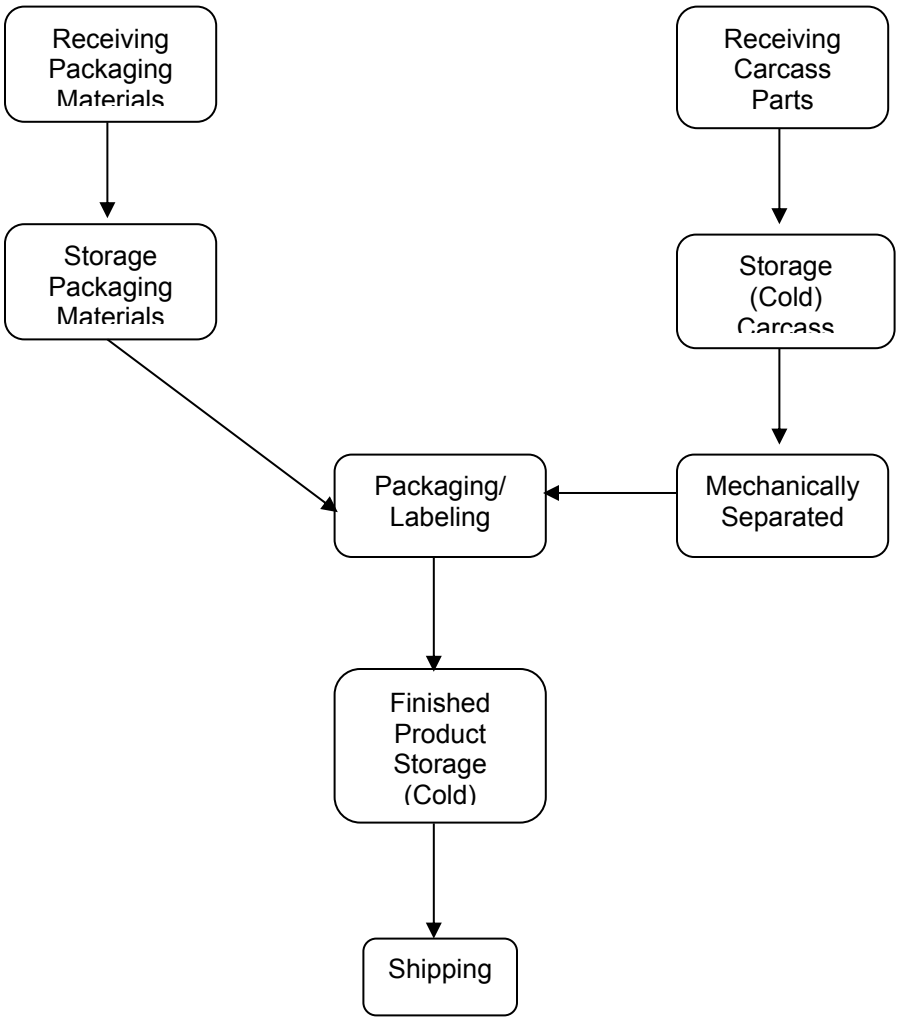
SLAUGHTER Example product: **Pork (carcasses)**



RAW PRODUCT – Non Intact
Example product: **Tenderized Beef Cuts**



MECHANICALLY SEPARATED PRODUCT FLOW CHART
Example product: **Mechanically Separated Pork**



RAW PRODUCT – Non Intact FLOW CHART
Example product: **Ground beef patties**