

Sausage Operations

Objectives

After completing this module, the student will be able:

1. Define the following terms as they apply to sausage operations.
 - Additive
 - Fresh
 - Condiments
 - Meat
 - Poultry
 - Meat byproduct
 - Poultry byproduct
 - Mechanically separated (species) product
 - Emulsion
 - Rework
2. Identify the 4 criteria that must be met for an additive to be added to a sausage product.
3. List at least 3 benefits of using water in the preparation of sausage products.
4. List 3 methods used to measure water added to sausage products.
5. Identify the percent water limitation for a:
 - Coarsely ground cooked sausage such as Polish or Kielbasa.
 - Finely ground, emulsified cooked sausage such as bologna.
 - Fresh sausage.
 - Liver sausage.
 - Specific loaf.
 - Non-specific loaf.
6. Describe the methods the establishment must use to identify restricted ingredients when it creates its own ingredient mixes or blends.

7. Identify the 3 types of casings used in the preparation of sausages products.
8. Given the following class of additives:
 - a. Antioxidants.
 - b. Binders and extenders.
 - c. Cure accelerators.
 - d. Curing agents.
 - e. Phosphates.Identify:
 - 1) The purpose of each class of additive.
 - 2) The maximum amount of each class of additive allowed in a specific sausage product or loaf.
 - 3) The portion of the sausage or loaf formula on which the maximum amount is based.
9. Describe the characteristics (product standard) for the following sausage products.
 - Fresh pork sausage
 - Whole hog sausage
 - Breakfast sausage
 - Fresh beef sausage
 - Italian sausage
 - Bologna/hot dog
 - Liver sausage
10. Given examples of fresh sausage formulations, perform accurate calculations and determine regulatory compliance for the following ingredients.
 - Added water
 - Antioxidants
 - Binders and extenders
 - Mechanically separated species (MSS)

Introduction

Sausage is a coarse or finely comminuted meat or poultry food product prepared from one or more kinds of meat or meat and meat byproducts, or poultry or poultry and poultry byproducts containing various amounts of water and usually seasoned with spices and flavorings (“condimental ingredients”). Any amount of condiment may be used up to the maximum amount needed to impart its normal characteristic flavor. The word “sausage” comes from the Latin word “salsus,” which means salted, or preserved by salting.

The practice of stuffing salted, chopped meat flavored with spices into animal casings is an ancient custom dating back to Grecian and Roman eras. Native Americans prepared a type of sausage consisting of chopped, dried meat, mixed with dried berries and pressed into cakes. The processed food industry in the United States sprang from the diverse ethnic backgrounds of the European immigrants after the Civil war. Sausage making was a method of preserving meat, and the immigrants brought their sausage making skills and unique recipes with them when they came to America. As the population expanded geographically, the availability of raw meat materials and differences in climate lead to unique manufacturing procedures. This resulted in sausages with different flavors, textures, and shapes. Some sausages took the names of the areas where they were thought to have originated. Many present-day sausages still carry those names, such as *frankfurter* (Frankfurt, Germany), *bologna* (Bologna, Italy), *berliner* (Berlin, Germany), *braunschweiger* (Brunswick, Germany) and *genoa* (Genoa, Italy).

Sausages are best classified according to the manner in which they are processed:

- Fresh (typically raw, but not always).
- Cooked and smoked.
- Cooked.
- Semidry or dry.

Fresh, as applied to sausage, means that the sausage's formulation does not contain curing agents (i.e., sodium or potassium nitrites or nitrates, or salt in sufficient quantities to preserve the product [9 CFR 317.8(b)(6)]). Some fresh sausages are sold *raw*. However, fresh *uncured* cooked sausages are more widely produced. Keep in mind that just because a sausage is fresh "uncured" does not automatically mean it is "raw."

Approximately 85% of all sausage produced today falls into the *cooked and smoked* class, with frankfurters (sometimes called franks, hot dogs, and wieners) accounting for approximately 55% of all sausages produced. The cooked and smoked class of sausage is characterized by the quality imparted to the product through the addition of nitrites and the smoking process, which adds a distinct flavor and aroma to the product.

Cooked sausages are usually stuffed into an impervious casing or stainless steel molds and cooked in a hot water bath or a heating unit until the desired internal temperature is reached. These sausages normally retain all their moisture because of the impervious casing or mold.

Semidry (e.g., summer and Genoa) and *dry* sausages (salamis and pepperonis) are characterized by a bacterially induced fermentation or direct acidification by encapsulated acids. This intentional encouragement of the growth of lactic acid-producing bacteria is considered useful for preserving, as well as achieving the desired tangy flavor typical of these products. The production of semidry sausages usually involves a combination of cooking and drying. After fermentation, dry sausages may remain uncooked or they may be cooked or smoked, but all undergo a carefully controlled air drying process (part of the cooked product stabilization process).

This module is designed to familiarize IPP with sausage operations, including the preparation of the four classes of sausage. It also identifies specific regulatory requirements for sausage products and the inspection methods IPP use to verify that an establishment's sausage product is in compliance with the regulatory requirements.

Meat and Poultry Components Used in Sausage Preparation

Sausage is usually made with fresh or frozen meat or poultry. Some sausage product's standard of identity allows the use of meat byproducts, poultry byproducts, mechanically separated species or kind, and cured meat products, such as bacon and cured trimmings.

Let's review some definitions for meat and poultry components that may appear in the standard of identity for a sausage.

Meat is muscle tissue from any cattle, sheep, swine, goat, or equine animal that is skeletal or that is found in the tongue, diaphragm, heart, or esophagus, with or without the accompanying and overlaying fat. It includes portions of bone, skin, sinew (tendon), nerve, and blood vessels normally accompanying the muscle tissue that are not separated from the muscle in the dressing procedure (9 CFR 301.2). It *does not* include the muscle found in the lips, snouts, or ears. For cooked sausage products, the definition of meat differs slightly from the definition of meat given in §301.2 of the regulations. For example, tongues, hearts, and weasands are not considered meat but are meat byproducts.

Meat byproducts may be used in the preparation of some sausage products. They must be listed in the ingredient statement of sausage. This term means any part derived from cattle, sheep, swine, goats, or equine animals, ***other than meat***, that can be used as human food (9 CFR 301.2). For hotdogs/franks/wieners, etc. listed in 9 CFR 319.180(g), *meat byproducts* include: pork stomachs and snouts; beef, veal, lamb, or goat tripe; beef, veal, lamb, goat, or pork hearts, tongues, fat, lips, weasands, and spleens; and partially defatted pork fatty tissue (PDPFT), or partially defatted beef fatty tissue (PDBFT). While there are many more types of byproducts, these are specifically permitted in the §319.180 regulated products. Other byproducts, such as organ meats (livers, kidneys, etc.), glands (e.g., lymph glands), skin, and fat may be used in sausages (other than §319.180 products) when byproducts are permitted.

Poultry Meat is deboned chicken or turkey meat, or both, without skin or added fat (kidneys and sex glands have been removed) (9 CFR 319.180(g)).

Poultry includes edible parts such as skin and fat when not in excess of their natural proportions, including chicken meat (9 CFR 381.118(b)).

Poultry byproducts includes skin, fat, and giblets (gizzard, heart, and liver) (9 CFR 381.1).

Mechanically Separated (Species, MSS or Kind of Poultry, MSKP) Product is a finely comminuted product resulting from the mechanical separation and removal of most of the bone and other tissue from attached skeletal muscle of livestock or poultry carcasses and parts of carcasses. These products must meet the requirement of 9 CFR 319.5 or 381.173.

Common Non-Meat Additives (Ingredients) Used in Sausage Preparation

The definition of an additive is “any safe ingredient added to a meat or poultry food product other than meat, poultry, or meat and poultry byproducts for a specific purpose.” When there is a proposal by the industry to include any additive in the manufacturing of a meat or poultry food product, the additive must meet the following criteria:

- It must be safe and suitable.
- It must not detract from the product or promote deception.
- It must serve a useful purpose or benefit the consumer.
- It must lend itself to inspectional and/or analytical control.

The burden of proof that a proposed additive meets the criteria is upon the industry, and the establishment must furnish written procedures for controlling the use of the additive (9 CFR 320.1(b)(11) and 381.175(b)(6)).

FSIS shares responsibility with FDA for the safety of food additives used in meat, poultry, and egg products. All additives are initially evaluated for safety by the FDA. When an additive is proposed for use in a meat, poultry, or egg product, its safety, technical function, and conditions of use must also be evaluated by FSIS's Risk Innovations and Management Staff (RIMS).

After an additive has been accepted, it may be necessary to limit or restrict its use (e.g., antioxidants, binders and extenders, and nitrite) to certain products and/or amounts to comply with the criteria. An extensive list of acceptable food additives and restricted use levels (if applicable) are found in 9 CFR 424.21(c). This list is also updated regularly in FSIS Directive 7120.1.

To ensure that all additives are accurately reflected on the finished sausage label, the additive (other than water or ice) must be properly labeled when it is brought into the establishment. The label must include the following information.

- The name of the product.
- A list of the ingredients, if the product is composed of two or more ingredients.
- The amount or percentage of each restricted ingredient.
- The name and address of the manufacturer, or other qualifying phrase such as "manufactured for," "packed for," or "distributed by."

Common food additives used in the preparation of sausage are discussed below.

Water

In the meat and poultry industry, water is the most common additive used in sausage preparation. In applying the first acceptance criterion stated above, we consider water to be generally recognized as safe (9 CFR 416.2(g)(1)).

In order to prevent water from *detracting* from the product or *promoting deception*, its use is limited in the preparation of most sausage products. In cooked sausage, except for those that fall under the fat and added water requirements, water is limited to 10% of the finished product. In all raw sausage products, water is limited to 3% of the total ingredients. When water or ice is added to the formulation, “water” must be identified in the ingredients statement on the product label (unless the product is literally sold dehydrated).

Next, water serves a *useful purpose* and *benefits the consumer*. These benefits are:

- *Controlling the temperature during preparation* and preventing “fating out” of the sausage during the cooking process.
- *Aiding in mixing the additives*; thus they are more uniformly distributed in the finished product.
Water has been called the “universal solvent” because it dissolves and uniformly distributes non-meat ingredients that are added to the formula in small amounts (e.g., cure agents). Water also solubilizes meat and poultry proteins, which aids emulsion behavior and binding properties.
- *Facilitating stuffing* by allowing a more uniform stuffing operation and reducing the occurrence of voids or pockets in the casing.
- *Improving the texture and tenderness* of the finished product.
Added water can also contribute to a pleasing tenderness and eating quality.
- *Improving the yield* by replacing the natural moisture lost during processing and allowing the product to be formulated to contain amounts of added water in the finished product as specified in the regulations.

Finally, water lends itself to *inspectional* and *analytical* control. Water is controlled through inspection by requiring a formula to indicate the amount of water being used in the

preparation of each sausage product. Water must always be added in *measured* amounts. Water may be measured by:

- a meter.
- weight (scale).
- volume.

It is the responsibility of the establishment to verify the accuracy of the measuring device as often as necessary. A sample of the finished product with a water limitation may be selected and sent to an FSIS laboratory for an added water determination.

Antioxidants and Synergists

By regulation, a fresh sausage formulation may have up to 30 or 50% fat content. Many semi-dry and dry sausages are characterized by the visual distinction between the size of the fat particles (white color) and the lean (red color) in the finished product. The raw meat and poultry components for these sausages are usually coarse ground and have higher fat content to achieve the final fat particle size for the visible distinction in color. Sausage formulations high in fat content may deteriorate rapidly (became rancid) under normal storage conditions without a stabilizer added to the formulation.

Oxidative rancidity occurs when the double bonds of polyunsaturated meat and poultry fats are exposed to oxygen (present in air) and undergo oxidation (breakdown) to form aldehydes, alcohols, and ketones. This process results in the development of "off" odors and flavors in the cooked/heated product.

Antioxidants are chemicals that react with oxygen before it can react with meat and poultry fats, thereby retarding oxidative rancidity and helping protect the flavor of the product. They are approved for use in all fresh and dried sausage products.

Antioxidants are normally added to a sausage formulation as part of a mixture of specific antioxidants, a synergist, and a carrier, or as part of a spice mixture. The synergist (e.g., citric acid) is used with antioxidants to increase their effectiveness. The antioxidants and

synergists approved for use in sausage and their regulatory limits are in the table in 9 CFR 424.21(c) and FSIS Directive 7120.1.

Binders and Extenders

Binders and extenders are used by the meat and poultry industry because they improve sensory characteristics of the product (texture, juiciness, and flavor), sliceability, and yield.

Many binders and extenders are strong water binders. They increase the water retention of the meat and poultry, which reduces the shrinkage of cured sausage during further processing (e.g., cooking and cooling). Improved water retention leads to higher product yields. When binders and extenders are included in a sausage's formulation, a higher product yield is attained because more pounds of product can be produced for a given weight of meat or poultry. Therefore, binders and extenders are not allowed in some sausages and have regulatory limits when added to other sausages. The binders and extenders allowed to be used in sausage products and their regulatory limits are in the table in 9 CFR 424.21(c) and FSIS Directive 7120.1. Since they increase the yield of the sausage product, the regulatory limit is based on the sausage's *finished weight*. Many binders and extenders are allergenic substances, e.g., soy flour and dry milk powder (nonfat dry milk, dried whey, or sodium caseinate). NOTE: While "soy flour" is a binder approved for use in certain sausages that permit binders, "textured soy flour" (or other textured soy products) is not approved for use and may not be used unless the sausage mixture is emulsified so as to remove the "textured" structure of the soy.

Salt

Salt (sodium chloride) is an important ingredient used in the manufacture of sausage. In addition to contributing to flavor, salt contributes several functional characteristics to the meat mixtures of cooked sausage products. Salt solubilizes and releases the myofibrillar proteins (e.g., actin and myosin) from the muscle fibers which are essential in establishing

emulsions. The myofibrillar proteins are very valuable in sausage making because they retain water and encapsulate fats, thus preventing fat separation during cooking.

While the sodium ion is responsible for flavor, it is the chloride ion that is responsible for another important function. The chloride ion improves water retention in cooked sausages because the myofibrillar proteins bind water in the presence of chloride improving product yield, texture, and palatability.

Salt also has bacteriostatic properties. It suppresses bacterial growth and extends the shelf-life of the product. In fermented semi-dry and dry sausages, it is the salt that inhibits the growth of undesirable microorganisms before the starter culture forms enough lactic acid to inhibit their growth.

Salt is considered to be self-limiting in product formulations and does not have a regulatory limit. Excessive amounts of salt would make the product unpalatable.

Cure Agents (Nitrites and Nitrates) and Cure Accelerators

Meat and poultry is cured with a pure (synthetic) source of nitrite or nitrate, usually *sodium nitrite*, which is often added in a salt and cure mixture. Nitrite is always added in conjunction with salt and has several important functions in cured sausage. The most obvious function is cured color and flavor development. When nitrite is added to the meat mixture it combines with the muscle pigment, myoglobin, to form the characteristic pink-red color of cured meat sausage. A “cured flavor” noted in cured hams and sausage seems to be due to nitrite and cannot be reproduced with other ingredients. Nitrite is a potent antioxidant which helps prevent stale, warmed over and rancid flavors. Like salt, nitrite also has bacteriostatic properties. It inhibits or suppresses the growth of spoilage microorganisms. It also slows the outgrowth or germination of *Clostridia spp.* spores and therefore provides an added food safety benefit against botulism. Botulism is not a problem under normal handling (proper cooling and refrigeration), but if the product is temperature abused, nitrite provides an extra measure of control. It is remarkable that nitrite can provide all these benefits at very low concentrations.

Nitrate is used as a source of nitrite or reservoir for nitrite. When nitrate is used as the curing agent, it must be converted (i.e., reduced) to nitrite by bacteria in the meat or poultry. This is a necessary step in the development of the cured color. The amount of nitrate that is reduced to nitrite is dependent upon the numbers of nitrate-reducing bacteria and several environmental conditions such as temperature, moisture content, salt content, and pH. For these reasons, the conversion rate and subsequent amount of nitrite that is formed is difficult to control. Similarly, the further reduction of nitrite to nitric oxide, which reacts with myoglobin (i.e., muscle pigment) to produce the cured color, is also affected by the same environmental conditions. If nitrite is used as the curing agent, there is no need for the nitrate reduction step and the development of the cured color is much more rapid. The poor control associated with the reduction of nitrate to nitrite, coupled with the fact that most processors today demand faster curing methods, has led to the diminished use of nitrate in meat and poultry products.

Nitrites and nitrates can be toxic to humans at very high levels. The use of these ingredients is carefully controlled. Supplies of nitrites and mixtures containing them must be kept securely under the care of a responsible employee of the establishment. Nitrite is often purchased pre-mixed with salt, sugar, corn syrup solids, or monosodium glutamate. When curing agents are mixed with these ingredients, the result is commonly referred to as a cure mix or *curing compound*. When a curing compound such “Prague” powder is received, the percentage of nitrite and/or nitrate in the compound must be indicated on the container.

Some manufacturers of curing compounds may tint their products with FD&C Red #3 dye as an aid to easy identification. Each 100 pounds of tinted compound may contain up to *0.45 grams of FD&C Red #3* and not less than *3 pounds of nitrite*. These compounds must be labeled to identify FD&C Red #3; however, no reference to the coloring is needed when the compound is added to a sausage product. This small amount would not add coloring.

Cure accelerators, such as ascorbates and erythorbates, are used to speed up the cure color development. They also stabilize the cure color (i.e., prevent fading) in the final product and increase the bacteriostatic effectiveness of nitrite. Since cure accelerators

aid the curing agents in cure color development, they may only be used in combination with the curing agents.

Cure agents and cure accelerators are *restricted ingredients* (RI) in comminuted meat and poultry products such as sausage products. A large portion of cooked sausages are cured; thus, the establishment will need to control the use of the curing agents and cure accelerators used in the formula. The cure agents and cure accelerators allowed to be used in sausage and their regulatory limits are in the table in 9 CFR 424.21(c) and FSIS Directive 7120.1.

Phosphates

Phosphates are frequently added to cooked sausage product formulations because of the numerous beneficial effects they have in the finished product. Phosphates increase the water retention, or water binding capacity, of the meat and poultry, which reduces the shrinkage (i.e., moisture loss) during further processing. The improved water binding results from the reaction of the phosphate ions with the meat and poultry proteins. Phosphates also improve the sensory characteristics of the product (texture, juiciness, and tenderness), improve the stability and uniformity of the cure color, and suppress the development of rancidity in sausage products. The phosphates allowed to be used in cooked sausage and their regulatory limits are in the table in 9 CFR 424.21(c) and FSIS Directive 7120.1. Phosphates are not allowed in raw sausage products.

Spices, Seasonings, and Flavorings

The wide range of available spices, seasonings, and flavorings is a primary reason for the variety of sausages in the marketplace. Spices, seasonings, sweeteners (sugars and carbohydrates), and liquid smoke added to meat and poultry mixtures impart flavor characteristics which make each sausage unique. Many additives in this group contribute more than flavor. Some have bacteriostatic properties, while others are antioxidants and color enhancers.

For example, natural smoke is a flavor additive and is also bacteriostatic, a color agent, and an antioxidant. Liquid smoke preparations also share these properties.

Starter cultures can be included in this group because they are flavor contributors even though their major function is to lower the pH of the product. The lactic acid produced by the starter culture creates the tangy flavor of fermented sausage. Starter cultures added to sausages are restricted to 0.5% in product formulation.

Spices and flavorings are used to add flavor to the sausage.

- *Spices* are aromatic substances (fragrant or sweet smelling) of vegetable or plant origin in the whole, broken, or ground form, with the exception of powered onions, garlic, and celery, that's function is to flavor the food, rather than as a nutritional substance. The active aromatic or pungent properties of spices that contribute the most to the flavoring effect are present in the volatile oils, resins, or oleoresins of the spice. Pepper, garlic, sage, mustard, paprika, and nutmeg are common spices used to produce the characteristic flavor of a sausage product. Because paprika also adds color and makes meat look brighter red, it must be listed as "paprika" in the ingredient statement of the label.
- *Flavorings* are substances that are extracted from a food, and contribute flavoring, such as spice extracts (e.g., oleoresin of black pepper).

Any amount spice, seasoning, or flavoring may be used up to the maximum amount needed to impart its normal characteristic flavor or to achieve its intended purpose. 9 CFR 317.2(f)(1) and 381.118(c)(1)(2) identify the requirements for additives that may be designated as "spice," "natural flavor," "natural flavoring," "flavor," or "flavoring" in the list of ingredients on labels for meat and poultry sausage products. For instance, natural spices, spice extracts, powdered onion, powdered garlic, or powdered celery may be designated as a "natural flavor," "natural flavoring," "flavor," or "flavoring." A flavor or flavoring, however, may not be listed as a "spice" in the ingredient statement. Some flavorings must be listed by their common and usual name on the label, e.g., salt, corn

syrup, and monosodium glutamate, cannot be included in the term “flavor” or “flavoring” in the ingredients statement.

NOTE: “Cultured celery powder” is not the same as “celery powder”. “Cultured celery powder” should be identified as “cultured celery powder” and sublisted. They may not be identified on labeling as “natural flavor,” “flavor,” “flavoring,” or “natural flavoring.”

Some sweeteners contribute more than just flavor. In sausage products, sweeteners not only counteract the harshness of salt, but sweeteners such as corn syrup (CS) and corn syrup solids (CSS, a dehydrated form of corn syrup) also increase water holding capacity (water retention) and improve casing peelability.

Sugars (typically sucrose and dextrose) are the primary food source for starter cultures (lactic acid-producing bacteria) that produce the characteristic tangy flavor of fermented sausages. Hence, the primary function of sugar in these products is to drive the fermentation process. Sucrose and dextrose do not have a regulatory restriction because adding excessive amounts would make the product too sweet and unpalatable. Other sweeteners such as corn syrup (consists of 20% water), corn syrup solids (20% water), and glucose syrup are also not restricted by regulation and may be used for their intended purpose. However, malt syrup and sorbitol have restrictions on their use in 9 CFR 424.21(c) when added to cured meat sausages because they are not as sweet as sucrose or dextrose. Sorbitol and malt syrup are not allowed in poultry products.

Natural Sources of Nitrite and Other Ingredients with Antimicrobial Properties

Many establishments are now adding natural occurring sources of sodium nitrate and nitrite such as celery powder instead of synthetic forms of sodium nitrite to their cooked sausage formulas. The naturally-occurring *nitrate* and *nitrite* contained in celery powder is sufficient to develop and maintain the pink coloring of fresh meat. Natural sources of sodium nitrite also provide equivalent functionality to pure sodium nitrite for controlling the growth of *C. perfringens* when the concentration is the same and a sufficient amount of natural source ascorbate (e.g., cherry powder) is used. Although the effect of natural occurring sources on the growth of *C. botulinum* has not been studied, FSIS has determined from expert opinion that sodium nitrite from natural sources will likely control

the growth of *C. botulinum* provided a cure accelerator is added to the formula. The concentration of sodium nitrite from natural sources such as celery juice and powder, beet juice, sea salt and cherry powder varies greatly depending on the source. Natural sources of nitrite are generally available in two forms:

- Vegetable juices and powders that contain sodium *nitrate*. These products must be used by the producer in combination with a bacterial culture that reduces the nitrate to nitrite in the product. When using natural sources of nitrate, the quantity of nitrite is not known because it is dependent on the conversion from nitrate to nitrite that occurs as a result of the presence of a bacterial culture.
- Vegetable juices and powders in which the sodium nitrate has been pre-converted to sodium *nitrite* by the supplier. Since the sodium nitrate has been pre-converted, the concentration of sodium nitrite is known. However, the amount still varies from batch to batch due to differences in the conversion rate.

Given these differences, FSIS recommends establishments use pre-converted sources of natural nitrite for food safety purposes because the quantity of nitrite is known. To use the third stabilization option to control the growth of *Clostridia spp*, establishments should ensure that at least 100 ppm ingoing nitrite is added from the natural source along with at least 250 ppm of ingoing ascorbate. In addition to ensuring that the level of nitrite is sufficient to control the growth of *C. perfringens* and *C. botulinum*, establishments should ensure the levels are also safe and suitable according to FSIS Directive 7120.1, "*Safe and Suitable Ingredients Used in the Production of Meat and Poultry Products*" and 9 CFR 424.21(c). IPP should review AskFSIS questions "Use of celery powder and other natural sources of nitrite as curing agents" and "Appendix B: Stabilization Option 3 for products containing celery powder and other natural sources of nitrite."

Natural sources of nitrite/nitrate are not approved as curing agents. When sausages that are required to be cured by regulation or by standard are formulated such that only natural sources of nitrate are used, these sausages are considered *uncured*. Sausage products such as hot dogs, franks and bologna formulated with natural sources of nitrite instead of curing agents in 9 CFR 424.21(c) must be labeled as "uncured" under 9 CFR 319.2.

Natural sources of nitrate include celery powder, cultured celery powder, sea salt, etc. In addition, the label must also contain the statement "no nitrates or nitrites added" per 9 CFR 317.17(c)(1), qualified by the statement "except for those naturally occurring in [name of natural source of nitrite such as celery powder]" in order to not be considered false and misleading under 9 CFR 317.8. In addition, these sausage products must bear adjacent to the product name in lettering that is in an easy to read style and at least one-half the size of the product name "Not Preserved—Keep Refrigerated Below 40°F At All Times" unless the sausage's pH is 4.6 or below or the Aw is .92 or less in accordance with 9 CFR 317.17(c)(2). Sausages that are not required to be cured and are not conventionally cured (e.g., "bratwurst," "sausage," and "longaniza") are formulated such that they include ingredients with natural sources of nitrate and are not required to be labeled as "uncured".

Many establishments are now adding sodium lactate/diacetate or other organic salts as an antimicrobial agent to their cooked sausage products in order to meet the requirements of Alternative 1 or Alternative 2, Choice 2 of the *Listeria monocytogenes* regulations (9 CFR 430.1 and 9 CFR 430.4). Several published research articles have shown that lactate/diacetate products and other organic salts can significantly inhibit the growth of *C. perfringens* during cooling and even extend the chilling times from 15 to 21 hours for cooked, uncured meat or poultry products. Regulatory limits for sodium lactate/diacetate and other organic salts when used as antimicrobial agents are listed in the table in 9 CFR 424.21(c) and FSIS Directive 7120.1.

NOTE: Sodium lactate and diacetate are also approved flavoring agents. When these ingredients are added to sausage formulas, IPP need to determine their intended purpose (e.g., antimicrobial agent or flavoring agent). Sodium lactate/diacetate and other organic salts when used as flavoring agents have regulatory limits listed in table in 9 CFR 424.21(c).

Food Ingredient Exercise

With the help of Attachment 1 - Excerpts from the Food Ingredient Chart from 9 CFR 424.21(c) specific to this module and information in this handout, answer the following questions.

1. When sorbitol is used in a cooked sausage product:
 - a. What percent is allowed?
 - b. What part of the formula is the percent based on?
2. One or more of the following binders may be used in cooked sausage: dried milk, calcium-reduced dried skim milk, nonfat dry milk, cereal, vegetable starch, starchy vegetable flour, soy flour, soy protein concentrate, and isolated soy protein.
 - a. What percent individually or collectively is allowed?
 - b. What part of the formula is the percent based on?
 - c. How much isolated soy protein is equivalent (equal) to the maximum amount of other binders?
3. Given the following ingredients, identify their purpose, the products to which they can be added, and the amount allowed.
 - a. Citric acid (acidifier)

Purpose

Products

Amount allowed

b. Sodium diacetate

Purpose

Products

Amount allowed

Fresh Sausage Preparation

Fresh sausage is made from pork. Beef, other meats, and poultry that have not been cured are also used in some fresh sausage products. Now let's discuss the example steps in the fresh sausage process. (NOTE: This is only one example. The process of preparing fresh sausage will vary from establishment to establishment.)

Receiving

Establishments may receive raw meat and poultry components, non-meat ingredients (e.g., spices, flavorings, and antioxidants), packaging material (e.g., trays, plastic film, and collagen casings) at the receiving step to produce the fresh sausage. Some establishments develop *written purchase specifications* to ensure that a consistent product is received. Purchase specifications are formal agreements between the supplier and the purchaser, and may include quality aspects (e.g., ratio of lean to fat for incoming trimmings, safety factors such as laboratory testing for pathogens). Raw components for fresh sausage could include advanced meat recovery products (AMR), trimmings with different fat content, boneless meat from older animals, head meat, cheek meat, diaphragm meat, and deboned poultry meat. Low temperature rendered products such as lean finely textured beef (LFTB) and boneless lean beef tissue (BLBT) are derived from beef trimmings and may be used as components in fresh sausage. Byproducts such as partially defatted beef/pork fatty tissue (PDBFT) and partially defatted chopped beef/pork (PDCB), which are also low temperature rendered products derived from beef or pork trimmings and other byproducts, may only be used as components in fresh

breakfast and Italian sausage in 9 CFR 319.143 and 319.145. Mechanically separated species (MSS) may constitute up to 20% of the meat and poultry product portion, or *meat block*, of the fresh sausage product. Meat and poultry ingredients used may be fresh, frozen, or a combination.

In some cases, swine such as older sows are slaughtered, immediately hot boned, and the whole carcass is used to produce whole hog pork sausage.

Weighing and Batching

Fresh sausage is seasoned with salt, sugar, spices, other flavorings and usually have antioxidants added to protect flavor. Water is added to facilitate chopping and to distribute the ingredients throughout the finished product. Binders and extenders such as soy flour or nonfat dry milk are allowed in breakfast sausage per 9 CFR 319.143.

Establishments must use a formula to create a consistent fresh sausage product. The formula lists the weights or percentages of ingredients to be used. Meat and poultry components and other ingredients are weighed before use to ensure that the proper amount of each ingredient is added to the batch. Any device used to measure ingredients must be accurate. Many establishments prepare sausage from purchased premixed or preblended ingredients. However, some establishments prepare their own spice or seasoning mixture by combining various ingredients as suited to their specific needs.

To insure that all ingredients are properly reflected on the finished product's label, establishments must ensure:

- Each ingredient is properly identified and individually weighed into separate containers in single batch formula amounts. This is the procedure most establishments use.

- If a mixture is prepared for a single batch formula containing both restricted (e.g., curing agent and antioxidant) and non-restricted ingredients in the same container, each container must bear the following information:
 - Product name.
 - Each ingredient listed in predominant order.
 - Percent of each restricted ingredient.
 - Net weight of the mixture and total weight of the batch.

Premixed or preblended additives/ingredients such as spices, flavorings, colors, and seasoning mixtures are considered to be “proprietary” mixtures when the precise recipe is not generally disclosed to processors by the mixture’s manufacturer. Such mixtures are under the jurisdiction of the Food and Drug Administration (FDA).

Proprietary mixtures may be used in inspected meat/poultry products *only* if the mixes’ components can be listed appropriately on the label of the finished product. Therefore, inspected establishments using proprietary mixes must assure the mixes have a label that includes:

- The name or code number of the proprietary mix and the name and address of the proprietary mix supplier; and

EITHER

- A complete listing of all ingredients, by common or usual name, with the percentage of each ingredient indicated.

OR

- All ingredients in the proprietary mix listed as required by FDA regulations, in order of predominance, by common or usual name (except those that still may be listed as “spices,” “natural flavor,” “natural flavoring,” “flavor,” or “flavoring.”); and
- The percentage of all restricted ingredients and the protein content (total nitrogen x 6.25) of the mix on a wet weight basis when the mixture contains proteinaceous ingredients; and
- A suggested list of ingredients that may be adapted for use by the inspected establishment on its product labels showing the mix ingredients in order of predominance, by common or usual name (except those that still may be listed as “spices,” “natural flavor,” “natural flavoring,” “flavor,” or flavoring as they would appear in the meat or poultry product ingredient statement.

If the establishment cannot provide an explicit breakdown of the ingredients in the preblended or proprietary mix, then the product would be misbranded and the IPP may withhold production (i.e., use of the label) until the suitability of the ingredient mixture and accuracy of the label is determined.

Comminution

Comminution is the process of reducing the particle size of meats or poultry. There are different methods of comminuting meat and poultry components. A *grinder* consists of a hopper into which the meat chunks are placed. The meat or poultry then moves along an auger or screw, through a cylinder, at the end of which there is a grinding plate and a knife. As the meat or poultry is pressed up against the plate, the knife turns and cuts off small bits of the meat. The size of meat or poultry particle produced is determined by the size of the holes in the grinding plate.

Other equipment can be used to achieve comminution. In addition to the grinder, establishments commonly use the *flaker* and the *bowl chopper*. Some producers use a combination of several of these in the production of a sausage. The flaker is used on

large frozen blocks of meat trimmings or deboned poultry. Product is pressed against knife blades, which shave off pieces of the still-frozen meat or poultry, enabling it to be used in formulation without thawing. 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 or poultry pieces in the bowl. The bowl chopper also mixes meat and poultry components as it chops. Sometimes the meat or poultry components go through several revolutions.

Mixing or Blending

The sausage formula comminuted raw meat or poultry components are transferred to a separate piece of equipment, called a *mixer* or *blender*, for mixing. The mixer consists of a chamber that the components are placed in, then blades or paddles turn and mix them. Water and ingredients are added at this point and the blades continue turning and mixing these with meat and poultry components, resulting in uniform distribution of all ingredients in the finished sausage.

Sometimes a silent cutter or bowl chopper is used to not only reduce the size of the meat and poultry components but also uniformly mix the water, spices, seasonings, and flavorings throughout the sausage product. The bowl chopper is run a few revolutions to comminute the meat or poultry components, then the water and ingredients are added. The bowl chopper is run several more revolutions to thoroughly mix all the ingredients in the formula.

Shaping—Linking, Patty Formation or Chubs

Fresh sausage is often shaped into different forms. After the meat and poultry components and non-meat ingredients have been mixed, the sausage is either placed in a stuffer and stuffed into natural casings, stuffed into collagen casings and linked, stuffed into short plastic casings (chubs), or shaped into skinless links. Fresh sausage may also be placed into patty forming machine and shaped into small patties.

Packaging/Labeling/Distribution

The final step for fresh sausage 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 instance, after the fresh sausage is shaped into links or patties, they may be frozen and then packaged in retail trays with 8 to 12 patties or 8 to 14 links per pound depending on the size of the patty or length and diameter of the link. Short plastic casings called *chubs* are usually sold in 1 or 2 lb. weights. Bulk fresh sausage may be packed in 10, 25, or 30 lb. weights.

Because of the moving parts and high mechanical forces 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 sausage products that may be contaminated with metal fragments.

After formation, shaping, packaging, labeling, and metal detection, the finished patties, links, or chubs are ready for storage and distribution.

Fresh Sausage Standards of Identity

A number of fresh sausage products (§319.140) are produced; many are specialty items. The most common products in this category are fresh pork sausage, country style pork sausage, whole hog sausage, fresh beef sausage, breakfast sausage, Italian sausage, bratwurst, linguica, and chorizo.

Of these, Italian sausage, linguica, and chorizo are the only sausages allowed to contain paprika. Paprika is normally prohibited in raw sausages because of its color enhancing properties.

Fresh Pork Sausage — 9 CFR 319.141

This is a product made from fresh or frozen boneless pork cuts and/or pork trimmings with *no* pork byproducts. It may contain mechanically separated pork product at a level of 20% of the *pork* being used in the formula (§319.6). This product is seasoned with condimental substances that are permitted by §424.21(c) of the regulations. Most condiments are permitted at a level sufficient for purpose and are mainly used as part of an operator's special formula. Sage and pepper are widely used in this type of product. Paprika, extenders and binders are *not* permitted. To facilitate chopping and mixing of the spices and flavorings, water and/or ice may be used in this product at a 3% level of the *total ingredients*. The total fat content shall not exceed 50% of the finished product.

- Farm or country style pork sausage

When these designations are used, all spices and flavorings must be natural. Oleoresins and other spice extracts are not permitted.

Whole hog sausage — 9 CFR 319.144

When this designation is used, the product is prepared from fresh or frozen boneless meat from swine in the proportion that is normal in a single animal. In a whole hog sausage, hams, loins, and all other primal cuts must be included. The fat content is limited to 50% total fat in the finished product. Water and ice may be used at a 3% level based on total ingredients. This is the *only* pork sausage product where limited use of pork byproducts is permitted (i.e., pork hearts, cheeks, and tongues are acceptable). Feet, snouts, and ears are *not* acceptable byproducts.

However, the amount of byproducts used cannot exceed natural proportions in a single animal (i.e., one heart, one tongue, and two cheeks would be allowed). Mechanically separated pork product is permitted when it comes from whole animals used in the production.

Fresh Beef sausage — 9 CFR 319.142

This is a sausage product prepared with fresh or frozen beef, or both. No beef byproducts are permitted. The finished product shall not contain more than 30% total fat. This compares with 50% for fresh pork and breakfast sausages. To facilitate mixing and chopping water and ice may be used up to 3% based on the total ingredients. Binders and extenders are not permitted. Approved condimental substances may be used in amounts as provided for in §424.21(c). Paprika is not permitted.

Breakfast Sausage — 9 CFR 319.143

This product is prepared with fresh and/or frozen meat or fresh and/or frozen meat and meat byproducts. It may contain MSS product at a 20% level based on the total meat and meat byproduct portion of the formula. Breakfast sausage may contain binders and extenders at a 3.5% level based on the finished product, except where lower levels are required by §424.21(c) of the regulations (e.g., 2% isolated soy protein). Binders and extenders used in breakfast sausage improve the texture of the product and extend or expand the product (i.e., increase the yield). This product may contain more than one species of meat and meat byproduct. The fat content is limited to 50% in the finished product. To facilitate chopping and mixing, water and ice may be used in an amount not to exceed 3% of the total ingredients. Paprika is not permitted.

Italian Sausage — 9 CFR 319.145

When the product name on labeling is “Italian Sausage” or “Fresh Italian Sausage,” it is by regulation a fresh sausage (fresh meaning it is not cured). Italian sausage must have at least 85% meat or a combination of meat and fat, but the fat content must not exceed 35% total of the finished product. Water and ice may be used for mixing and chopping but must not exceed 3% of the total ingredients. The product may contain approved condimental substances, including *paprika*. The paprika in this product is considered a flavoring, although it has very few flavoring qualities. It is used mainly for the effect it has on the color and appearance of the product. The product *must* contain salt, pepper, and either fennel or anise, or a combination of fennel and anise. This product may contain the

following optional ingredients: red or green peppers or both; dehydrated or fresh onions, garlic, and parsley; sugar, dextrose, corn syrup, corn syrup solids, glucose syrup; monosodium glutamate and antioxidants. Corn syrup, corn syrup solids, and glucose syrup are used for flavoring. Mechanically separated pork is permitted at a level of 20% of the pork or pork and pork fat being used in the formula. This standard is very prescriptive of the ingredients that may be used in the formulation. If an ingredient is not identified in the regulation as one that is required or one that is optional it would not be permitted at all without altering the product name.

NOTE: At times Italian sausage may be cured and/or cooked and/or smoked. When the formula includes sodium nitrite/nitrate and/or potassium nitrite/nitrate at levels permitted by 9 CFR 424.21 or if it has an internal brine concentration of at least 10% it is considered “cured.” If it is cured and/or cooked and/or smoked, the water is still limited to 3% of the total ingredients at the time of formulation as specified in 9 CFR 319.145. When the product is cooked or cured or smoked, the product name must reflect the process in the following manner:

- Cooked Italian Sausage.
- Smoked Italian Sausage (this name may also be used when the product is both cured and smoked).
- Cooked Cured Italian Sausage.
- Cured Italian Sausage.

We will talk more about cured products in the subsequent module.

Bratwurst (Fresh)

Bratwurst is German for a sausage made with pork, but in some products a combination of meats (e.g., beef and veal) is used. “Bratwurst” by standard of identity in the FSLPB is a fresh sausage (meaning it is not cured). The product has changed somewhat from its

original formulation. The original product contained lemon rind or lemon juice as a flavoring agent. This is not true of today's formulations. It is often flavored with allspice and caraway. This product is prepared with fresh, uncured, uncooked, unsmoked meat (predominately pork). When fresh bratwurst is sold raw, water and ice may be used at a level of not more than 3% of the total ingredients at the time of formulation. Bratwurst may contain binders and extenders at a 3.5% level based on the finished product, except where 2% levels are required by §424.21(c) of the regulations. There is no fat limitation for this product. It may contain byproducts when properly declared in the ingredients statement. Vegetables, cheese, and fruit are also acceptable when properly declared as part of the product name (e.g., "Cheddar Bratwurst").

NOTE: There is also a standard for "Cured Bratwurst" where the formula would include sodium nitrite/nitrate and/or potassium nitrite/nitrate at levels permitted by 9 CFR 424.21 or the finished product has an internal brine concentration of at least 10% to cure the product. When bratwurst is cured, the product name is required to be "Cured Bratwurst." "Cooked Bratwurst" may contain no more than 10% of added water in the finished product. The amount of water in cooked bratwurst is based on the allowance in 9 CFR 319.140 for cooked sausage. If the Bratwurst is both cured and cooked, the product name would be "Cooked Cured Bratwurst."

Chorizo (Fresh)

"Chorizo" is Spanish for a sausage containing pork. This product is prepared with fresh, uncured, uncooked, unsmoked meat (usually pork but beef or any red meat may be used). There is no fat limitation for this product. It may contain byproducts, e.g., salivary glands, when properly declared in the ingredients statement. It may be seasoned with Spanish pimento and red pepper. The product may contain approved condimental substances, *including paprika*. When Chorizo is sold raw, the formula shall not contain more than 3% added water in accordance with §319.140. These products may contain vinegar listed in §424.21(c). The vinegar used must have a strength of no less than 4 grams of acetic acid per 100 cubic centimeters (20°C). A minimum strength for vinegar added to chorizos is required in order to control dilution with additional water. The

minimum strength specified above is consistent with the trade and regulatory issuances of the FDA.

NOTE: Chorizo may also be cooked, dried, semi-dry, or cured. When Chorizo is sold cooked, it may contain no more than 10% of added water in the finished product. The amount of water in cooked Chorizo is based on the allowance in 9 CFR 319.140 for cooked sausage. Chorizo is unlike other types of sausage in that the product name may be “Chorizo” for all the varieties of preparation (fresh, raw, cooked, dried, semi-dry, or cured). However, these terms may still be included with the product name when they are truthful.

Fresh Poultry Sausage

Sausage products made from poultry must be labeled to indicate the kind of poultry, such as “chicken sausage” or “turkey Italian sausage.” Products containing more than one kind of poultry or red meat must declare the added ingredient in the product name (e.g., “chicken sausage links, beef added.”

Bratwurst may be made with poultry when properly named; for example, “chicken bratwurst”. Poultry bratwurst has the same requirement as bratwurst and may contain beef fat without limitation when properly identified in the product name (e.g., “turkey and beef fat bratwurst.”

Ground poultry labeled as “(Kind) Meat,” for example, “chicken meat” or “turkey meat,” must not contain skin, added fat, kidneys, or sex glands. Product that contains skin in natural proportions would be labeled “chicken” or “turkey.”

The basic sausage standards per §319.140 also apply to fresh poultry sausages *except there are no added water or fat content limits for poultry sausage*. When a poultry version of a specific red meat sausage standard is made, then the basic red meat sausage standard would apply, excluding any water or fat limitations. For example, a product named “Turkey Italian Sausage” would need to include salt, pepper, and fennel or anise

and may include the optional ingredients identified in the standard but it would not be limited to 35% fat or 3% water.

Fresh (Not Cured) Sausage Allowable Ingredients

	Fresh Pork	Whole Hog	Breakfast	Fresh Beef	Italian	Bratwurst	Chorizo
Antioxidants	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Water/Ice	3%	3%	3%	3%	3%	3%	3%
Mechanically Separated Species	20%	20%	20%	20%	20%	Yes	Yes
Fat	50%	50%	50%	30%	35%	No limit	No Limit
Binders and Extenders	None	None	3.5%	None	None	3.5%	3.5%
			2.0%*			2.0%*	2.0%*
Paprika	None	None	None	None	Yes	None	Yes
Byproducts	None	Natural Proportions	Yes	None	Yes	Yes	Yes
Nitrite	No**	No**	No**	No**	No**	No**	No***
Phosphate	No	No	No	No	No	No	No
Meat or Meat and Fat Content					85% Minimum		
Reference	§319.141	§319.144	§319.143	§319.142	§319.145	§319.140, FSLPB	§319.140, FSLPB

*Isolated soy protein and sodium caseinate are limited to 2% of the product's finished weight due to their high protein content. Other binders and extenders are limited to 3.5% individually or collectively.

**If curing agents are added, the product name would have to include the term "Cured" (e.g., "Cured Italian Sausage" or "Cured Bratwurst").

***When curing agents are added to chorizo, the word "cured" *is not* required to be part of the product name. It cannot be labeled with the term "Fresh."

Cooked Sausage Preparation

Raw meat and poultry components used in the preparation of cooked sausage include many of the same components used in raw sausage preparation. Many establishments carefully control the quality of the incoming ingredients through purchasing specifications. Meat and poultry components may have quality specifications such as percent fat, moisture, and protein. These are parameters that will affect the final quality of the product.

Lean beef and pork are the most widely used components. Lean beef and pork contributes to color (more *myoglobin*, or muscle pigment) and has good water holding capacity, which aids the emulsion process. Many formulations include at least some *poultry* products (turkey or chicken), and some products are made exclusively with poultry. In addition, many cooked sausages can be formulated with byproducts (e.g., PDCB, PDBFT, mechanically separated poultry, and organ meats such as hearts); therefore, IPP may see more use of them in cooked sausage operations. The meat or poultry components may be, fresh, frozen, cured, or cooked when they are received.

The establishment must have a formula that lists the weights or percentages of ingredients to be used in the preparation of each cooked sausage product. Cooked sausage may or may not be cured. These sausages usually contain added water, phosphates, various spices and flavorings, and may contain byproducts, binders and extenders. Some large volume establishments use a system called *least cost formulation*. This is a computerized program that allows the processor to determine the specific allocation of ingredients required for a given product at a minimum cost. The product can be manufactured subject to ingredients available. These establishments carefully analyze samples of each batch of ingredients and enter the data into the computer program. The program determines how many pounds of each ingredient to use, in combination, to produce the desired product. Theoretically, each finished batch of product will then be identical to each other batch. Of course, the final retail label must have a list of ingredients in the correct *order of predominance*, despite any variations caused by the least cost formulation system.

The receiving, pre-weighing, and comminuting steps for cooked sausages are similar to those previously discussed for fresh sausage. Hence, these steps are not discussed during the overview of cooked sausage preparation on the following pages.

Mixing, Blending, Formulating

The combining of the meat and poultry components, water, and nonmeat ingredients or the blending step (*formulation*) is one of the most important steps in the preparation of cooked sausage. During this step, the fat and protein of the meat and/or poultry, salt, and water are combined (through chopping and mixing) to form an emulsion. Basically, an emulsion is a semi-fluid mass with fat particles dispersed and suspended in the meat and/or poultry protein and added water.

Careful control of the amount of each ingredient is essential in forming an emulsion and the quality of the final sausage product. The sausage manufacturer must select a mix of raw meat and/or poultry and nonmeat ingredients with the appropriate water binding characteristics. Different meats and poultry vary in their ability to bind water. Lean beef (e.g., bull, cow, and shank meat) have high water binding ability. Regular pork, beef trimmings with more fat, and poultry have medium water binding ability. Low water binding meats contain high levels of fat, such as jowls and briskets. Organ meats such as liver and heart have no binding qualities.

Water binding capabilities are directly proportional to the *myosin* in the muscles. Myosin is the muscle protein that has the ability to bind water and emulsify fats. The paler the muscle, the less “bind” it contributes to the mixture. Lean beef and pork have higher amounts of myosin, which is why beef and pork are often components in the formulation of cooked sausage products. Myosin is *solubilized* (i.e., released from the muscle fibers) by salt. The solubilized protein and water combine, surround the fat particles, and suspend and hold the fat particles within the mixture. The protein and water must keep the fat suspended in the meat and/or poultry mixture to prevent the occurrence of undesirable quality defects (e.g., pockets of fat) during the cooking step.

Some establishments will *pre-blend*, or grind and mix the meats with water and salt, and sometimes with the nitrite, then hold the mixture for a period of time in a cooler. The rest of the non-meat ingredients in the formula are blended into the mixture once the mixture is very moist and has a pourable consistency. Some operations further reduce the particle size of the mixture and further blend the ingredients by running the mixture through an emulsifier that has several faster moving blades. The result is a finely comminuted paste.

If the sausage is expected to maintain its finely comminuted consistency throughout the stuffing and cooking cycles, several important formulation and blending factors must be considered. When too much fat is added, there may not be enough protein to encapsulate and coat the fat. Likewise, over chopping of the meat and/or poultry mixture may create such a large surface area that there will not be enough protein solution to coat all the fat. Over chopping also increases the meat and/or poultry mixture's temperature, which could cause some of the fat to partially render (i.e., liquefy). The protein and water is then unable to hold a "liquid fat" in suspension, a situation that can cause the sausage to "short out." Other terms used to describe this condition are "greasing out" or "fat capping."

High acid content of product or a low pH has also been blamed for some instances of emulsion breakdown. Yet another cause of emulsion breakdown is the rapid heating of products to a high temperature before the proteins can coagulate.

Stuffing

After emulsification, the mixture (or "batter") is *stuffed* into casings. Stuffing the semisolid mixture into any type of casing can be done in a number of ways. For instance, the establishment may use automatic stuffers (air or water piston types, or open hopper pump types). They may stuff by hand or from a screw feed. Some machines, such as the Frank-O-Matic, may contain a system designed to spray a vinegar solution, citric acid, or artificial smoke on the outer surface of the stuffed casing as a means of aiding peelability after cooking or to impart flavor.

Following stuffing, the product is *linked* by pinching and twisting the casing to form separate units of sausage. The sausages are still held together by the casing. These

lengths of casings are then placed on racks or trees and are ready to be loaded into the smokehouse. Some establishments load trees into individual smokehouses; however, some large volume establishments use continuous smokehouses and chillers.

Cooking and/or Smoking

The majority of cooked sausages are smoked. The smoking and cooking of any sausage product requires a working knowledge of the smoke-generating equipment, the method of heat application and the cooking procedures for each type of product. The smokehouse parameters that must be controlled are temperature, time, and humidity.

Sausage products are smoked and cooked because:

- Heat and smoke destroys and/or inhibits some bacteria responsible for spoilage and increases the shelf life of the product.
- Smoke enhances flavor, the color of the surface of the sausage, and protects the sausage from oxidation that can lead to off-flavors.
- The heat alone or smoke and subsequent heat are used to cook some sausage products to make them ready for consumption. The product must be exposed to a high enough temperature in order to produce a fully cooked, ready-to-eat product. Cooking is a very important step, because it is here that any vegetative pathogens that may be in the product are eliminated.

Smoke is a complex mix of chemical compounds, including phenols, alcohols, organic acids, carbonyls, hydrocarbons, and gases. The phenols and carbonyls produce the color and flavor of smoke. The preservative (bactericidal) effect of smoke is due to the combined effects of heating, drying, and depositing the chemical components of the smoke on the sausage's surface. Smoke is often produced in a *smoke generator*. Liquid smoke is also used.

Non-resinous hardwoods (e.g., oak, hickory, mesquite, alder, and fruit woods like apple, cherry, and pecan), preservative-free hardwood and fruit wood sawdust, corncobs, and corncob meal are acceptable for producing smoke. If a product were labeled “hickory smoked,” the establishment must provide support that the sawdust or wood used for smoking has hickory in it.

The usual procedure for smoking product is to rapidly raise the temperature to between 110°F - 120°F. During this first heating period, smoke is applied to achieve the characteristic flavor and color. This time period will vary depending on the type of product and type of casing. The temperature is then increased to fully cook the sausage and complete the heating cycle .

Chilling or Cooling

After the sausage has been cooked or smoked and cooked according to the establishment’s desired final internal temperature, the cooling process begins. Cooked sausages are often showered with cold water inside the smokehouse or oven. This removes some of the heat from the product and immediately halts the cooking process. Showering also helps prevent wrinkling of smaller sausage products. The shower is usually not sufficient to complete the cooling process. Product is typically moved to another chiller or cooler to finish cooling. Chilling usually continues until the sausage’s internal temperature is 40°F or below.

Some establishments use very cold water as a chilling medium, sometimes with salt added to lower the temperature below the normal freezing point of water. This is called *brine chilling*. Some establishments may use cold air, and others use a combination of methods. Cooling and chilling are also referred to as the *stabilization* process, which prevents the outgrowth of spore-forming pathogens that may be present and could survive the cooking process.

Peeling or Slicing

After the sausage product, such as hotdogs or frankfurters, has been chilled to the desired temperature, it is removed from the artificial casings in a machine called a *peeler*. This equipment quickly runs the sausage through a tunnel that has a tiny blade that slices the casing. Steam or air is then used to blow the casing away from the sausage and separate the sausage links. If you closely examine the outside of a hotdog, you might see where the casing had been cut. This blade is a potential source of contamination since it contacts every hot dog. This is a potential source for cross-contamination with biological hazards. After peeling, the hotdogs or frankfurters are typically packaged in labeled plastic wrapping and distributed to retail stores, hotels, and restaurants.

Other types of cooked sausages such as beef salami and bologna may be removed from the casing after cooling, sliced at the establishment, and then packaged in plastic wrapping, labeled, and distributed to hotels, restaurants, institutions (HRI), and retail stores.

Standardized (Specific) and Nonspecific Loaves

Many establishments that produce cooked sausages may also produce loaves. Some loaves have a standard of identity, such as “meatloaf” (NOTE: “pork loaf,” “beef loaf,” “chicken loaf,” “veal loaf,” and “corned beef loaf” would follow the general “meatloaf” standard). Other loaves do not have specific standards and are referred to as “nonspecific loaves.”

Like bologna and hot dogs, loaves are comminuted, emulsified, semisolid products made from one or more kinds of raw skeletal muscle meat or raw skeletal muscle meat and raw or cooked poultry meat that are seasoned and cured. The same processing steps used to produce bologna are often used to produce loaves.

Nonspecific loaves have two categories, one that has a descriptive name that includes the species or kind and a second category only used for red meat products that use a fanciful or coined name followed by the ingredients statement. Nonspecific loaves (that do not have a standard formula) with a descriptive name include “pork olive loaf,” “olive loaf made with chicken and pork,” “Morcella blood pudding,” “ham and cheese loaf,” and “spiced chicken luncheon loaf.”

On the other hand, a nonspecific loaf with only a fanciful/coined name (i.e., a name that does not refer to a meat food product or a species of meat) is required to be immediately followed by the ingredients statement whereas the ingredients statement becomes the product name. A few examples of non-specific loaves with a fanciful/coined name include “pickle and pimento loaf,” “olive loaf,” “New England brand loaf,” “spiced luncheon loaf,” “pickle loaf,” “Dutch brand loaf made in the US,” “Chinese brand links made in the US,” “mock drumsticks,” “pudding,” “souse.” Each of these fanciful/coined names will need to be followed by the ingredients statement without intervening text or graphics. This type of non-specific product is only permitted for red meat products (products that bear the red meat mark of inspection although they may have some poultry ingredients). It may not be used for poultry products (ones that would bear the poultry mark of inspection).

Specific meat loaves must meet either the standard of identity in 9 CFR 319.261 or in the FSLPB. Specific meat loaves subject to 9 CFR 319.261 have an added water limit (up to 3%) and cannot contain binders. The meat loaves subject to 9 CFR 319.261 are typically canned whereas other types of meat loaves (e.g., meat loaf) fall under the FSLPB standard of identity. Meat loaves addressed in the FSLPB may contain binders and extenders up to 12%, PDFCB/P up to 25% and water without limitation. Poultry specific loaves may contain binders and extenders, fat and water without limitation. If a specific loaf is cured, the cure agents are restricted ingredients and have regulatory limits.

Nonspecific red meat loaves (e.g., pickle loaf or pickle and pimento loaf) may contain binders and extenders, byproducts, fat and water without limitation. The only restrictions are on the curing agents and curing accelerators used and label accuracy. When labeling nonspecific meat loaves, the ingredients statement must directly follow the product name with no intervening text or graphics.

NOTE: There are no poultry nonspecific loaves with only fanciful/coined names (i.e. carry the poultry legend) because “kind” must be in the product name.

Casings

Meat and poultry sausages and loaves may be stuffed into three basic types of casings. Each type has certain advantages and disadvantages.

A *natural* casing is an animal casing. Natural casings are derived from various sections of viscera and must be inspected for condition and nodules. They must also be thoroughly flushed and rinsed throughout its entire length before being stuffed. The natural casings most often used are those from the “rounds” of hogs and sheep. The term “rounds” refers to the small intestines. The establishment may also use rounds from cattle and calves. “Middles” are derived from the large intestines of cattle and hogs.

Another source of natural casing is the “bung,” which comes from the cecum, or blind gut of cattle. Bladders are also used for products such as headcheese and mortadella. Hog stomachs may also be used as containers for food products.

Natural casings have some advantages. They tend to be elastic, shrinking with the product as it is cooked. They’re digestible and therefore do not have to be removed before the product stuffed into them is consumed. They’re permeable to smoke and moisture.

However, there are several disadvantages. They’re difficult to clean properly, which can make them expensive to prepare. Natural casings must be flushed before being used. Some animal casings are brought into the establishment labeled “pre-flushed.” These casings are generally packed in salt or salt and glycerin solution and only need to be rinsed before being used. Materials such as antibiotics, antioxidants, preservatives, nitrites, and nitrates are not permitted in pre-flushed casings. They’re seldom uniform in size throughout, which makes it difficult to predetermine the accurate weight of individual sausages. With the exception of hog and sheep rounds, all natural casings must be removed before the product stuffed into them can be used for rework. Storage is also a

problem, because they must be refrigerated. They're not strong, which can result in "blowouts."

A second type of casing used today is the *artificial* casing. Artificial casings are generally strong, uniform in size, and easy to handle. They can be stored in a dry nonrefrigerated area. They're permeable to smoke and moisture. They can be purchased in just about any size or shape that the establishment desires.

The majority of artificial casings are one of three types: *fibrous*, which is made of special paper impregnated with cellulose and which can be purchased impermeable to moisture; *saran*, made of synthetic resins (plastics) that can be modified by the addition of harmless chemicals; or *hydrocellulose*, made from regenerated cellulose. The cellulose is obtained mostly from wood pulp and cotton linters (short fibers that adhere to cottonseed after the first ginning).

The most obvious disadvantage of an artificial casing is its indigestibility. It must be removed before product consumption.

The *collagen* casing is the last major type of casing and combines good features of both natural and artificial casings. Rework of product stuffed in edible collagen casings may be used in the production of emulsion-type sausage without removing the casing since collagen is a natural constituent of meat. Collagen is the major fibrous element of the connective tissue and is widely distributed in skin, bone, tendon, and arterial walls.

Rework

At one time or another, the sausage manufacturer may want to use product referred to as "rework." Rework product is defined as product that has partially or fully completed the processing cycle and is not sellable but still wholesome, and is added to a new batch of product or formulation. It does not include product such raw meat batter added back to the grinder or stuffer hopper from the same batch or formulation.

There are several reasons product rework occurs:

- Casings may split during the cooking or smoking cycle, making the product unsaleable.
- During slicing/packaging, individual pieces or slices are broken or slices are uneven or irregular shaped, making them unsalable.
- The product ends from slicing are unsaleable.

There is also the “returned goods” aspect of rework. *Only* after any returned or damaged product is reinspected can product that is still wholesome be used as food.

The sausage manufacturer may place rework product back into “like” product. For example, if the casing of a stick of bologna splits during the cooking cycle, the packer may remove the casing and add the bologna to another chopper of bologna product. The most important consideration that an establishment should be concerned with, other than wholesomeness, is that all of the ingredients in the rework are reflected on the label applied to the new batch of product.

There is no limitation on the amount of rework that can be added to a new product; however, the sausage manufacturer will usually restrict the amount used to 10% or less. Because rework has no binding capabilities, the quality of the new product could be lessened if too much rework was added.

In some cases, the sausage manufacturer may elect to add rework to an inferior formula with like or similar ingredients. This use of rework would also be acceptable provided the ingredients statement does not change. Rework cannot be listed as a composite. If additional ingredients are in the rework and not in the original formulation, those additional ingredients must be listed in proper order of predominance on the finished product label. These additional ingredients will more than likely be listed in the “less than 2%” section of the ingredients statement. With the exception of products in edible collagen casings and casings from hog or sheep rounds, all casings must be removed from rework before regrounding or chopping. Excess ends of collagen casings must be removed.

All rework products should bear proper identification throughout the formulation process, specifying the product name and ingredients. For the purpose of calculating restricted ingredients, IPP must *not* include the rework product weights. This rework product has already met the requirements for restricted amounts at the time of its formulation, and is actually being used as a filler.

Cooked Sausage Standards of Identity

A variety of cooked, or cooked and smoked sausage products are produced. The most common products in cooked and smoked category are hotdogs, franks, wieners, bologna, cooked salami, and kielbasa. Braunschweiger is a cooked sausage that is not smoked.

Sausage — 9 CFR 319.140

Sausage is the coarse or finely comminuted meat food product prepared from one or more kinds of meat or meat and meat byproducts, containing various amounts of water as provided for elsewhere in this part, and usually seasoned with condimental proportions of condimental substances, and frequently cured. Sausage may contain binders and extenders if permitted by the regulations. Cooked sausages such as Polish sausage, cotto salami, braunschweiger, liver sausage, and similar cooked sausage products may contain no more than 10% of added water in the finished product. Sausage may contain mechanically Separated (Species) used in accordance with §319.6.

Frankfurter, frank, furter, hotdog, wiener, vienna, bologna, garlic bologna, knockwurst, and similar products — 9 CFR 319.180

Frankfurter, frank, furter, hotdog, wiener, vienna, bologna, garlic bologna, knockwurst and similar cooked sausages are comminuted, semisolid sausages prepared from one or more kinds of raw skeletal muscle meat or raw skeletal muscle meat and raw or cooked poultry meat, and seasoned and cured, using one or more of the curing agents in

accordance with a regulation permitting that use. They may or may not be smoked. The finished products shall not contain more than 30% fat. Water, ice, or both may be used to facilitate chopping and mixing or to dissolve the curing ingredients, but the sausage shall contain no more than 40% of a combination of fat and added water. These sausage products may contain only phosphates approved in §424.21(c) or FSIS Directive 7120.1. Such products may contain raw or cooked poultry meat and/or Mechanically Separated (Kind of Poultry) without skin and without kidneys and sex glands used in accordance with §381.174, not in excess of 15% of the total ingredients, excluding water, in the sausage, and Mechanically Separated (Species) used in accordance with §319.6. Such poultry meat ingredients shall be designated in the ingredient statement on the label in accordance with the provisions of §381.118.

These sausages shall be labeled with their generic name (e.g., frankfurter, hotdog, wiener, bologna, knockwurst). When they are prepared with meat from *a single species* of cattle, sheep, swine, or goats they shall be labeled with the term designating the particular species in conjunction with the generic name, such as “Beef Frankfurter.”

Partially defatted product may be used in these sausage products at a level of 15% or less of the meat or meat and meat byproducts, or poultry or poultry and poultry byproducts (meat block) portion of the formula. Partially defatted tissue is the result of low-temperature rendering of wholesome fat from boning and trimming lines. The fat is rendered to a temperature not to exceed 120°F and the protein is extracted from the fat, resulting in an emulsion-like product. Partially defatted beef or pork fatty tissue is considered a byproduct when added to cooked sausage products such as frankfurters and bologna. Therefore, a statement indicating “variety meats” or “byproducts” must be added to the label contiguous to the product name. In addition, the ingredients statement would have to reflect these byproducts by name in descending order of predominance.

Binders and extenders listed in §424.21(c) or FSIS Directive 7120.1 may be used in these cooked sausages. When a binder or extender is added to these products, it shall be declared in the ingredients statement by its common or usual name in order of predominance.

Braunschweiger or Liver Sausage — 9 CFR 319.182

“Braunschweiger” is a cooked sausage made from fresh, cured, and/or frozen pork, beef, and/or veal and at least 30% pork, beef, and/or veal livers computed on the weight of the fresh livers. It may also contain pork and/or beef fat. Mechanically Separated (Species) may be used in accordance with §319.6. Binders and extenders may be used as permitted in §319.140. The product may have a smoked taste characteristic, which may be imparted by use of smoked meats, smoke flavoring or smoking. If the product is prepared from components of a single species, its name may reflect the species, e.g., “beef braunschweiger.” Braunschweiger may also be labeled as any of the following: “Braunschweiger - A Liver Sausage,” “Braunschweiger - A Liverwurst,” or “Braunschweiger (Liver Sausage)” or “Braunschweiger (Liverwurst).”

“Liver Sausage” or “Liverwurst” is a cooked sausage made from fresh, cured, and/or frozen pork, beef, and/or veal and at least 30% pork, beef, veal, sheep, and/or goat livers computed on the weight of the fresh livers. It may also contain pork and/or beef byproducts. Mechanically Separated (Species) may be used in accordance with §319.6. Binders and extenders may be used as permitted in §319.140. If the product is prepared from components of a single species, its name may reflect that species, e.g., “Pork Liver Sausage.”

NOTE: Braunschweiger and liver sausages are stuffed into impervious casings (plastic or fibrous) or molds and cooked. There is very little or no cook shrink; thus the establishment must closely control the amount of water added at the time of formulation.

NFSCP PHIS Tasks

Performing the General Labeling Task

Inspection program personnel perform this task to verify general labeling regulatory requirements and determine if the label accurately reflects the finished product.

• General Labeling Requirements

Verifying that the general labeling requirements have been met involves:

- observing the application of the label or labeling.
- selecting labels and labeling for review.
- reviewing the establishment's labeling records.

When IPP observe the packaging and labeling operations, they ensure that immediate containers of meat and poultry products have a label attached to them and that shipping containers bear the required information.

When IPP select and review the label/labeling being applied to the container or package, they determine if:

- the label contains the mandatory features and other required information such as a qualifying statement or descriptive designation.
- any printing or colors on the label and packaging material gives a false impression or does not meet specific formatting criteria.

Product is misbranded if its label is missing a required feature, qualifying statement, or descriptive designation or is anyway false or misleading.

When IPP review the establishment's labeling file, they determine if the:

- label is on file and either met the generic approval requirements or was sketch approved by LPDS.
- label required sketch approval by LPDS and if so, the sketch is attached to the final label.
- label is being used beyond the expiration date if it has been granted a temporary approval by LPDS.
- product's formulation (if applicable) and processing procedures are attached to or accompany the label/labeling.

If IPP find noncompliance, they issue an NR and take the appropriate action necessary to ensure misbranded product does not enter commerce.

• **Label Accurately Reflects the Product**

Determining that the label accurately reflects the finished product involves reviewing the product's formulation record and observing its actual preparation and, in some cases, performing formula calculations.

When IPP perform this task, they should select one or more batches of product at formulation and verify ingredient amounts comply with the formula on file and that no undeclared ingredients are added or declared ingredients are omitted.

The verification may involve:

- observing pre-weighed ingredients for proper identification and weights.
- observing establishment employees weighing ingredients.
- actually weighing pre-weighed ingredients to determine if the weight on the container is accurate.

An ingredient added at a different level than indicated in the product formula could affect the ingredient order of predominance on the label. The product is misbranded if a declared ingredient is omitted, an ingredient is added but not

declared on the label, or the ingredient order of predominance is not accurate. Depending on the type of undeclared ingredient (e.g., an allergen) that is added to the product, it may be either adulterated or misbranded or both.

The regulations and many product standards of identity allow the establishment to add various ingredients to the formulae of certain meat and poultry products. Some meat and poultry components used in the formulation may have regulatory limits. Some nonmeat ingredients have a specified maximum amount or percentage allowed in the product. These nonmeat ingredients are called restricted ingredients. The establishment may add the component or ingredient in any amount up to its permitted limit.

If the product is formulated with a meat or poultry component with a regulatory limit or with a restricted ingredient, the IPP should select one or more batches of product during formulation. They should determine the amount or percentage of the meat or poultry component and/or the amount one or more restricted ingredients used in the formula. The IPP verifies that the:

- percentage of meat or poultry component meets the regulatory limit, ○ restricted ingredient is allowed in the product, and ○ the amount of the restricted ingredient added to the product does not exceed the regulatory limit.

Verifying meat and poultry components or restricted ingredients are in compliance with regulatory limits usually requires the IPP to perform a formula calculation. When meat or poultry components or restricted ingredients are added at levels in excess of their maximum regulatory limit, they become *economic adulterants*.

If IPP find noncompliance, they issue an NR and take the appropriate action necessary to ensure adulterated or misbranded product does not enter commerce.

Performing the Labeling-Product Standards Task

Inspection program personnel perform this task in establishments that produce products that have a standard of identity or composition which requires a minimum percentage of meat or poultry and/or specific ingredients to be in the finished product.

NOTE: A product's standard of identity may be listed in the CFR or in the Food Standards and Labeling Policy Book (FSLPB).

When IPP perform this task, they review the establishment's label records (includes product formulations, e.g., batch ingredients and recipes, processing procedures, and final labels) to determine what ingredients are in the finished product and the amount or percentage of the meat or cooked poultry meat added to product's formulation.

They should also select one or more batches of product at formulation and verify that the ingredients that must be in the finished product are actually being added to formulation. This verification may involve observing the pre-weighed ingredient names and observing the product's preparation.

Some products have a standard of identify that *requires a minimum percentage of raw meat or cooked poultry meat, or edible portion from an amenable species* to be added to its formulation. For example, fresh Italian sausage products must contain at least 85% meat, or a combination of meat and fat. Braunschweiger must contain a minimum of 30% fresh beef, pork, or veal liver.

When the product's standard of identity lists a minimum percentage of meat or poultry component required in the finished product, the IPP should select one or more batches of product during preparation and verify the weight of the meat or poultry component. The IPP should perform a calculation to determine the percentage of the meat or poultry component in the product using the weights obtained at the time of formulation. The product name is false or misleading if a required ingredient is omitted or the finished product doesn't contain the required amount or percentage of meat or poultry component.

If IPP find noncompliance, they issue an NR and take the appropriate action necessary to ensure misbranded product does not enter commerce.

Supplemental Information

TITLE:	Sausage Operations
RESOURCES:	FSIS Regulations FSIS Directive 7620.3, Processing Inspectors' Calculations Handbook FSIS Directive 7000.1 Sausage Operations Module
SUPPLEMENTS:	Each supplement introduction highlights the information for that supplement.
PURPOSE:	These calculations and references will provide inspection program personnel with sufficient knowledge to accurately determine compliance and initiate appropriate actions during their verification of various sausage operations.
NOTE:	For the purpose of all supplement problems, an answer to 2 decimal points is acceptable.

Do not round up when calculating restricted ingredients.

Supplement 1 - Restricted and Required Ingredients in Fresh Sausages

This section of the handout includes information on food ingredients and their limits for use in the preparation of fresh sausage. It provides IPP with the background necessary to determine compliance when water, restricted ingredients, and/or meat components which have regulatory limit are added to fresh sausage formulations. It covers the following mathematical calculations.

- Added water
- Fat content for verifying antioxidants
- Mechanically separated pork
- Binders and extenders added to breakfast sausage
- Antioxidants

A calculation for the minimum meat or meat and fat content for Italian sausage is also provided.

NOTE: In the establishment, FSIS Directive 7620.3, Processing Inspectors' Calculations Handbook, can be used to assist you.

When verifying fresh sausage regulatory requirements during the performance of the General Labeling and Labeling-Product Standards tasks, IPP need to follow specific calculation methods.

Fresh Sausage Example Problem 1

An IPP has the General Labeling task on her schedule today. The establishment is making fresh sausage patties and tray packaging them. She observes the label below being applied to the film wrapped trays.

COUNTRY SAUSAGE PATTIES

BHA, BHT, Citric Acid added to protect flavor

Includes: Hams, Shoulders, Loins, Sides and Pork

PREVIOUSLY HANDLED FROZEN FOR YOUR PROTECTION
REFREEZE OR KEEP REFRIGERATED

NET WT. 10 OZ. (283g)

10 OZ. COUNTRY SAUSAGE PATTIES
INGREDIENTS: Pork, Water, Salt, Dextrose, Flavorings, Sugar, Monosodium Glutamate, Sodium Acetate, BHA, BHT, Citric Acid.

Nutrition Facts		Amount/Serving	% DV*	Amount/Serving	% DV*
Total Fat 13g		20%	Total Carb. 0g		0%
Sat. Fat 4g		20%	Fiber 0g		0%
Trans Fat 0g			Sugars 0g		
Cholest. 40mg		13%	Protein 9g		
Sodium 400mg		17%			
*Percent Daily Values (DV) are based on a 2,000 calorie diet.			Vitamin A 0% • Vitamin C 0% • Calcium 0% • Iron 2%		

COOKING INSTRUCTIONS
Panfry: Preheat skillet to 350°F. Cook approximately 4 minutes on each side until center is no longer pink. Cook to an internal temperature of 160°F.

She observes the following sausage patty formula posted near the blenders in the processing room. She also observes the pre-weighted ingredients for one batch. The ingredient weights and names agree with the posted formula.

Sausage Formula (Batch)	
Regular pork trimmings (60% fat)	280.00 lb.
Pork hams, loins, shoulders, sides (30% fat)	160.00 lb.
Water	18.00 lb.
Hunts Fresh Sausage Flavoring Mix	10.00 lb.
Sugar	<u>2.00 lb.</u>
	470.00 lb. total batch weight

In the production office, the IPP finds the same label and formula as above in the establishment's label file. The IPP also finds the following additional information attached to the formula.

NOTE: This product is formulated to yield a finished product with a fat limit of 40%. Hunts Fresh Sausage Flavoring Mix:

Salt	5 lb.
Dextrose	2 lb.
Black pepper	1 lb.
Sage	12 oz.
Nutmeg	9 oz.
MSG	7 oz.
Sodium Acetate	3 oz.
BHA, BHT, Citric acid	<u>1 oz.</u>
	10.0 lb.

Directions: Use one bag flavoring mix to each 470 pound batch of sausage patties.

There is a letter from the flavoring mix manufacturer that states that the BHA, BHT and citric acid are added to the flavoring mix as an antioxidant compound which is made up of the following ingredients and their percentages: (butylated hydroxyanisole BHA-30%, butylated hydroxytoluene (BHT) - 10%, citric acid - 10%, and a salt carrier - 50%.

When used according to directions, the flavoring mix complies with government requirement for antioxidants.

Requirements the IPP needs to verify in this product formula:

1. Does the added water comply with the added water limit for this type of product?
2. Is the intended fat requirement met, based on calculated fat total?
3. Is the antioxidant in compliance with the regulatory limit in this type of product?

Determining the Added Water Content

Given: Total amount of the ingredients is 470 pounds.

Step 1: Subtract the amount of water from the formula.

Subtract the allowed percentage of water from 100%.

$$\begin{array}{r} 470 \text{ lb. (100\%)} \\ - \underline{18 \text{ lb. (3\% - water limitation)}} \\ 452 \text{ lb. (97\% - batch weight less water)} \end{array}$$

Step 2: Divide the batch (formula) weight minus the water weight (452 lb.) by the percentage of the formula this figure represents (97%).

$$452 \div 0.97 = 465.97 \text{ lb. (total amount of product with the addition of 3\% water)}$$

Step 3: Subtract 452 lb. from 465.97 lb.

$$\begin{array}{r} 465.97 \text{ lb. (100\% total ingredients)} \\ - \underline{452.00 \text{ lb. (97\% batch weight with no water)}} \\ 13.97 \text{ lb. (3\%) water permitted} \end{array}$$

OR

Multiply 465.97 lb. (100%) by 3%

$$\begin{array}{r} 465.97 \text{ lb.} \\ \times \underline{.03} \\ 13.97 \text{ lb. of water permitted} \end{array}$$

The answer to the first question is “NO”. The added water is in excess of 3% that is allowed in raw sausage patties. The IPP should retain all of the sausage patties produced from the beginning of the shift and any other lots of sausage patties produced using the same formula that is still in the establishment.

Determining the Fat Content for Subsequent Antioxidant Determination

Look first at what is given:

40% target fat level in the finished product.

Pork hams, shoulders, loins, and sides contain 30% fat.

Regular pork trimmings contain 60% fat.

Total number of lb. in the meat portion of the formula

= 280 lb. + 160 lb., or 440 lb.

Step 1. Determine the amount (in pounds) of fat permitted in the total formula.

$$\begin{array}{r} 470 \text{ lb. (batch weight)} \\ \times \underline{0.40} \text{ (40\% target fat content)} \\ 188 \text{ lb. fat based on target} \end{array}$$

Step 2. Determine the amount of fat that is being added in the meat portion of the formula.

$$\begin{array}{r} 280 \text{ lb. (regular pork trimmings)} \times \underline{0.60} \text{ (60\%)} \\ = 168 \text{ lb. fat added} \end{array}$$

$$\begin{array}{r} 160 \text{ lb. (pork hams, shoulders, loins, and sides)} \times \underline{0.30} \text{ (30\%)} \\ = 48 \text{ lb. fat added} \end{array}$$

$$\begin{array}{r} 168 \text{ lb.} \\ + \underline{48 \text{ lb.}} \\ 216 \text{ lb. total fat added} \end{array}$$

Step 3. Compare the total fat added with the fat content target for the formula.

$$\begin{array}{r} 216.0 \text{ lb. fat being added} \\ - 188.0 \text{ lb. fat allowed for establishment's target} \\ \hline 28.0 \text{ lb. over} \end{array}$$

Step 4. Determine level of fat in the finished product.

$$\begin{array}{l} 216 \div 470 \text{ (batch weight)} \\ = 0.4595 \times 100 \\ = 45.95\% \text{ fat (as formulated) in the finished product.} \end{array}$$

NOTE: What if this batch of country sausage patties was actually labeled country *pork* sausage patties? Adding the word “pork” in the product name changes the standard of identity from 9 CFR 319.140 to 319.141. Even though the batch was not formulated to meet the establishment’s targeted fat content of 40% in the finished product, it is still in compliance because the fat content did not violate the maximum 50% fat content allowed in the finished product. If the IPP’s fat content calculation showed that this batch of country *pork* sausage patties was formulated with a fat content above 50%, the calculation can only be used as an indicator of the establishment’s noncompliance with the pork sausage standard. A fat standard noncompliance at the time of formulation should be confirmed through laboratory analysis. The IPP would need to contact his or her supervisor to get approval to submit a collector generated sample. Regulatory action for a fat content noncompliance *must* be based on the laboratory result.

Antioxidant Determination

To verify the compliance of a restricted ingredient that has a regulatory limit based on the fat content of the product, e.g., an antioxidant, IPP must be able to calculate the amount of fat in the product. A product’s laboratory fat analysis history or the establishment’s target fat content for the product is used as the basis for determining the maximum level of antioxidants allowed in the product. If a product has less fat in it than its targeted fat

content, but the antioxidant level is based on the targeted fat content, the product is out of compliance for antioxidants. When antioxidants are added to sausage products, there shall appear on the label in prominent letters, in close proximity without intervening text or graphics to the product name, a statement identifying the antioxidant by its common and usual name or abbreviation such as “BHA, BHT and Citric acid added to help protect flavor.”

Limitations for antioxidants (e.g., BHA, BHT, and propyl gallate) and *synergist* (e.g., citric acid) in raw sausage

- Individual antioxidants (0.01% of fat content), except tocopherols
- Tocopherols (0.03% of fat content). They cannot be used in combination with other antioxidants.
- Antioxidants in combination (0.02% of fat content)
- Synergist (0.01% of fat content)

Most antioxidants used are in a mix or compound containing a carrier, two or more individual antioxidants, and possibly a synergist. It will not be necessary to calculate for each antioxidant or synergist. One calculation will be sufficient if the following rules are applied.

- If *no individual antioxidant or synergist is more than half of the total antioxidants* in the mix or compound: Use 0.02% to calculate for the total of all antioxidants in combination.
- If *one individual antioxidant or synergist is more than half the total antioxidants* in the mix or compound: Use 0.01% to calculate for that individual antioxidant or synergist.

NOTE: An antioxidant (e.g., BHA, BHT, or TBHQ) can never be added to a product in an amount greater than its individual limit (0.01%, 0.003%, etc.) even when it is used in combination with other antioxidants (i.e., in a mixture). This is why the calculation for an antioxidant mixture is based on the 0.01% limit anytime an individual antioxidant makes up 50% or more of the total antioxidants in the mixture.

- If *one individual antioxidant or synergist is exactly half (50%) of the total antioxidants* in the mix or compound: Use either 0.01% to calculate for that individual antioxidant or synergist, *or* 0.02% to calculate for the total of all antioxidants in combination. (The result will be the same.)

In this determination, we used the target amount of fat in the formula as if it had been found to be correct. In reality, the IPP would use the computed amount of fat in the formula (45.95%) if it were not in violation of the fat limitation given in the product standard.

Given: The amount of antioxidant compound in the flavoring mix (1.0 oz.) The percentage of fat in the finished product (40%)

Step 1. Determine the weight represented by the fat content. In this example, 470 lb. represents the batch weight and of this 470 lb., 40% is the fat target, so:

$$\begin{array}{l} 470 \text{ lb. (batch weight)} \\ \times 0.40 \text{ (40\%--fat content)} \\ \hline 188 \text{ lb. (the amount of fat in the finished product)} \end{array}$$

Step 2: Determine the total content of the antioxidant/synergist mixture and the percentage of each ingredient. This information is attached to the label in the establishment's file. (See percentages above.)

Step 3 Determine what percentage of the mixture is made up of antioxidants. In other words, total the percentages of antioxidants in the mix or compound. For this example:

$$\text{BHA (30\%)} + \text{BHT (10\%)} = 40\% \text{ total antioxidants}$$

Step 4. If any one of the antioxidants or synergist makes up more than half of the antioxidant total, multiply the fat weight by 0.0001 (0.01%) to determine the amount of antioxidant allowed. If no single antioxidant or synergist makes up more than half (20%) of the antioxidant total, multiply the fat weight by 0.0002 (0.02%) to determine the amount of antioxidant allowed. Since BHA (30%) is more than half (20%) of the antioxidant total (40%) the IPP would multiply the fat weight by 0.0001 (0.01%) to determine the amount of antioxidant allowed.

188 lb.

$$\times 0.0001 (0.01\%)$$

0.0188 lb. maximum antioxidant allowed for this example.

Step 5. If one individual antioxidant or synergist makes up more than half of the antioxidant total, divide the amount of antioxidant allowed (from Step 4) by the percent of the *major* antioxidant or synergist to determine the amount of antioxidant compound that can be used. If no individual antioxidant or synergist makes up more than half of the antioxidant total, divide the amount of antioxidant allowed (from Step 4) by the percentage of *total* antioxidants to determine the amount of antioxidant compound that can be used. In this example, BHA (30%) makes up more than half (20%) of the total antioxidants; therefore, the IPP would divide the amount of antioxidant allowed (from Step 4) by the percentage of the major antioxidant in the mix, in this case BHA, to determine the amount of antioxidant compound that can be used.

$$\begin{aligned} &0.0188 \text{ lb.} \div .30 (30\% - \text{BHA}) \times 16 (16 \text{ oz. in lb.}) \\ &= 1.0 \text{ oz. (maximum amount of antioxidant compound allowed)} \end{aligned}$$

The answer to the third question is YES, the antioxidant compound used in this batch of pork sausage is in compliance.

Fresh Sausage Example Problem 2

An IPP has the Labeling-Product Standards task scheduled today. The establishment is making fresh Italian sausage and packaging it in film wrapped trays. She observes the following labels being applied to the trays.

SWEET	ITALIAN	SAUSAGE
<p>240 FOR YOUR PROTECTION PREVIOUSLY FROZEN CALORIES PER LINK REFREEZE OR KEEP REFRIGERATED</p> <p>U.S. INSPECTED AND PASSED BY DEPARTMENT OF AGRICULTURE 38 EST.</p>		
<p>INGREDIENTS: PORK, WATER, CORN SYRUP, CONTAINS 2% OR LESS OF: SODIUM LACTATE, SALT, DEXTROSE, CORN SYRUP SOLIDS, SPICES, POTASSIUM CHLORIDE, MALTODEXTRIN, NATURAL FLAVORS (CONTAINS MALTODEXTRIN), OLEORESIN OF PAPRIKA, OLEORESIN OF CAPSICUM, SUGAR, SILICON DIOXIDE (ANTI-CAKING), CALCIUM STEARATE (ANTI-CAKING), CORN OIL (PROCESSING AID)</p>  <p>NET WT. 18 OZ (1 lb. 2 Oz.) 510g</p>		

She observes the following Italian Sausage formula posted near the blenders in the processing room.

Sweet Italian Sausage Formula

Pork Trimmings	(20% fat)	175.00 lb.
Pork jowls (skinned)	(80% fat)	100.00 lb.
Water and ice		9.00 lb.
Corn syrup		9.00 lb.
Sodium lactate		6.00 lb.
Salt		6.00 lb.
Dextrose		5.50 lb.
Corn syrup solids		5.00 lb.
Spices (fennel and black pepper)		4.00 lb.
Potassium chloride		2.50 lb.
Maltodextrin		2.00 lb.
Natural flavors		2.00 lb.
Oleoresin of Paprika		1.50 lb.
Oleoresin capsicum		1.00 lb.
Sugar		1.00 lb.
Silicon dioxide		0.50 lb.
Calcium stearate		0.50 lb.
Corn oil		<u>0.50 lb.</u>
		331.00 lb. Total Batch Weight

The IPP verifies:

1. The minimum meat or meat and fat requirement for Italian sausages
2. A fresh sausage labeled "Italian Sausage" contains pork or pork and pork fat and salt, pepper and fennel or anise or combination of fennel and anise.

NOTE: The added water in the Italian Sausage would be verified during the General Labeling task as demonstrated in the previous example problem.

Minimum Meat and Meat and Fat Determination for Italian Sausages

Italian sausages must contain a minimum of 85% minimum meat or meat and fat based on total ingredients.

Step 1: Determine the weight of the pork or pork and pork fat in the formula.

Pork trimmings	175 lb.
Pork jowls	<u>100 lb.</u>
Total	275 lb. total pork

Step 2: Divide the weight of the pork by the batch weight (total ingredients) and multiply the result by 100.

$$275 \text{ lb.} \div 331 \text{ lb.} \times 100 = 83.08\% \text{ pork}$$

NOT in compliance because a minimum of 85% pork is required in the formula.

Fresh Sausage Example Problem 3

An IPP has the General Labeling task scheduled today. The establishment is making fresh breakfast sausage links and packaging them in trays. He observes the label below being applied to the trays.



Ingredients: Pork, mechanically separated pork, water, soy flour, salt natural flavorings, sugar, collagen casing **Contains Soy**

He observes the following breakfast sausage formula posted near the blenders in the processing room.

Breakfast Sausage Formula

Pork	(30% fat)	210.00 lb.
Pork jowls (skinned)	(88% fat)	187.00 lb.
Mechanically separated pork	(30% fat)	50.00 lb.
Water and ice		20.00 lb.
Soy flour		15.00 lb.
Salt		8.00 lb.
Sugar		5.00 lb.
Natural Flavorings		<u>5.00 lb.</u>
		500.00 lb. total batch weight

Finished product with 50% fat content .

The IPP verifies the compliance of:

1. Mechanically separated pork (MSP)
2. Water
3. Extenders and binders

Mechanically Separated Pork Determination

20% MSP is permitted based on the total meat and meat byproduct portion (meat block) of the formula.

Step 1: Determine the weight of the meat block in the formula.

Pork trimmings	210 lb.
Pork jowls	<u>187 lb.</u>
Total	397 lb. (without MSP = 80% of meat block of the formula)

Step 2: Divide the weight of the meat block by the percentage of the formula that it represents (80%).

$$\begin{aligned} & 397 \text{ lb.} \div 0.8 \text{ (80\% represents the meat block of the formula without the MSP)} \\ & = 496.25 \text{ lb. (100\%)} \text{ when 20\% MSP is added} \end{aligned}$$

Step 3: Multiply the amount of the formula (100%) with 20% MSP by the regulatory limit for MSP (20%) to determine the maximum amount of MSP allowed in the formula.

$$\begin{aligned} & 496.25 \text{ lb.} \\ & \times \underline{0.2} \text{ (20\% - MSP limitation)} \\ & 99.25 \text{ lb. of MSP permitted} \end{aligned}$$

In compliance because 50 lb. is being used in the formula.

Shortcut method

Total MSP added to the product divided by the meat and meat byproduct (meat block)
50 (lb. in formula) divided by 447 lb. (including MSP)
 $50 \div 447 = 11.18\%$ being used in the formula (in compliance)

Water and Soy Flour (Binder) Determination

Added water is limited to 3% and binders and extenders are limited to 3.5% based on total ingredients.

Step 1: Subtract the pounds of the water and binder from the batch weight.

	500 lb.	(100.0% batch weight)
Deduct water	- 20 lb.	(3.0% added water limit)
Deduct soy flour	- <u>15 lb.</u>	<u>(3.5% binder limit)</u>
465 lb.		(93.5%--the formula less the water and soy flour)

Step 2: Divide the remaining amount of the formula by the percentage it represents.

$$\begin{aligned} &465 \text{ lb.} \div 0.935 \text{ (93.5\%)} \\ &= 497.3 \text{ lb. (total ingredients weight, maximum amount of water and soy flour included)} \end{aligned}$$

Step 3: Multiply the total ingredients weight by the regulatory limit for soy flour (binder) and added water to determine the maximum amount each ingredient allowed.

497.3 lb. (total weight with maximum amount of water included)

$$\begin{aligned} &\times \underline{0.03} \text{ (3\% water permitted)} \\ &14.9 \text{ lb. of water permitted in the formula} \end{aligned}$$

(20 lb. is being used, which is 5.1 lb. over maximum amount of water allowed)
497.3 lb.

$$\begin{aligned} &\times \underline{0.035} \text{ (3.5\% binder and extenders permitted)} \\ &17.4 \text{ lb. of soy flour permitted in the formula} \end{aligned}$$

(15 lb. being used, which is 2.4 lb. under maximum amount of soy flour allowed)

Fresh Sausage Workshop

Using the methods outlined in this handout, perform the required calculations to answer the questions related to the following fresh sausage formula. If you need help, contact your instructor.

You are a CSI assigned to an establishment that produces several types of pork sausage and Italian sausage. When you arrive at the establishment, you log-on to your computer and bring up the task calendar in PHIS. The Labeling Products Standards and General Labeling tasks are on the task calendar for today. You proceed to the processing room and note that both processing lines are in operation today. At the end of line one, Italian sausage stuffed into natural casings is being tray packed and placed in cardboard shipping containers. You verify that the shipping containers have an inspection legend and handling statement (“keep refrigerated”). The label below is being applied to the film wrapped trays.



Ingredients: Pork, water, corn syrup, green peppers, and less than 2% of the following: salt, spices, paprika, dextrose, monosodium glutamate, flavoring, BHA, propyl gallate, citric acid.

You take one label from the roll of labels and ask the production supervisor to show you the formula for the Italian sausage. He opens a binder at his work bench and shows you the following formula.

Italian Sausage

Formula 1 (Batch)

Pork Trimmings	(20/80% fat/lean ratio)	285.00 lb.
Pork Jowls (Skinned)	(85/15% fat/lean ratio)	155.00 lb.
Spice and Seasoning Mix		14.00 lb.
Water		13.00 lb.
Corn Syrup	(20% water)	10.00 lb.
Green Peppers		10.00 lb.
Salt		6.00 lb.
Paprika		4.00 lb.
Dehydrated Parsley		<u>3.00 lb.</u>
		500.00 lb. Total batch weight

(Fat content target is 35%)

*Spice and Seasoning Mix (14 lb.)

Fennel	3 lb.
MSG	3 lb.
Dextrose	3 lb.
Cumin	2 lb. 7.75 oz.
Black Pepper	2 lb. 7.0 oz.
Acme antioxidant mix	1.25 oz.

You write down the meat block, water, and antioxidant mix weights, and fat to lean ratios for the meat ingredients from the formula in your small green notepad and take the label to your office. You review the standard of identity for Italian sausage in §319.145.

For the Labeling Product Standards task, you perform the calculation to answer the following questions.

1. Does the product contain the required meat or meat and fat combination?
2. Is the product name "Italian Sausage" in compliance with the standard of identity for Italian sausage based on the ingredients used in the formula?

As part of the General Labeling task, while you were looking at the formula in the binder you compared the ingredients statement on the label you brought from the packaging area with the formula in the binder. All ingredients were listed by their common and usual name in descending order of predominance. In your office, you determine that the label contains all of the mandatory features (required information). Next, you proceed to the QC office to determine if the label you have with you is on file. It is in the establishment's file and the processing procedures and formula are attached. The formula in the file is the same formula as you observed on the processing floor. You proceed to the spice room. You notice pre-weighed non-meat ingredients in plastic bags for 2 batches of the Italian sausage. You weigh the spice and seasoning mixture, salt, and paprika for one of the batches. The weights recorded on the bags were accurate and agreed with the formula you observed. You look at the label on the barrel of Acme antioxidant mix and write down the ingredients and percentages (BHA 20%; propyl gallate 20%; citric acid 10% and salt 50%) in your green notepad.

You return to your office and you perform the calculations necessary to answer the following questions.

1. Is the water content in the Italian sausage in compliance with the standard of identity?

2. What is the fat content of the Italian sausage?

3. Is the antioxidant mix in compliance with the maximum fat content for Italian sausage?

Supplement 2 - Restricted and Required Ingredients in Cooked Sausages, Dry Sausages, and Loaves

This section includes information on food ingredients and their limits for use in cooked sausage, semi-dry and dry sausage, and specific and nonspecific loaves. It provides IPP with the background necessary to determine compliance when restricted ingredients and/or meat and poultry components which have a regulatory limit are added to cooked sausage, dry sausage, or loaf formulations. It covers the following mathematical calculations.

- Curing agents and curing compounds in cooked, semi and dry sausages, and loaves.
- Curing accelerators in cooked sausages, semi and dry sausages, and loaves.
- Poultry products when added to cooked sausages listed in 9 CFR 319.180.
- Binders and extenders when added to cooked sausages.
- Phosphates when added to cooked sausages and loaves.

It also includes mathematical calculations for:

- Projected finished weight (PFW) which necessary to determine the compliance of ingredients that are limited in the finished sausage product.
- Minimum liver requirements for certain cooked sausages.

NOTE: In the establishment, FSIS Directive 7620.3, Processing Inspectors' Calculations Handbook can be used to assist you.

When verifying cooked sausage, semi-dry and dry sausage, and specific and nonspecific loaf regulatory requirements during the performance of the General Labeling and Labeling-Product Standards tasks, IPP need to follow specific calculation methods.

Cure Agent, Cure Compound, and Cure Accelerator Compliance Determinations

IPP may use two methods to determine curing agent, curing compound, and curing accelerator compliance. They can determine the ingoing parts per million of the cure agent and cure accelerator used in the sausage or loaf formula and then compare their result against the ingoing amount allowed by the regulations. If the calculated ingoing amount is equal to or less than the amount allowed by regulation, the product is in compliance. Alternatively, they could determine the maximum amount of the cure agent, cure compound or cure accelerator allowed in the sausage or loaf formula and then compare their calculated result to the amount that is actually being used in the formula. If the amount used in the sausage or loaf formula is equal to or less than the maximum amount allowed, the product is in compliance.

Cure Agent and Cure Accelerator Regulatory Limits

Limits for restricted ingredients (RI) permitted in comminuted meat and poultry products (sausages and loaves) are expressed in terms of ounces (oz.) in the Table of Approved Substances in section 424.21(c) of the regulations. The same limits may be expressed in parts per million (ppm) which are more convenient units for verifying food additive compliance. The conversion of curing agent and cure accelerator weight limits to parts per million (ppm) limits is shown in Table 1.

TABLE 1 - Conversion of Restricted Ingredient Weight or Percentage Limitations to PPM Limitations

Cure Agent Limits in Regulations	Converted to Maximum PPM Limit
<p><i>Nitrite</i></p> <p>¼ oz. to 100 lb. of chopped meat and/or meat byproduct and/or poultry product</p> <p><i>Nitrate</i></p> <p>2¾ oz. to 100 lb. chopped meat and/or meat byproduct and/or poultry product</p>	<p>General PPM Equation for Comminuted Product (e.g., Cooked Sausage and Loaves):</p> <p>¼ oz. = .25 oz. ÷ 16 oz. = 0.015625 lb.</p> <p>$\frac{0.015625 \text{ lb.} \times 1,000,000}{100 \text{ lb. of meat/poultry}} = 156.25 \text{ or } 156 \text{ ppm}$</p> <p>2¾ oz. = 2.75 oz. ÷ 16 oz. = 0.171875 lb.</p> <p>$\frac{0.171875 \text{ lb.} \times 1,000,000}{100 \text{ lb. of meat/poultry}} = 1,718.75 \text{ or } 1,718 \text{ ppm}$</p>

Cure Accelerator Limits in Regulations	Converted to Maximum PPM Limit
	Conversion equations are the same as those for the curing agents.
<i>Ascorbic Acid and Erythorbic Acid</i> ¾ oz. to 100 lb. meat or meat byproduct or poultry product	$\frac{3}{4} \text{ oz.} = .75 \text{ oz.} \div 16 \text{ oz.} = .04687 \text{ lb.}$ $\frac{.04687 \text{ lb.} \times 1,000,000}{100 \text{ lb.}} = 468.7 \text{ or } 469 \text{ ppm}$
<i>Ascorbate and Erythorbate</i> ⅞ oz. to 100 lb. meat or meat byproduct or poultry product	$\frac{7}{8} \text{ oz.} = .875 \text{ oz.} \div 16 \text{ oz.} = 0.0546875 \text{ lb.}$ $\frac{0.0547 \text{ lb.} \times 1,000,000}{100 \text{ lb.}} = 547 \text{ ppm}$

<p><i>Glucono delta-lactone (GDL)</i></p> <p>8 oz. to 100 lb. meat or meat byproducts or poultry product</p> <p>16 oz. (1 lb.) to 100 lb. of meat (1%) (Genoa salami only)</p> <p><i>GDL is allowed only in cured comminuted sausage products that carry the meat inspection legend</i></p> <p><i>Sodium Acid Pyrophosphate (SAPP)</i></p> <p>8 oz. in 100 lb. meat or meat and meat byproduct or poultry product</p> <p><i>SAPP is allowed only in cured comminuted sausage products that carry the meat inspection legend</i></p>	<p>8 oz. = 8 oz. ÷ 16 oz. = 0.5 lb.</p> <p>$\frac{0.5 \text{ lb.} \times 1,000,000}{100 \text{ lb.}} = 5,000 \text{ ppm}$</p> <p>16 oz. = 1 lb.</p> <p>$\frac{1 \text{ lb.} \times 1,000,000}{100 \text{ lb.}} = 10,000 \text{ ppm}$</p> <p>8 oz. = 8 oz. ÷ 16 oz. = 0.5 lb.</p> <p>$\frac{0.5 \text{ lb.} \times 1,000,000}{100 \text{ lb.}} = 5,000 \text{ ppm}$</p> <p>(5000 ppm = 0.005 = 0.5%)</p> <p><i>SAPP is limited 5,000 ppm either alone or in combination with other curing accelerators. For example, if a formula had 500 ppm ingoing erythorbate, then only 4,500 ppm ingoing SAPP would be allowed in the formula</i></p>
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NOTE: As a matter of policy, the Agency requires a *minimum* of 120 ppm of ingoing nitrite in *all* cured "Keep Refrigerated" products, unless the establishment can demonstrate that safety is assured by some other preservation process, such as thermal processing, pH or moisture control. This 120 ppm policy for ingoing nitrite is based on safety data reviewed when the bacon standard was developed.

There is *no* regulatory *minimum* ingoing nitrite level for semi-dry and dry sausage products that have been processed to ensure their shelf stability (such as having been subjected to adequate pH controls, and/or moisture controls in combination with appropriate packaging). However, 40 ppm nitrite is useful in that it has some preservative effect. This amount has also been shown to be sufficient for color-fixing purposes and to achieve the expected cured meat or poultry appearance.

Curing Agent (Nitrite and Nitrate) Compliance Determinations

The amount of ingoing cure agent permitted in comminuted products such as bologna, specific loaves (e.g., ham loaf), nonspecific loaves (olive and pepper loaf) and semi-dry and dry salami, is based on the *green weight of the meat and/or poultry and/or meat/poultry byproducts (meat block)* used in the formulation of the product. Because nitrite and nitrate, after being converted to nitric oxide, function by reacting chemically with the meat or poultry muscle pigment (myoglobin), the amounts of nitrite or nitrate permitted in the cure must be based on the meat block used in the formulation, **not** the finished weight of the product. Using finished weight as the weight base for these calculations would be unacceptable because more curing agent than is allowed could be added to the product. Excess nitrite or nitrate can be toxic.

Either the sodium or the potassium salt of nitrite may be used for curing products, but the weight limitation (based on sodium) is the same for both salts. This limitation was established when the sodium salt was the only one permitted. Later, the use of the potassium salt was allowed at the same level. This level is safe, but rather conservative because potassium is a heavier element than sodium and a greater weight of a potassium salt must be used for the equivalent amount of nitrite or nitrate to be in the product.

Cure Agent Used Individually

Calculation Equation:
$$\frac{\text{lb. of cure agent} \times 1,000,000}{\text{lb. of meat block}} = \text{ingoing ppm}$$

Example Problem #1: A bologna formula contains *325 pounds* of meat and $\frac{3}{4}$ *ounce* of nitrite. What is the ingoing parts per million of nitrite?

To determine the ingoing level of nitrite, convert the ounces of nitrite to pounds, then insert the known weights into the equation and calculate.

Step 1: $.75 \text{ oz.} \div 16 = 0.0468 \text{ lb. nitrite}$

Step 2:
$$\frac{0.0468 \text{ lb.} \times 1,000,000}{325 \text{ lb.}} = 144 \text{ ppm ingoing nitrite}$$

Since 144 ppm is less than the 156 ppm regulatory limit for nitrite, this bologna formula is in compliance.

Example Problem #2: An Old Fashioned Pepper loaf formula contains *375 pounds* of meat and meat byproducts and *12 ounces* of nitrate. What is the ingoing parts per million of nitrate?

To determine the ingoing level of nitrate, convert the ounces of nitrate to pounds, then insert the known weights into the equation and calculate.

Step 1: $12 \text{ oz.} \div 16 = 0.75 \text{ lb. nitrate}$

Step 2:
$$\frac{0.75 \text{ lb.} \times 1,000,000}{375 \text{ lb.}} = 2,000 \text{ ppm ingoing nitrate}$$

Since 2,000 ppm is more than the 1,718 ppm regulatory limit for nitrate, this pepper loaf formula is **NOT** in compliance.

Cure Agent Used in the Formula in a Curing Compound or Mix

Remember that the percentage of nitrite and/or nitrate must be indicated on the compound or mix container. To determine the ingoing ppm of the cure agent, the formula must be altered to include the cure agent's percentage in the mix.

Calculation Equation:

$$\frac{\text{lb. of cure mix} \times \% \text{ of cure agent in mix} \times 1,000,000}{\text{lb. of meat block}} = \text{ingoing ppm}$$

Example Problem: A wiener formula contains *500 pounds* of meat and poultry and *1 pound* of cure mix containing 8% nitrite. What is the amount of ingoing nitrite?

To determine the ingoing level of nitrite, insert the known values into the equation and calculate.

$$\frac{1 \text{ lb.} \times 0.08 (8\%) \times 1,000,000}{500 \text{ lb.}} = 160 \text{ ppm ingoing nitrite}$$

Since 160 ppm is more than the 156 ppm regulatory limit for nitrite, this wiener formula is **NOT** in compliance.

Maximum Curing Agent Allowed

The amount of nitrite permitted for use in cured comminuted meat or poultry food products is $\frac{1}{4}$ *ounce* for every 100 pounds of meat, poultry, meat byproducts, or poultry byproducts (meat block) in the formula. The amount of nitrate permitted for use in cured comminuted meat or poultry food products is $2\frac{3}{4}$ *ounce* for every 100 pounds of meat, poultry, meat byproducts, or poultry byproducts (meat block) in the formula.

Calculation Equation:

$$\left(\frac{\text{lb. of meat block}}{100 \text{ lb.}} \times \text{restricted limit per 100 lb. meat block} = \right) \text{maximum amount of cure agent allowed}$$

Example Problem #1: A cotto salami formula contains *400 pounds* of meat, meat byproducts and poultry. What is the maximum amount of nitrite allowed this formula?

To determine the maximum amount of nitrite allowed, insert the known values into the equation and calculate.

$$\left(\frac{400 \text{ lb. meat block}}{100 \text{ lb.}} \right) \times .25 \text{ oz.} = 1.00 \text{ oz. of nitrite allowed}$$

If more than 1.00 oz. of nitrite was added to the cotto salami formulation, the product would be out of compliance.

Example Problem #2: A dry salami formula contains *200 pounds* of meat. What is the maximum amount of nitrate allowed in this formula?

To determine the maximum amount of nitrate allowed, insert the known values into the equation and calculate.

$$\left(\frac{200 \text{ lb. meat block}}{100 \text{ lb.}} \times 2.75 \text{ oz.} = 5.5 \text{ oz. of nitrate allowed} \right)$$

If more than 5.5 oz. of nitrate was added to the dry salami formulation, the product would be out of compliance.

Maximum Cure Compound or Mix Allowed

To determine the maximum amount of cure mix allowed in a formula, the IPP must first calculate how much cure agent is allowed by using the equation and calculation previously demonstrated. Once the maximum amount of cure agent allowed has been determined, use the following equation to determine the maximum amount of cure mix/compound allowed.

Calculation Equation:

Amount of cure agent allowed ÷ % of cure agent in the mix = Maximum amount of cure mix allowed

Example Problem #1: A hotdog with variety meats formula contains *350 pounds* of meat and meat byproducts. How much cure mix containing *6.25% nitrite* would be allowed?

Step 1: $\frac{350 \text{ lb. meat block}}{100 \text{ lb.}} \times .25 \text{ oz. } (\frac{1}{4} \text{ oz.}) = 0.875 \text{ oz. maximum nitrite allowed}$

Step 2: $0.875 \text{ oz. nitrite allowed} \div 0.0625 (6.25\%) = 14 \text{ oz. maximum cure mix allowed}$

If more than 14 oz. of cure mix was added to the hot dog formulation, the product would be out of compliance.

Example Problem #2: A summer sausage formula contains *600 pounds* of meat. How much cure compound containing *12% nitrate* would be allowed?

Step 1: $\frac{600 \text{ lb. meat block}}{100 \text{ lb.}} \times 2.75 \text{ oz.} = 16.5 \text{ oz. maximum nitrate allowed}$

Step 2: 16.5 oz. nitrate allowed \div 0.12 (12%) = 137.5 oz. or 8.59 lb. maximum cure mix allowed

If more than 137.5 oz. (or 8.59 lb.) of cure mix was added to the summer sausage formulation, the product would be out of compliance.

NOTE: If nitrate is used in conjunction with nitrite, the limits of the two ingredients are calculated separately and the permitted maximum (weight or ppm) of each may be used.

Cure Accelerator Compliance Determinations

Since the cure accelerators aid the cure agents, cure accelerator amounts are calculated on the basis of the *green weight of the meat and/or poultry and/or meat/poultry byproducts (meat block)* in the sausage formulation and are controlled on an ingoing basis.

All the methods for calculating nitrite and nitrate amounts also apply in the calculation of cure accelerator amounts. Different limits apply, depending upon which cure accelerator is used in the sausage or loaf formulation.

Curing Accelerator Added Individually

Calculation Equation:
$$\frac{\text{lb. of cure accelerator} \times 1,000,000}{\text{lb. of meat block}} = \text{ingoing ppm}$$

Example Problem: A Kielbasa formula contains 325 *pounds* of meat and meat byproducts and 2.5 *ounces* of sodium erythorbate. What is the ingoing parts per million of sodium erythorbate?

To determine the ingoing level of sodium erythorbate, convert the ounces of sodium erythorbate to pounds, then insert the known weights into the equation and calculate.

Step 1: 2.5 oz. \div 16 = 0.15625 lb. sodium erythorbate

Step 2: $\frac{0.15625 \text{ lb.} \times 1,000,000}{325 \text{ lb.}}$ = 480.76 ppm ingoing sodium erythorbate

Since 480.76 ppm is less than the 547 ppm regulatory limit for sodium erythorbate, this Kielbasa formula is in compliance.

Maximum Curing Accelerator Allowed

The following is a list of common curing accelerators and the maximum amount allowed for *each 100 lb. of meat, meat byproducts, poultry, and poultry byproducts (meat block) in the formula.*

- Ascorbic acid and erythorbic acid - 3/4 oz.
- Sodium ascorbate and sodium erythorbate - 7/8 oz.
- Glucono delta lactone and sodium acid pyrophosphate—8 oz. (allowed only in products that carry the meat inspection legend). Sodium acid pyrophosphate is limited to 8 oz. alone or in combination with other curing accelerators.

Calculation Equation:

$$\left(\frac{\text{lb. of meat block}}{100 \text{ lb.}} \times \text{restricted level/100 lb. meat block} = \text{max. amount of cure} \right)$$

accelerator allowed

Example Problem: A pickle loaf formula contains *400 pounds* of meat, meat byproducts and poultry. What is the maximum amount of ascorbic acid allowed this formula?

To determine the maximum amount of ascorbic acid allowed, insert the known values into the equation and calculate.

$$\left(\frac{400 \text{ lb. meat block}}{100 \text{ lb}} \right) \times .75 \text{ oz. } \left(\frac{3}{4} \text{ oz.} \right) = 3.00 \text{ oz. of ascorbic acid allowed}$$

If more than 3.00 oz. of ascorbic acid was added to the pickle loaf formulation, the product would be out of compliance.

Curing Agent and Cure Accelerator Workshop

Work the following problems.

1. An olive loaf formula contains *600 pounds* of beef, pork and mechanically separated chicken. Determine the maximum amount of sodium nitrite *and* sodium erythorbate permitted in this formula.
2. A chicken frankfurter formula contains *700 pounds* of chicken meat and chicken byproducts, *7 ounces* of sodium erythorbate, and *26 ounces* of cure mix containing *6.25% sodium nitrite*. What is the ingoing parts per million of sodium erythorbate and sodium nitrite? Is this formula in compliance?

3. A pepperoni formula contains *500 pounds* of pork and beef. How much *curing compound* containing *8% nitrite* would be allowed?

Adding Poultry Products to Cooked Sausage Products

Cooked sausage products identified in 9 CFR 319.180 of the regulations, e.g., bologna, frankfurters and hot dogs, may contain poultry products that, individually or in combination, are not in excess of 15% of the *total ingredients, excluding water or ice*.

Before determining the amount of poultry allowed in a cooked sausage formulation, it might be a good idea to identify which poultry products are allowed and which are not allowed. For example, sausages listed in 9 CFR 319.180 *cannot* contain the following poultry items:

- Kidneys
- Sex glands

These sausages may contain the following poultry products:

- Poultry meat and/or poultry (raw/cooked)
- Poultry gizzards or poultry hearts (§381.1)
- Either chicken or turkey
- Comminuted poultry if labeled "Kidneys and Sex Glands Removed" (§319.180(b))

For the purpose of clarification, review the following definitions. The term "poultry products" includes:

- Poultry meat (§319.180(g)) - Deboned chicken or turkey meat, *without* skin or *added* fat

- Chicken or turkey (§381.118) - Includes edible parts such as skin and fat when not in excess of their natural proportions
- Poultry byproducts (§381.1) - Skin, fat, gizzard, heart, and liver.

For the purpose of labeling, *all* poultry must be declared in the ingredients statement. Examples of acceptable terminology: chicken meat, turkey meat, mechanically separated chicken, mechanically separated turkey, chicken gizzards, chicken hearts, turkey gizzards, and turkey hearts.

NOTE: If a sausage manufacturer adds *more* than 15% poultry product to a sausage product listed in 9 CFR 319.180, a “made with” statement in close proximity to the product name without intervening text must appear on the label. An acceptable product name would be “Bologna Made with Chicken and Pork, Beef Added”. See Policy Memo 005A.

Example Problem

The *total batch* weight excluding water may contain 15% poultry products.

The establishment formulates a 650 lb. batch of bologna containing 110 lb. of water, and 70 lb. of mechanically separated chicken. Is the mechanically separated chicken in compliance (MSC)?

Step 1: For the purpose of calculation, the IPP would remove the water, leaving 540 lb, which includes the MSC.

$$650 \text{ lb. (batch weight)} - 110 \text{ lb. (water)} = \mathbf{540 \text{ lb. (batch weight excluding water)}}$$

Step 2: At this point the IPP does not know whether or not the 70 lb. of MSC is in compliance, so he or she removes it from the formula.

$$540 \text{ lb. (weight excluding water)} - 70 \text{ lb. (MST)} = \mathbf{470 \text{ lb. (excluding water and MSC)}}$$

Now, the IPP has 470 lb. of the batch weight remaining. For the purpose of calculating poultry product restrictions only, the 470 lb. represents 85% of the batch.

Step 3: Any time the IPP divides a figure by its represented percentage, the result will be 100% (total ingredients).

$$470 \div 0.85 \text{ (i.e., 85\%)} = \mathbf{552.94 \text{ lb.}}$$

552.94 lb. is the batch weight including the maximum amount of MSC allowed (but excluding water).

Step 4: Subtract the 470 lb. (85%) from 552.94 lb. to determine the maximum amount of MSC.

$$552.94 - 470.00 = \mathbf{82.94 \text{ lb.}} \text{ maximum MSC allowed}$$

In this batch/formula, the establishment could have used a maximum of 82.94 lb. of mechanically separated chicken. Since the establishment was only using 70 lb, the frankfurter formula is in compliance with poultry restrictions.

Poultry Products Compliance Workshop

Establishment 38 is formulating franks with a batch size of 425 lb. The formula calls for 68 lb. of water and 65 lb. of chicken meat.

Answer the following questions.

What is the maximum amount of chicken meat permitted in the franks formula?

- (a) 343.52 lb. (b) 51.52 lb. (c) 43.8 lb.

Is the amount of chicken meat in this batch in compliance?

YES

NO

Show your calculation below.

“Calculated or Projected” Finished Weight for Binder and Extender and Phosphate Compliance Determinations in Cooked Sausages

Calculations for the ingoing amount of binders and extenders and phosphates in cooked sausages are based on the *finished weight* of the product. These ingredients function by affecting the entire product, not just the meat or poultry portion. In addition, binders and extenders are potential economic adulterants, not potential health hazards like nitrite and nitrate. Therefore, a *calculated or projected finished weight is an acceptable basis for calculation*. The calculated or projected finished weight (CFW or PFW) is the weight the product is expected to have after it is processed.

This section will discuss the steps used to determine a "calculated" or "projected" finished weight (CFW or PFW) for *cooked sausage products*. This is the method identified in the Processing Inspectors' Calculations Handbook to calculate a product's finished weight.

Cooked sausage products identified in 9 CFR 319.140, e.g., Polish sausage, beef salami, and cotto salami are limited to 10% added water. These sausages are coarse ground and

the fat is visible to the consumer, therefore there is no fat limit. The visible fat is self-limiting.

Cooked sausage products identified in 9 CFR 319.180, e.g., frankfurters, bologna, hot dogs and knockwurst, are finely ground or emulsified and are limited to 30% total fat or a total of 40% fat plus added water.

An establishment may target for 15% water and 25% fat, or *any* combination of fat plus added water that equals 40%.

NOTE: IPP use the regulatory limit for added water in the cooked sausage (10%) to determine the CFW or PFW unless the establishment management informs them that their sausage product formulation targets a higher percentage of added water (12%, 15%, etc.).

Various binders and extenders are permitted, individually or collectively, in comminuted meat products (sausages and bockwurst in Part 319 of the regulations) at a *maximum level of 3.5% of the finished product weight*. Because of their high protein content, isolated soy protein (ISP) and sodium caseinate are limited to 2% of the finished product weight. Comminuted meat and poultry products such as cooked sausage, luncheon meat, specific and nonspecific loaves may contain 0.5% phosphates in the ***total or final*** product. A CFW or PFW is an acceptable basis for this calculation.

The CFW or PFW *always* includes the *maximum* targeted water. Once the IPP determines a CFW or PFW, he or she can use the weight to calculate the maximum amount of binders and extenders and phosphates allowed in each formula.

The establishment has the following bologna formula on file. The IPP determines the CFW or PFW and then verifies that the binder and phosphates are in compliance.

Beef	250 lb.
Pork	250 lb.
Water and ice	70 lb.
Rework (like product)	50 lb.
NFDM	18 lb.
Salt	5 lb.
Flavorings	4 lb.
Sodium phosphates	2 lb. 10 ½ oz.
Sodium erythorbate	4 ¼ oz.
Sodium nitrite	<u>1 ¼ oz.</u>
Batch weight total	650 lb.

(Finished Product Target = 10% Water and 30% Fat).

Is the amount of nonfat dry milk (NFDM) and sodium phosphate the establishment intends to use in the formula in compliance?

Always remove rework weights from the formula total. (This is true for all calculations.)

Step 1: Subtract the rework from the batch weight

650 lb. - 50 lb. (rework) = **600 lb.**

600 lb. is now considered 100% of the batch total.

Step 2: Subtract the *weight and percentage* of the targeted added water and the restricted ingredient(s) that have regulatory limits based on the PFW.

600 lb. - 70 lb. (water) = **530 lb.** (90% batch weight, i.e., 100% -10% max water)

530 lb. - 18 lb. (NFDM) = **512 lb.** (86.5% batch weight, i.e., 90% - 3.5% max NFDM)

512 lb. – 2.65 lb. (sodium phosphate) = **509.35 lb.** (86.5% batch weight, i.e., 86.5% - 0.5% max sodium phosphate)

509.35 lb. is actually 86.0% of this formula.

Step 3: Divide this portion (509 lb.) by its percent (86.0%), to determine 100% of the formula.

$509.35 \div 0.86$ (i.e., 86.0%) = **592.26 lb. PFW**

This represents the projected finished weight of this formula, including a maximum 10% added water, a maximum 3.5% NFDM and a maximum of 0.5% sodium phosphate.

Step 4: Now, multiply the PFW by 3.5% to determine the maximum amount of NFDM allowed.

592.26×0.035 (i.e., 3.5%) = **20.72 lb.** (NFDM allowed).

In this formula, the amount of NFDM used (18 lb.) is less than the maximum amount allowed (20.72 lb.); therefore, the amount of NFDM added to the formula is in compliance.

Step 5: Then, multiply the PFW by 0.5% to determine the maximum amount of sodium phosphate allowed.

592.26×0.005 (i.e., 0.5%) = **2.96 lb.** (sodium phosphate allowed).

In this formula, the amount of sodium phosphate used (2.65 lb.) is less than the maximum amount allowed (2.96 lb.); therefore, the amount of sodium phosphate added to the formula is in compliance.

Binder and Extenders and Phosphates Compliance Workshop

The establishment has the following hot dog formula using soy flour and sodium phosphate.

Beef	275 lb.
Pork	152 lb.
Water and ice	93 lb.
Rework	40 lb.
Soy Flour	21 lb.
Corn syrup	13 lb.
Salt	8 lb.
Seasonings	4 lb. 12 oz.
Sodium phosphate	3 lb.
Ascorbic acid	3 oz.
Sodium nitrite	<u>1 oz.</u>
Total batch	610 lb.

(Finished Product Target = 15% Water - 25% Fat)

Corn syrup consists of 20% water and 80% solids. Therefore, you must calculate the amount of water being added to the formula through use of corn syrup. This amount must be added to the total amount of water removed.

Answer the following questions.

What is the maximum amount of soy flour allowed in this formula?

- (a) 19.46 lb. (b) 21.00 lb. (c) 21.35 lb.

What is the maximum amount of sodium phosphate allowed in this formula?

- (a) 3.05 lb. (b) 3.00 lb. (c) 2.78 lb.

Is this amount of soy flour and sodium phosphate used in the formula in compliance?

YES

NO

Show your calculations below.

Minimum Liver Compliance Determinations for Certain Cooked Sausages

Liver sausages listed in 9 CFR 319.182 must be formulated with at least 30% pork, beef, veal, sheep, and/or goat livers computed on the weight of the fresh livers. The minimum amount of liver is determined based on the total batch weight.

Example Problem

The establishment has the following Braunschweiger formula:

Skinless pork jowls	250 lb.
Pork livers	100 lb.
Water	17 lb.
Salt	8 lb.
Corn syrup	4 lb.
Sodium lactate	3 lb.
Dried onions	3 lb.
Sodium diacetate	2 lb.
Dextrose	1 lb. 7.6 oz.
Flavorings	1 lb. 7.6 oz.
Sodium nitrite	<u>0.8 oz.</u>
TOTAL	390 lb.

Determine the minimum amount of liver required in this formula.

Step 1: Subtract the liver weight and the minimum percentage (30%) from the batch weight (100%).

390 lb. – 100 lb. = **290 lb.** (70%, i.e., 100% total ingredients - 30% minimum liver)

Step 2: Divide the remaining portion of the formula (290 lb.) by the percentage it represents (70%).

$290 \text{ lb.} \div 0.70 \text{ (i.e., 70\%)} = \mathbf{414.28 \text{ lb.}}$ (total ingredients including 30% minimum liver)

Step 3: Subtract 290 lb. (70%) from 414.28 lb. (100% total ingredients with 30% minimum liver).

$414.28 \text{ lb.} - 290 \text{ lb.} = \mathbf{124.28 \text{ lb.}}$ minimum fresh liver required

A minimum of 124.28 lb. fresh liver is required in this Braunschweiger formula. This formula is not in compliance because the amount of liver in the formula (100 lb.) is less than minimum amount of fresh liver that is required to be added to the formula.

Cooked Sausage Workshop

Using the methods outlined in this handout, perform the required calculations to answer the questions related to the following cooked sausage formulas. If you need help, contact your instructor.

Scenario 1

You are a CSI assigned to an establishment that produces several types of cooked and smoked sausages, cooked sausages, and non-specific loaves. When you arrive at the establishment, you log-on to your computer and bring up the task calendar in PHIS. The Labeling Products Standards and General Labeling tasks are on the task calendar for today. You start the General Labeling task by proceeding to the processing room.

The establishment is stuffing Braunschweiler sausage into impervious saran casings (sticks) and cooking them in water. You notice staged, properly identified, pre-weighed ingredients for a batch of the Braunschweiler sausage in plastic totes and brown bags on a rack next to the large blender. You have the production supervisor weigh the sodium nitrite, sodium ascorbate, and nonfat dry milk (NFDM). You write the weights in your small green notepad. You proceed to the grinding area and notice the meat components staged in stainless steel totes for a batch of the Braunschweiler sausage. You have the production supervisor weigh the pork livers and you write the weight of the livers in your green notebook.

You enter the ready-to-eat product packaging room and find that the establishment is slicing the Braunschweiler sticks into 1 lb. portions and shrink wrapping the portions in plastic film that has the labeling below applied to it. You take a piece of plastic film with the labeling on it from the end of the packaging line.



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BACON (CURED SODIUM, DRY MILK, FLAVORINGS, LACTATE, SODIUM NITRITE	INGREDIENTS: PORK LIVERS, PORK FAT, PORK, BACON (CURED WITH WATER, SALT, SUGAR, SODIUM PHOSPHATES, SODIUM ASCORBATE, SODIUM NITRITE), WATER, NONFAT DRY MILK, CORN SYRUP, CONTAINS 2% OR LESS SALT, FLAVORINGS, DEXTROSE, DEHYDRATED ONION, SODIUM LACTATE, POTASSIUM LACTATE, SODIUM DIACETATE, SODIUM ASCORBATE, SUGAR, SODIUM NITRITE
---	---

You proceed to the production office. You ask the production supervisor to show you the formula for the Braunschwieger sausage being produced today. He opens a binder in the office and shows you the following formula.

Braunschweiger

Pork Livers	150 lb.
Pork Fat	150 lb.
Skinned Pork Jowls	75 lb.
Bacon	53 lb.
Rework	25 lb.
Water	20 lb.
Nonfat Dry Milk	16 lb.
Corn Syrup	11 lb.
Salt	8 lb.
Flavorings*	6 lb.
Potassium Lactate	3 lb.
Sodium Lactate	2 lb.
Dehydrated Onion	2 lb.
Dextrose	1 lb. 12 oz.
Sodium Diacetate	1 lb.
Sugar	14 oz.
Sodium Ascorbate	4 oz.
Sodium Nitrite	2 oz.
TOTAL	525 lb.

*Flavorings (6 lb.)

White Pepper	2 lb.
Marjoram	2 lb.
Mace	1 lb. 12 oz.
Ground Cloves	4 oz.

You compare the sodium nitrite, sodium ascorbate and liver weights you recorded in your green notepad with the weights in the above formula. The ingredient weights you recorded are the same as the ingredient weights in the above formula. You compare the ingredients statement on the plastic film wrap you have with the formula in the binder (above) and answer the questions on the next page.

1. Identify the byproduct(s) used in the formula.

2. Is the ingredients statement in compliance?

YES

NO

You review the labeling on the plastic film wrap and verify that all required information (i.e., the mandatory labeling features) is on it.

NOTE: The mandatory labeling features were discussed in the labeling module.

You proceed to your office and for the Labeling Product Standards task, you perform the calculation necessary to answer the following questions.

1. Does the Braunschweiger formula contain the required amount of liver?

2. Is the product name "Braunschweiger Sausage" in compliance with the standard of identity for a liver sausage based on the ingredients used in the formula?

You continue performing the General Labeling task by performing the calculations necessary to answer the following questions.

1. Is the sodium nitrite in compliance?

NOTE: Do not include previous cured products in the meat and meat byproducts (meat block) portion of the formula.

2. Is the sodium ascorbate in compliance?

NOTE: Do not include previous cured products in the meat and meat byproducts (meat block) portion of the formula.

3. Is the nonfat dry milk (NFDM) in compliance?

NOTE: For this problem only, use the batch weight to determine NFDM compliance. It is normal for this type of product to have less than 10% added water in the formula (because it is cooked in an impervious casing, thus there isn't any cook shrink). If you were to calculate a CFW for this formula, the CFW would be greater than the batch weight.

Scenario 2

You are a CSI assigned to an establishment that produces several types of cooked and smoked sausages, cooked sausages, and non-specific loaves. When you arrive at the establishment, you log-on to your computer and bring up the task calendar in PHIS. The General Labeling task is on the task calendar for today. You start the task by proceeding to the packaging room. The establishment is packaging 8 to 1 lb. franks in pre-labeled plastic film in the ready-to-eat (RTE) product packaging room.

You take a discarded film with the pre-printed label (shown below) from the end the packaging line with you to the production office.

ABC'S Quality Franks

KEEP REFRIGERATED

INGREDIENTS: Beef, Pork, Water, Mechanically Separated Chicken, Soy flour, Salt, Contains 2% or Less Corn Syrup, Dextrose, Potassium Lactate, Flavorings, Sodium Diacetate, Sodium Phosphates, Paprika, Ascorbic Acid (Vitamin C), Sodium Nitrite **Contains Soy**

Nutritional Facts	Amount serving	%DV*	Amount serving	%DV*
Total Fat 11g		17%	Total Carb. 2g	1%
Serv. Size 1 Frank	Sat. Fat 4g	21%	Fiber 1g	3%
Servings 8	Trans Fat 0g		Sugars 0g	
Calories 120	Cholest. 15mg	8%	Protein 5g	
Fat Cal. 100	Sodium 480mg	20%		

*Percent Daily Values (DV) are based on a 2,000 calorie diet

Vitamin A 0% • Vitamin C 0.5% • Calcium 0% • Iron 2%

U.S.
INSPECTED
AND PASSED BY
DEPARTMENT OF
AGRICULTURE
EST. 38

ABC PACKING, P.O. BOX 0000
ANYWHERE, USA 00000

NET WT.
16 OZ.
(1 LB)

Further Process

101

The label on the plastic film is on file and the processing procedures and formula are attached to it. You write the ingredients and weights from the formula down in your green notepad. You proceed to the production room.

The establishment has a continuous system for producing small diameter cooked sausages, e.g., sausage in casings on metal trees enter a cooking and chilling tunnel and then the finished sausage enters the RTE product packaging room.

You notice staged, properly identified, pre-weighed ingredients for a batch of franks in plastic totes and brown bags on a rack next to the large blender. You have the production supervisor weigh the sodium nitrite, ascorbic acid, and soy flour. You compare their weights to the weights from the formula you wrote in your small green notepad. The weights are the same. You proceed to the grinding area and notice the meat and poultry components are staged in stainless steel totes for a batch of frankfurters. You have the production supervisor weigh the mechanically separated chicken and you compare the weight on the scale to the weight of the mechanically separated chicken in your green notebook. The weights are the same.

You ask the sausage foreman to show you the formula for the frank. He opens a binder at his work bench and shows you the following formula.

Beef (boneless cow meat)	250 lb.
Pork Trimmings	200 lb.
Mechanically Separated Chicken	100 lb.
Water and Ice	120 lb.
Frank Rework (like product)	50 lb.
Soy Flour	22 lb.
Salt	15 lb.
Corn Syrup	11 lb. 12 oz.
Dextrose	8 lb.
Potassium Lactate	7 lb.
Flavorings	7 lb.
Sodium Diacetate	4 lb.
Sodium Phosphates	3 lb.
Curing Mix (6.25% nitrite salt carrier)	1 lb. 6 oz.
Paprika	10 oz.
Ascorbic Acid	<u>4 oz.</u>
TOTAL	800 lb.

(Finished Product Target = 10% Water and 30% Fat)

You compare the weights you recorded in your green notepad with the weights in the above formula. The ingredients and weights you recorded from the formula on file in the production are the same as ingredients and weights in the above formula. You compare the ingredients statement on the frank label you have with you (i.e., the label being applied to product) to the frank formula above. All ingredients were listed by their common and usual name in descending order of predominance. You also verify that the mandatory features (required information) are on the label.

NOTE: The mandatory labeling features were discussed in the labeling module.

You proceed to your office and perform the calculations necessary to answer the following questions.

1. Is the sodium nitrite in compliance?
2. Is the ascorbic acid in compliance?
3. Is the soy flour (binder) and sodium phosphates in compliance?
4. Is the amount of mechanically separated chicken in compliance?

Attachment 1: Excerpts from the Food Ingredient Chart in 9 CFR 424.21(c)

(c) The food ingredients specified in the following chart are approved for use in the preparation of meat products, provided they are used for the purposes indicated, within the limit of the amounts stated, and under other conditions specified in this part and Part 317 of this chapter. Part 319 of this chapter specifies other food ingredients that are acceptable in preparing specified meat products. This chart also contains food ingredients that are acceptable for use in poultry products, provided they are used for the purpose indicated, within the limits of the amounts stated and under other conditions specified in this part. No meat or poultry product shall bear or contain any food ingredient that would render it adulterated or misbranded, or which is not approved in this part, or by the Administrator in specific cases.

Class of Substance	Substance	Purpose	Products	Amount
Acidifiers	Acetic acid	To adjust acidity	Various meat and poultry products.	Sufficient for purpose.
	Citric acid .....	.....do .....	.....do	Do.
	Glucono delta-lactone .....	.....do .....	.....do	Do.
	Lactic acid .....	.....do .....	.....do	Do.
	Phosphoric acid .....	.....do .....	.....do	Do.
	Tartaric acid .....	.....do .....	.....do	Do.
Anti-Coagulants....	Citric acid	To prevent clotting	Fresh blood of livestock	0.2 percent with or without water. When water is used to make a solution of citric acid added to the blood of livestock, not more than 2 parts of water to 1 part of citric acid shall be used.
	Sodium Citrate .....	.....do .....	.....do	Not to exceed 0.5 percent based on the ingoing weight of the product. When water is used to make a solution of sodium citrate added to livestock blood, not more than 2 parts of water to 1 part of sodium citrate shall be used.

Binders and Extenders	Algin.....	To extend and stabilize product	Breading mix, sauces (meat only) and various poultry products	Sufficient for purpose in accordance with 21 CFR 172.5
	Cereal.....	To bind and extend product	Sausages as provided in 9 CFR Part 319, bockwurst	3.5 percent individually or collectively with other, binders for use in meat.
	Dried milk.....	....do	Chili con carne, chili con carne with beans	8 percent individually or collectively with other, binders for use in meat.
	Gelatin.....	....do	Sausages as provided in 9 CFR Part 319	3.5 percent individually or collectively with other, binders for use in meat.
	Gums, vegetable	To bind and extend product	Various poultry products	Sufficient for purpose in accordance with 21 CFR 172.5
	Isolated soy protein ...	....do	Egg roll (meat only) and various poultry products	Sufficient for purpose in accordance with 21 CFR 172.5
		....do	Sausages as provided in 9 CFR Part 319, bockwurst	2 percent
		....do	Imitation sausages; nonspecific loaves; soups; stews (meat only) and various poultry products	Sufficient for purpose in accordance with 21 CFR 172.5
		....do	Chili con carne, chili con carne with beans	8 percent individually or collectively with other, binders for use in meat.
		....do	Spaghetti with meatballs and sauce, spaghetti with meat and sauce and similar products.	12 percent individually or collectively with other, binders for use in meat.

	Whey, Dry or dried	To prevent purging of brine solution	Cured pork products as provided for in 9 CFR 319.104(d)	Not to exceed 2 percent of product formulation, not permitted in combination with other binders approved for use in cured pork products.
		To bind or thicken	Sausages as provided in 9 CFR Part 319, bockwurst	3.5 percent individually or collectively with other binders and extenders for use in meat.
		....do	Imitation sausages; nonspecific loaves; soups; stews (meat only)	8 percent individually or collectively with other binders and extenders for use in meat.
		....do	Chili con carne, chili con carne with beans, pork or beef barbecue sauce	8 percent individually or collectively with other binders and extenders for use in meat.

Class of Substance	Substance	Purpose	Products	Amount
Flavoring Agents Protectors and Developers	Calcium lactate.....	To protect flavor	Cooked semi-dry and dry products including sausage, imitation sausage, and nonspecific meat food sticks.	0.6 percent in product formulation
	Citric acid.....	.....do Flavoring	Various poultry products Chili con carne	Sufficient for purpose Do.
	Corn syrup solids, corn syrup; glucose syrup	To flavor product	Various poultry products, sausage, hamburger, meat loaf, luncheon meat, chopped or pressed ham.	Do.
	Dextrose .....	.....do	Sausage, ham, and cured products	Do.
	Sodium acetate.....	To flavor products	Various meat and poultry products	Not to exceed 0.25% of formulate in accordance with 21 CFR 184.1721.
	Sodium diacetate.....	.....do .....	.....do	Not to exceed 0.25% of formulate in accordance with 21 CFR 184.1754.
	Sodium lactate .....	.....do	Various meat and meat food products, poultry and poultry food products, except infant formula and infant food	Not to exceed 2 percent of formulation in accordance with 21 CFR 184.1768.
	Sorbitol	To flavor, to facilitate the removal of casings from product, and to reduce caramelization and charring.	Cooked sausage labeled frankfurter, frank, furter, wiener, and knockwurst; cured pork and pork products, as provided for in 9 CFR Part 319	Not to exceed 2 percent of the weight of the formula excluding the formula weight of water or ice, when used in accordance with 21 CFR 184.1835.

Attachment 2: Demonstrating the Use of the Calculation Aid

Accessing the Calculation Aid on FSIS Computers

Step 1: Click on the Start button (or Windows button) in the computer screen lower left corner.

OR

Click on FSIS Applications on the Windows desktop.

Step 2: Highlight and double click on Calculation Aid in the menu.

NOTE: The Calculation Aid was created in 1996. It still refers to task codes, e.g., 04B04, which were replaced with actual task names, e.g., General Labeling task.

Calculation Aid Menu

Antioxidants	Net Weights
Batter/Breading	Percent Batter/Breading
Beef Cheek Meat (lb of beef cheek meat known)	Percent Proteinaceous Ingredients
Beef Cheek Meat (lb of beef known)	Projected Finished Weight
Binders and Extenders	Shrink
Cure Accelerators	Shrink (dry cured pork product)
Cure Agents	Volume of a Container
Fat Content	X % Solution (uncooked product)
Gain	X% Solution (cooked product)
Maximum Amount of Poultry	Yield
Minimum Meat or Poultry	



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Fresh Sausage Example 1 (page 43)-Fat Content Determination

Calculation Aid Menu


Antioxidants	Net Weights
Batter/Breading	Percent Batter/Breading
Beef Cheek Meat (lb of beef cheek meat known)	Percent Proteinaceous Ingredients
Beef Cheek Meat (lb of beef known)	Projected Finished Weight
Binders and Extenders	Shrink
Cure Accelerators	Shrink (dry cured pork product)
Cure Agents	Volume of a Container
Fat Content	X % Solution (uncooked product)
Gain	X% Solution (cooked product)
Maximum Amount of Poultry	Yield
Minimum Meat or Poultry	



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04B04 - Percentage of Fat in a Formula


	470	lb batch weight				
X	40	target fat percentage				
	188	lb fat in product				

	lb fat from ingredients	216			
	470	lb batch weight	X 100 =	45.95	% fat on product

meat/poultry/byproduct		% fat		lb fat
280	X	60	=	168
160	X	30	=	48
	X		= +	0
				216

lb fat from ingredients

Calculate



Reset

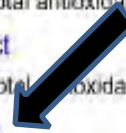
Fresh Sausage Example 1-Antioxidant Determination (page 48)






Antioxidants

- Maximum Antioxidant Allowed - Raw Product
- Maximum Antioxidant Allowed - 100% Fat Product
- Maximum Antioxidant Mix Allowed - 100% Fat Product
(No antioxidant/synergist is one half or more of the total antioxidants)
- Maximum Antioxidant Mix Allowed - 100% Fat Product
(An antioxidant/synergist is one half or more of the total antioxidants)
- Maximum Antioxidant Mix Allowed - Raw Product
(No antioxidant/synergist is one half or more of the total antioxidants)
- Maximum Antioxidant Mix Allowed -Raw Product
(An antioxidant/synergist is one half or more of the total antioxidants)





04B04 - Maximum Antioxidant Mix Allowed

(raw product, e.g., meatballs)

x

x

470

40

188

.01

0.01

30

lb batch weight

percentage fat in product, e.g. 25%

lb fat

lb fat

antioxidant/synergist restricted limit

maximum lb antioxidant allowed

lb

restrictive antioxidant/synergist percent, e.g. 25% BHA

Add-up antioxidants

Example: BHA 25%

BHT 15%

+ Propyl gallate 8%

Total
Percent
48%

When an individual antioxidant or synergist is more than half of the total antioxidant percentage use .0001 (.01%) as the restricted limit.

0.01

=

0.06

lb antioxidant mix allowed


0.06

x 16 =

1

oz antioxidant mix allowed

Calculate



0.06

lb antioxidant mix allowed

1

oz antioxidant mix allowed

Reset

Further Processing and Labeling Inspection Course

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Fresh Sausage Example Problem 2-Minimum Meat and Meat and Fat Determination for Italian Sausages (page 51)

Calculation Aid Menu

Antioxidants	Net Weights
Batter/Breading	Percent Batter/Breading
Beef Cheek Meat (lb of beef cheek meat known)	Percent Proteinaceous Ingredients
Beef Cheek Meat (lb of beef known)	Projected Finished Weight
Binders and Extenders	Shrink
Cure Accelerators	Shrink (dry cured pork product)
Cure Agents	Volume of a Container
Fat Content	X % Solution (uncooked product)
Gain	X% Solution (cooked product)
Maximum Amount of Poultry	Yield
Minimum Meat or Poultry	



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Minimum Meat or Poultry




Percent Meat or Poultry in a Product with a Single Component

Percent Meat or Poultry in a Product with Multiple Components

Percent Meat/Poultry in a Product Containing a Standardized
Product with Multiple Components Plus Other Components

Corned Beef Hash

Spaghetti and Meat Balls

**04B01 - % Meat or Poultry**
(single component product)

meat/poultry in the formula

275


331

batch weight

X 100 =

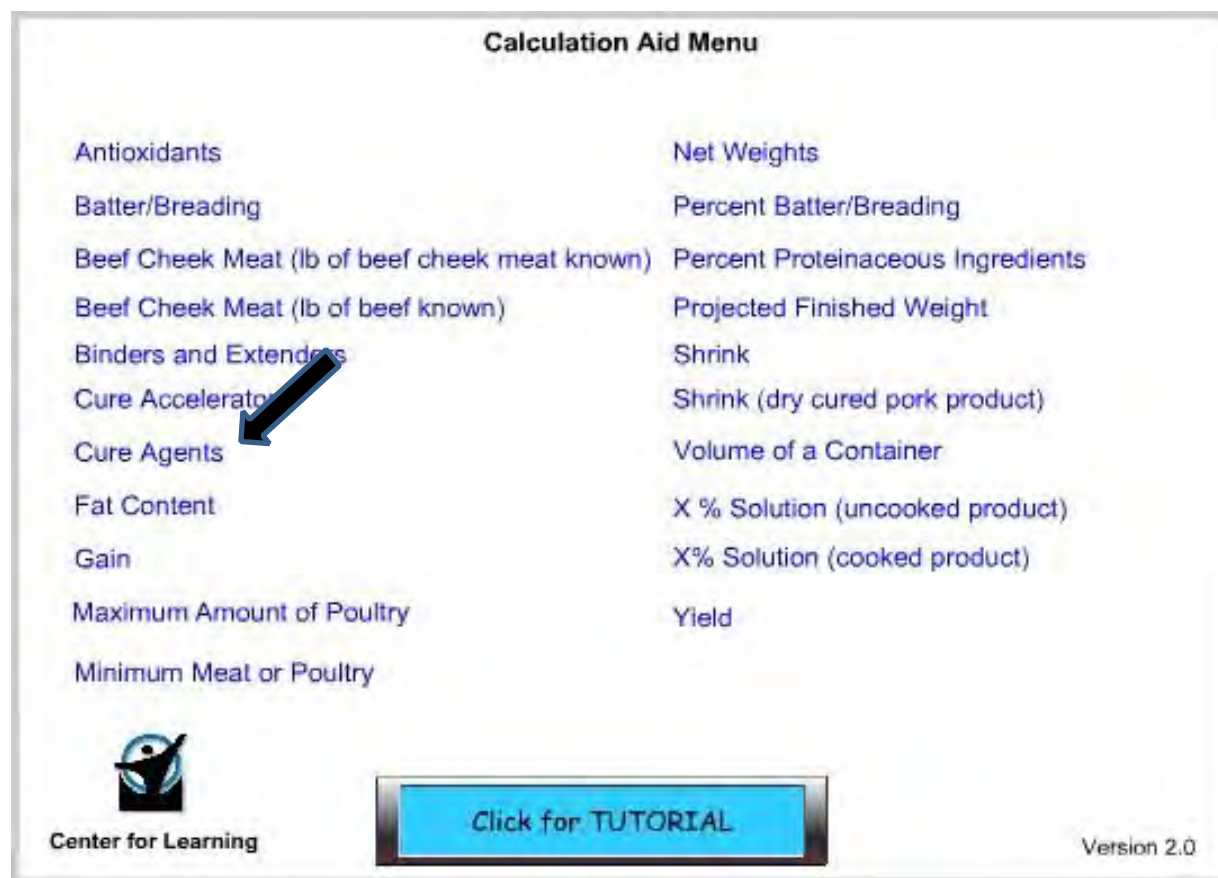
83.08

% meat/poultry in the formula

Calculate 

Reset

Cure Agent PPM Example Problem 1 (page 62)





Curing Agents

Maximum Amount of Nitrite - Comminuted Product (ppm formula)


PPM of Ingoing Nitrite - Comminuted Product

Maximum Amount of Nitrite - Communitied Product (.25 oz per 100 lb. of meat block)

PPM of Ingoing Nitrite - Pickle Cured Product

Maximum Amount of Nitrite - Pickle Cured Product

Maximum Amount of Nitrate - Communitied Product (2.75 oz per 100 lb. of meat block)



04B04 - In-going PPM

lb of sodium nitrite

x 1,000,000


=

144

ppm

325

lb of meat block

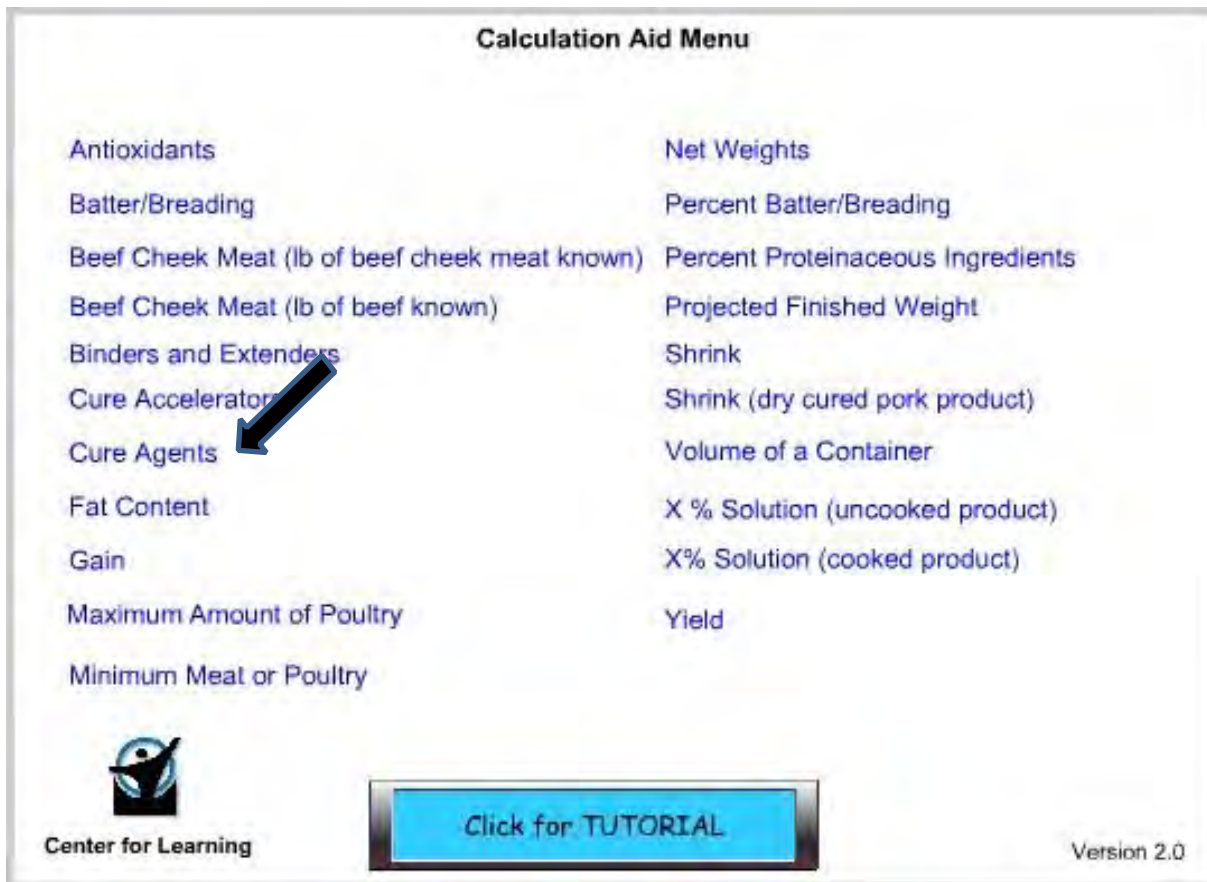
Calculate 

Reset

Further Processing and Labeling Inspection Course

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Maximum Amount of Cure Agent Example Problem 1 (page 64)






Curing Agents

- Maximum Amount of Nitrite - Comminuted Product (ppm formula)
- PPM of Ingoing Nitrite - Comminuted Product
- Maximum Amount of Nitrite - Communitied Product (.25 oz per 100 lb. of meat block)
- PPM of Ingoing Nitrite - Pickle Cured Product
- Maximum Amount of Nitrite - Pickle Cured Product
- Maximum Amount of Nitrate - Communitied Product (2.75 oz per 100 lb. of meat block)





04B04 - Maximum Nitrite

lb of meat block

400

100

=

4

units


units

4

x 0.25 oz =

1

oz maximum amount of nitrite allowed

Calculate 

Reset

Cure Accelerator PPM Example Problem (page 66)

Calculation Aid Menu

Antioxidants	Net Weights
Batter/Breading	Percent Batter/Breading
Beef Cheek Meat (lb of beef cheek meat known)	Percent Proteinaceous Ingredients
Beef Cheek Meat (lb of beef known)	Projected Finished Weight
Binders and Extenders	Shrink
Cure Accelerators	Shrink (dry cured pork product)
Cure Agents	Volume of a Container
Fat Content	X % Solution (uncooked product)
Gain	X% Solution (cooked product)
Maximum Amount of Poultry	Yield
Minimum Meat or Poultry	




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**04B04 - In-going PPM Cure Accelerator**

lb of cure accelerator

.15620

lb of meat block


325

X 1,000,000

=

480.61

ppm of cure accelerator


Calculate 

Reset

Maximum Amount of Cure Accelerator Example Problem (page 67)







04B04 - Maximum Cure Accelerators

lb of meat block

400

100

=

4

units

Erythorbic Acid:

4

units

x .75 =

3

oz

Sodium Ascorbate:


4

units

x .875 =

3.5

oz


Calculate 


Reset

Poultry Products Added to Cooked Sausage Products Example Problem

Calculation Aid Menu

Antioxidants	Net Weights
Batter/Breading	Percent Batter/Breading
Beef Cheek Meat (lb of beef cheek meat known)	Percent Proteinaceous Ingredients
Beef Cheek Meat (lb of beef known)	Projected Finished Weight
Binders and Extenders	Shrink
Cure Accelerators	Shrink (dry cured pork product)
Cure Agents	Volume of a Container
Fat Content	X % Solution (uncooked product)
Gain	X% Solution (cooked product)
Maximum Amount of Poultry	Yield
Minimum Meat or Poultry	






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04B04 - Maximum Amount of Poultry

	650	lb batch weight	
-	110	lb water and ice	
-	70	lb poultry	
	470	minimum lb (85%)	

minimum lb (85%) 470 <hr style="width: 100%;"/> 0.85	=	552.94 lb	
--	---	------------------	--

552.94 lb	-	470 minimum lb (85%)	
		82.94 maximum amount of poultry	

Calculate


Reset