

## PLANT FAMILIARIZATION: Characteristics and Manufacturing Processes - Poultry

### *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 poultry industry.

### INTRODUCTION

The purpose of this module is to give you a brief introduction to the poultry industry. We will not be covering the details of how we regulate the poultry industry; this is addressed in other modules. This module will give you an overview of the processes used and the products produced by the establishments that we regulate. During the module, you'll see some video footage of different **production processes**. These are shown 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 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 your inspection procedures. 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 what FSIS calls **processing categories**. These processing categories are addressed and defined in the Pathogen Reduction/Hazard Analysis and Critical Control Points (PR/HACCP) regulations, 417.2 (b). The 9 different processes include the following:

- Slaughter (**03J**)
- Raw product - not ground (**03C**)
- Raw product - ground (**03B**)
- Heat treated but not fully cooked - not shelf stable (**03H**)
- Fully cooked - not shelf stable (**03G**)
- Product with secondary inhibitors - not shelf stable (**03I**)
- Not heat treated - shelf stable (**03E**)
- Heat treated - shelf stable (**03F**)
- Thermally processed - commercially sterile (**03D**)

The focus of this module will be on the processing categories that are covered in the slaughter process: 03J, 03C, and 03B. The letters and numbers that you see following the processing categories refer to the **PBIS code** that is associated with each category. PBIS (Performance Based Inspection System) is covered in another module. However, we will show these codes along with the processing categories to help you get familiar with them.

Every product produced by an establishment (when the hazard analysis reveals any food safety hazard that is likely to occur) 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 **other consumer protection**, which would render product adulterated. Some examples are products with low net weights or with water added above allowed limits. Safety or **public health protection** 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. Throughout this module we will point out processes where quality or safety issues are important.

## **SLAUGHTER PROCESS (03J)**

Slaughter is the process whereby healthy, live poultry are humanely stunned, bled, defeathered, and eviscerated. The resulting carcass may be cut up and/or processed in some fashion. During the process, inedible waste and products (e.g., products not used for human food such as the feathers) are produced. Edible byproducts (e.g., livers and gizzards) are also produced.

SLAUGHTER - (03J) includes all poultry classes. Some examples are whole chickens and turkeys. Some of the products, such as whole poultry, will be distributed for sale following the slaughter process. However, most products go for further processing.

### ***Poultry slaughter process***

In addition to the different **kinds** of poultry, or **species**, such as chickens or turkeys, there are also different **classes** of poultry. Classes are groups based on physical characteristics like age or sex, such as fryers, roasters, or hens.

The process diagram for poultry slaughter is found as an appendix at the end of this module. The birds are received by the establishment in cages. Before unloading the birds from the truck, **antemortem inspection** (process to detect and condemn animals that are unfit for slaughter) is performed. This inspection is done to identify any disease conditions in poultry. Some disease conditions are unacceptable because they may affect human health. Others are unacceptable from a quality standpoint.

After receiving the live poultry the first step in the slaughter procedure is unloading the birds from the cages onto a conveyor belt where they are delivered into a dark room with a minimum of excitement and discomfort.

Thereafter, the birds are hung, stunned (electrical current), and then passed through a “kill machine” which severs the carotid arteries in the neck resulting in death by the rapid loss of blood (**exsanguination**).

At this point the birds are scalded; thereafter, they go through the picking process (feather removal), head removal, and other dressing processes until they are transferred to the evisceration line. The establishment may use a variety of methods and types of machinery to accomplish each of these steps.

The presentation step entails placing the carcass and its visceral organs in position to facilitate inspection for disease conditions.

After the inspection step is completed the next subsequent steps are removal of the viscera, neck removal, and further dressing procedures.

The processing of byproducts may be covered in either the slaughter HACCP plan, or in another processing category.

The **salvage** step refers to interventions the plant employees would perform to remove contamination, bruises, or other unwholesome conditions from a carcass, so that the carcass is acceptable for human consumption and eligible for the marks of inspection.

Poultry chilling is the last step in the dressing procedure and is usually done in a large container of chilled water called a **chiller**, which holds a large number of poultry carcasses. It is very important that the chiller water does not become contaminated with fecal matter from any poultry carcass, because it could potentially contaminate **all** carcasses that enter the chiller. The amount of time birds spend in the chiller is a quality issue because the birds gain water weight.

As mentioned before, the plant may use a variety of equipment to accomplish poultry slaughter, such as an automatic stunner, an automatic scalding, a picker, an outside bird washer, an eviscerating trough, oil sac cutter, etc., to allow it to process thousands of birds per hour.

### ***Poultry Slaughter Interventions***

The poultry industry has historically depended upon knife trimming, chlorine, and water washing to address carcass contaminants. In recent years, scientific research has brought new interventions to the young chicken slaughter process, which we will look at now.

- **Antimicrobial Sprays or Dips**

Many establishments have added antimicrobial carcass treatments after the final carcass wash and prior to chilling. Some chemicals commonly used include the following:

**Trisodium Phosphate (TSP)**—this compound is being used in many establishments as a drench, spray, or dip and has been shown effective in preventing the attachment of bacteria to the skin. Used in concentrations of 8-12%, it has been shown capable of reducing *Salmonella* incidence 27-47%. TSP has been approved for use in establishments using online reprocessing of contaminated birds.

**Acidified Sodium Chlorite** (Sanova®)—Applied at ambient temperature by spray at 500-1200 ppm, this compound has been shown to achieve an average reduction in *Salmonella* prevalence of 27% and an average reduction of *Campylobacter* prevalence of 25%. Applied as a spray or dip, Acidified sodium chlorite has also been approved for use in establishments using online reprocessing of contaminated birds.

**Chlorine**—used at 20 ppm as a spray, it has been shown to produce a significant reduction in bacterial numbers.

- **Hot Water Sprays**

Hot water sprays (140° F), with or without chlorine, are being used on a trial basis to determine the effectiveness of reducing bacterial pathogens. Initial results showed a significant reduction in *Campylobacter* on the carcasses.

- **Chiller Treatments**

Several chemicals have been investigated as antimicrobial additives to the chiller water, but the most commonly used in practice are *chlorine* and *chlorine dioxide*. Chlorine is the most widely used sanitizer in poultry processing and levels up to 50 ppm at the fresh water intake may be used in the chillers. Chlorine dioxide may be used in chillers at a level not to exceed 3 ppm. Both have been shown to control cross-contamination by killing bacteria in the water and preventing their transfer from one carcass to another. Some poultry slaughter establishments are using a system which injects ozone into the chill water tank in order to reduce the numbers of bacteria in the 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 poultry slaughter establishment may utilize a TSP rinse followed by chlorine treatment in the chill water. Some commercial applications have combined these different interventions to provide an enhanced antibacterial effect.

## **RAW PRODUCT - NOT GROUND (03C)**

The RAW PRODUCT - NOT GROUND (03C) processing category includes all raw products which are not ground in their final form. Some examples are poultry parts, fabricated products, and edible byproducts (e.g., livers, gizzards).

### ***Cut up***

Cut refers to creating the various cuts from the carcass to produce particular types of product. Examples include cut-up chicken such as legs, thighs, breasts or wings.

### ***Byproducts***

The processing category of RAW PRODUCT - NOT GROUND (03C) includes edible byproducts. Consumer demand has had an effect on production levels of various byproducts.

**Edible byproducts** - Some of the edible byproducts include hearts, livers, and gizzards. They may be sold as fresh or frozen items, or used to make other processed foods.

## **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 technology that industry uses 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)***”.

The process begins with bones. Poultry carcasses for this process have usually already had most of the muscle tissues removed by hand or machine boning. These carcasses are sometimes called “frames” or “shells”. 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 poultry and may be used as an ingredient in the formulation of quality food products, it is not poultry, as defined in the regulations. In particular, the consistency of mechanically separated product and its mineral content are materially different from those of poultry. 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 or poultry products, and it must be identified in the ingredients statement of the label.

## **RAW PRODUCT - GROUND (03B)**

This processing category includes all raw products that are ground. Some of the common products are ground poultry products. Establishments differ in how they design their production processes, and you may see many variations of the basic processes that we illustrate. Poultry for use in ground products may come into the establishment from outside suppliers, or it may be produced within the establishment. Dry 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.

**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.

### ***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.

### ***Storage***

Poultry 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° - 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, halt 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 poultry. 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 poultry trimmings 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 poultry is pressed up against the plate the knife turns and cuts off small bits of the poultry. The size of the 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 poultry pieces in the bowl. The bowl chopper also mixes product as it chops it.

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

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-poultry ingredients, if used, are added at this stage.

After comminuting and mixing, the ground meat mixture is often **shaped** into different forms. Ground poultry 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.

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. Labels must accurately reflect the 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. Another establishment might group all of these products into one HACCP plan. The important focus is not what processing category, but rather whether all of the regulatory requirements have been met.

<b>Examples Of Products In Each Process Category</b>		
<b>Slaughter 03J01/02</b>	<b>Raw--Not Ground 03C01/02</b>	<b>Raw—Ground 03B01/02</b>
Chicken, whole	Chicken parts	Ground chicken
Turkey, whole	Turkey breast cutlets	Ground turkey
Duck, whole	Boneless skinless chicken breasts marinated in seasoning solution	Chicken sausage with feta cheese and spinach
Squab	Turkey leg	Turkey Italian sausage
Rock Cornish hen	Boneless skinless chicken thighs	Turkey breakfast sausage



## WORKSHOP

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

<b>Product</b>	<b>Processing category</b>
1. Chicken liver	_____
2. Whole turkey	_____
3. Chicken breast	_____
4. Chicken fingers	_____
5. Ground chicken patties	_____
6. Whole chicken	_____

**Define the following industry terms:**

Pathogens

Comminution

Formulation

**What is the food safety significance of the following procedures?**  
(What is it about this step that must be controlled in order to ensure safety?)

Chilling

Evisceration

Grinding

## PROCESS FLOW DIAGRAMS

The following process flow diagram is an **example** of a format that you may see in use by the industry. Please keep in mind that these are to be used as a classroom aid only.

**SLAUGHTER (03J) FLOW CHART**  
Example product: Young Chicken

