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This publication is designed to provide reasonably accurate and authoritative information in regard to the subject matter covered.
Sausage Manufacture and Food Safety

History of Sausage

- Among oldest meat products in history
  - ~1500 B.C.
- The word sausage derived from Latin word sal/sus
  - Means preserved or salted
- By Middle Ages, many varieties produced
  - Climate of region
  - Availability of spices

History of Sausage - Names

- Ties to a city, town or region
  - Frankfurters --- Frankfurt, Germany
  - Wiener --- Vienna, Austria
  - Genoa Salami --- Genoa, Italy
  - Bologna --- Bologna, Italy
  - Braunschweiger --- Braunschweig, Germany
  - Lebanon Bologna – Lebanon County, PA

Sausage Manufacture

Finished Product Goals

- ~20 to 30% fat
  - Flavor, flavor, flavor
- Firm texture
  - But not dry
- Aromatic & flavorful
- Desirable appearance
  - Inside & out

Raw Material Selection

- Option #1
  - Semi-Lean meat
    - 75 to 85% lean
- Option #2
  - A) Lean meat
    - ≥ 90% +
  - B) Higher fat meat
    - 50% or less lean
The Basics of Seasonings

Functional Ingredients & Spices

Curing Agents

- Different Types
  - Sodium Nitrate
  - Sodium Nitrite

- Different Forms
  - Pure (100%)
  - 6.25%
    - Prague powder
    - Modern cure
    - Lepp's cure
    - Tender-Quick®
  - 0.5% nitrate & 0.5% nitrite

Roles of Nitrite

- Functions:
  - Produce pink cured color
  - Characteristic cured flavor
  - Inhibit pathogenic and spoilage microorganisms
  - Slow rancidity

How Much Nitrite to Use: 6.25% Nitrite Cure Mix

- Cure mix (6.25% nitrite) is added at no more than 4 oz per 100 lbs (1 oz per 25 lbs) of meat. This is equivalent to adding a maximum allowable limit of 156 ppm (0.0156%) nitrite.
- Nitrite Calculations
  - Step 1 - Setup equation & cross multiply and divide:
    \[ \frac{4\text{ oz}}{100\text{ lb}} = \frac{x}{73\text{ lb}} \rightarrow 100x = 292 \]
  - Step 2 - Solve for "x":
    \[ \frac{292}{100} = x \rightarrow 2.92\text{ oz} \]
  - 2.92 oz of 61.76 grams of 6.25% cure mix should be added to 73 lbs of sausage

Salt

- Most important functional ingredient
- Performs 3 functions
  - Extract proteins (binds meat)
  - Inhibits bacterial growth
  - Helps flavor
- 2 - 3% used

How Much Nitrite to Use: 0.5% Nitrate & 0.5% Nitrite Cure Mix

- Cure mix (0.5% nitrate, 0.5% nitrite) should not be added at more than 3 lbs per 100 lbs (0.75 lb per 25 lbs) of meat. This is equivalent to adding 150 ppm (0.015%) of both nitrate and nitrite.
- The salt used in the formulation may be partially or completely replaced by cure mixes with low nitrate and nitrite contents.
- Nitrite Calculations
  - Step 1 - Setup equation & cross multiply and divide:
    \[ \frac{2.5\text{ lb}}{100\text{ lb}} = \frac{x}{73\text{ lb}} \rightarrow 100x = 146 \]
  - Step 2 - Solve for "x":
    \[ \frac{146}{100} = x \rightarrow 1.46 \text{ lb} \]
- 1.46 lbs of 0.5% nitrate & 0.5% nitrite cure mix should be added to 73 lbs of sausage (an additional 6 to 8 lbs of salt may also be included)
Nitrite Caution

- Use care when using:
  - If ingested in excess levels, can cause severe sickness
    - 3-7 grams of 100% nitrite toxic/lethal dose
  - Mixing up ingredients
    - Punch incident
  - Nitrosamine concern
    - Extremely high levels added
    - Bacon

Sweeteners

- Types:
  - Sugar
  - Dextrose
  - Brown sugar

- Functions
  - Offsets saltiness
  - Provides flavors
  - Helps brown when cooking

- 0.5 – 3.0% used

Water

- How much to use
  - 0 to 10%

- Functions
  - Facilitates mixing
  - Controls / adjustment of temperature
  - Dissolves ingredients and spices
  - Distributes ingredients and spices

Spices

- Single ingredients
  - Pepper
    - Black
    - Red
  - Mustard
  - Etc..

- Spice packs
  - A.C. Legg
  - Excalibur
  - Etc.

Sausage Manufacture

- Two common approaches
  - Coarse Grind – Mix – Fine Grind
  - Coarse Grind – Fine Grind – Mix

- Important points
  - Keep cold
  - Keep clean

Sausage Manufacture

1. First (coarse) grind
  - Grind lean meat separate
  - ~½" plate
  - Keep cold (<40°F)
    - Fat particle definition
    - Food safety

2. Transfer to mixer
Sausage – Additions / Mix

3. Add
   - Salt
   - Curing salt
   - ½ of water
   - Or
   - Spice Pack

4. Mix 3 to 5 minutes
   - Slightly tacky to tacky

Sausage – Additions / Mix

5. Add
   - [Fat Meat (if fat & lean separate)]
   - Sugar
   - Spices
   - Other ½ of water

6. Mix for ~ 2-3 minutes
   - Should be tacky / sticky

Sausage – Final (fine) Grind

7. Final (fine) Grind
   - Keep cold (< 45°F)
   - Final particle size in mind
     - ½”
     - 3/16”
   - Addition of other ingredients
     - Cheese (finely diced)

Sausage - Stuffing

8. Stuffing
   - Casing color
     - Clear
     - Colored
   - Casing size
     - Varies
   - Long ropes
   - Links

Casing Choices

- Natural
  - Pork or lamb
- Fibrous
  - Plant fibers
- Collagen
  - Beef hide

Cooking Sausages

- Cooking methods
  - Smokehouses
  - Smokers
  - Grills / Ovens
  - Water baths
- Cooking goals
  - Destroy any microorganisms
    - ≥ 165 °F measured at geometric center
  - Use high quality calibrated thermometer
  - Achieve desired texture
    - Slowly ramp temperatures

Sausage Manufacture & Food Safety
Cooling / Storing Sausages

- Keep out of "Danger Zone"
  - 40 to 140 °F
  - Chill quickly

- Storing suggestions
  - Vacuum package
  - Frozen

A Few Thoughts on Food Safety

Requirements for Bacterial Growth

- Food
- Water (Moisture)
- Oxygen (Most bacteria)
- Desirable Temperature
- Desirable pH

Marinades

Store raw meat, poultry and seafood at 32 °F – 40 °F

Marinate foods under refrigeration
Never defrost at room temperature

Separate large amounts of food into small, shallow containers

Cross Contamination

- Besides undercooking foods, cross contamination is another leading cause for foodborne illness

Questions?
MANUFACTURING GUIDE TO PRODUCING PROCESSED MEAT PRODUCTS

I. Sausage Types

Sausage can be simply defined as a product manufactured from ground or chopped meat; combined with salt, spices and other ingredients; and shaped in some manner, usually by means of various sizes and types casings. The origin of sausage-type products precedes recorded history. Over the centuries, sausage making has been refined and developed into an art strongly tied to various ethnic groups. Today scientific principles are employed to improve production procedures, product quality and product safety.

By altering raw materials (including specie and composition), processing procedures, spice and other non-meat ingredient usage and level, casing size and type, smoking and cooking procedures, a wide variety of sausages can be produced. Classification of all sausages into specific categories is very difficult, since any given sausage may be produced in a number of different ways. However, a majority of sausage products fall under four main classifications. Below is a very simple and broad classification of the various sausage types based upon processing procedures and product characteristics.

**Fresh Sausage:**
Raw sausages made from select cuts of fresh meat, usually pork but sometimes also beef which has not been cured. This style of sausage must always be kept under refrigeration and must be cooked thoroughly before serving. Examples include fresh pork sausage, fresh Italian sausage, and fresh bratwurst.

**Cooked Sausage:**
Ready-to-eat sausages which are fully cooked during manufacture. Many are also smoked. These products may be eaten without heating, but often are reheated before serving. Examples include frankfurters, bologna, cotto salami, smoked sausage, cooked bratwurst and liver sausage.

**Dry & Semi-Dry Sausages:**
These are drier products and were originally made in the winter for consumption in the summer before the advent of artificial refrigeration. Today, we enjoy this unique product category due to early preservation techniques employed long ago. All dry and semi-dry sausages have a characteristic "tangy" flavor due to the accumulation of lactic acid produced from a microbial fermentation of added sugars (or in some cases by direct addition of encapsulated acids). These sausages are dried to varying extents during processing. Semi-dry sausages typically lose 10-20 percent of the original weight during

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manufacturing and have a slightly firm and moist texture. Examples include summer sausage, snack sticks and landjaeger. Dry sausages typically lose 25-40 percent of the original weight due to manufacturing and have a much firmer and drier texture. Examples include pepperoni, hard salami, and Genoa salami. With the proper amount of acidification and drying, these sausages can be shelf stable and thus some do not require refrigeration.

**Luncheon Meats and Jellied Products:**
There is a wide variety of popular products under the general heading of luncheon meats. In general, these products are mixtures of chopped meat usually processed in pans or metal molds. Examples include pickle and pimento loaf, olive loaf, ham and cheese loaf, and honey loaf. Jellied products consist of cooked meat chunks suspended in gelatin. Examples include souse, jellied roast beef loaf and head cheese.

II. Sausage Ingredients

**Meat:**
Beef, veal, pork, lamb, mutton and poultry are all suitable for use in sausage. If you slaughter your own animals, meat off of the head, trimmings off of the carcass and less popular cuts can be saved for sausage. If you purchase meat ingredients for making sausages, inexpensive cuts such as beef short ribs, chuck cuts, round cuts, and pork shoulder cuts can be used. Tenderness won't be a problem since we're producing a ground or comminuted product. Whatever the source, use only raw meat ingredients that are fresh and wholesome. High quality sausages can be made only if the starting raw materials are of high quality.

Venison and other game meat may be substituted for all or part of the lean meats in sausage recipes. Because game is often slaughtered in the field under less sanitary conditions, it is especially important to be aware of the wholesomeness and condition of this type of meat. You must trim away evidence of spoilage (discoloration, off-odors, stickiness, slime, etc.). It is very common to remove all of the trimmable fat from venison, as this fat typically results in sausages with less desirable flavors and textures. Venison fat can also contribute to the development of rancid off-flavors.

**Salt:**
Salt is the most important non-meat ingredient used in sausages. Salt enhances the flavor of the sausages, and aids in preserving them against microbial spoilage (although the low, present day salt levels exert less of a preservative effect that the higher levels of the past). Salt also "solubilizes" and extracts the muscle protein on the surface of meat particles. This semi-fluid protein film coagulates during heating, binding the meat particles together and producing a firm sausage texture. Most sausage formulations contain 2 to 3% salt. Salt levels can be adjusted to suit your tastes. "Lite" salt, a blend of sodium chloride and potassium chloride, can be used to reduce the amount of sodium in the product (be aware that excessively high levels of potassium chloride can impart a bitter flavor to the product).

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Curing Ingredients: Nitrites and Nitrates:
The purpose of these "curing" ingredients is: (1) to inhibit the growth of certain microorganisms (including the one that causes botulism); (2) to develop the typical pink color of cured meats; and (3) to enhance the flavor of the product. Nitrite is the specific active ingredient which carries out the functions listed above. When nitrate is used, it must be first converted to nitrite by microorganisms present in the meat. Potassium nitrate (saltpeter) was the salt historically used for curing. However, sodium nitrate has nearly entirely replaced the use of nitrate today.

Extreme caution must be used when adding nitrite to the sausage batter since overdoses of this ingredient can be toxic to humans. As little as 3-7 grams of nitrite can be very toxic and lethal to humans. Because of the safety concern in using nitrite, it is not readily available in pure (100%) form. In addition, since straight sodium nitrite is added at a very low level (1/4 ounce per 100 pounds of meat) it would be difficult to accurately weigh out the desired amount on commonly available scales. Therefore, for safety and accuracy, salt blends already containing nitrite at the proper level are best used by home sausage makers when the recipe calls for nitrite or nitrate addition. Mortons "Tender Quick Salt" (contains 0.5% nitrate, 0.5% nitrite and 99.0% salt) is an example of such a blend, containing a very small amount of nitrite and nitrate. It is available in many grocery stores. When this blend is used as the salt source for products which call for nitrite or nitrate, these curing ingredients will automatically be added to the batter at a safe and proper level.

Most commercial meat processors obtain their nitrite in the form of a "curing salt." This is usually a blend of 6.25% sodium nitrite and 93.75% salt (colored pink by most manufactures to clearly distinguish it from salt or sugar). At this dilution rate, processors add 4 ounces of the curing salt to 100 pounds of meat (0.4 ounces or 11 grams per 10 lbs. of meat) to achieve the proper level of nitrite addition (156 parts per million).

Cooked sausages can be made without adding nitrite if desired. Such sausages will be brown in color (rather than pink), and more susceptible to flavor changes and microbial spoilage. It is best to vacuum package this products and store them in the freezer, if possible.

Spices:
Much of the distinguishing flavors of different varieties of sausage is due to the type and quantity of spices in the recipe. Home sausage makers will usually use ground or whole natural spices in their products. The commercial meat processing industry today also uses spice extracts (extracts from natural spices which contain the characteristic flavors) in place of some natural spices. When these extracts are used, they are listed as "flavorings" on the product label.

Spices can be a significant source of bacterial contamination to sausages. Buy the best spice you can, for maximum flavor and greatest purity. Spices can loose volatile flavor components during storage. Store in covered containers and avoid long periods at high

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temperatures (i.e. above 80°F). Spices which are over one year old may have lost some of their flavor, particularly if they were not stored well.

**Sugars:**
A variety of sugar sources can be used to impart sweetness and flavor to sausages. These include sucrose (table sugar), brown sugar, dextrose, and corn syrup. Sugars also react with proteins during heating to produce browning which enhances flavor and appearance.

**Ascorbic Acid:**
Ascorbic acid (vitamin C) or sodium ascorbate speed the development of the pink cured color in sausages containing nitrite. Sodium erythorbate is chemically similar to ascorbate and is also used for this purpose. These "cure accelerators" are an optional ingredient for home sausage makers. When used, sausages can be heated and smoked immediately after stuffing. If ascorbate or erythorbate are not used, the batter or stuffed sausages should be held overnight (refrigerated) before smoking and heating, to allow time for good cured color development. These ingredients are used at the rate of 7/8 oz. per 100 pounds of meat.

**Binders and Extenders:**
These are miscellaneous ingredients which may improve flavor, help the sausages better retain fat and moisture (binders), or lower the cost of the sausage recipe (extenders). The best known of these ingredients include non-fat dried milk, cereal flours, and soy protein products. These products can be incorporated to suit your taste. In most commercial products they are restricted to less than 3.5% of the product weight.

**Water:**
Government regulations permit various levels of added water to be retained in many finished sausage products. This varies from 3% in fresh sausages such as bratwurst, to as much as 25% in low-fat cooked sausages, such as hot dogs or bologna. From a practical standpoint, 3% water could be added to fresh sausages if desired, and 10 to 15% to cooked sausages (remember some of that water will be lost from the product during cooking). Water aids the salt in "solubilizing" meat proteins (by forming a brine), helps the mixing of the batter, aids in the distribution of spices, and contributes to the juiciness of the final product. Added water usually improves the quality of many sausages.

**Starter Culture:**
This is an inoculum of lactic acid bacteria which converts added sugar to lactic acid, producing the tangy flavor in fermented sausages. Many sausage processors mix a starter culture into the batter of summer sausage, snack sticks, etc. prior to the stuffing step, to insure later production of lactic acid in the sausage. Historically, processors relied upon chance inoculation by bacteria normally present in meat. However, if insufficient numbers of naturally-occurring lactic acid bacteria are present, little tang may develop in the sausage. Starter cultures come in frozen or freeze-dried forms, and are available from suppliers which serve the meat industry. Although most starter cultures will ferment common table sugar (sucrose), the simple sugar dextrose is the choice of most sausage makers to include in their fermented sausage recipe.

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In order to get a successful fermentation and acid production, the stuffed sausages must be held at temperatures favorable for bacteria growth (80-100°F) for 10 to 15 hours to allow the starter culture bacteria to grow and ferment the sugar to lactic acid. A noticeable fermented aroma is usually present during this “fermentation period” indicating that fermentation is indeed occurring. Without an effective starter culture in the batter to rapidly produce acid, these abusive fermentation temperatures can pose a microbiological safety risk by allowing dangerous bacteria to instead grow.

**Encapsulated acids:**
In recent years some processors have acidified their sausage by adding encapsulated citric or encapsulated lactic acid to the batter, rather than using a starter culture. Encapsulated acids are small beads of acid surrounded by a lipid coat. These acids are gently blended into the batter near the end of final mixing (do not grind after mixing – don’t want to disrupt the lipid coat). The sausage can then immediately be cooked, and when the batter temperature reaches approximately 137°F, the lipid coat melts releasing the acid. Direct addition of acid must be done in this encapsulated form because direct addition of non-protected acid to the batter during mixing would cause the meat proteins to coagulate while still in the mixer, ruining product texture and resulting in a texture similar to crumbles.

Encapsulated acids would be the easiest way for home meat processors to get a tangy flavor into their summer sausage, if they desired it. Usual addition level of encapsulated acid is 12 to 16 ounces per 100 pounds of meat (depending on level of acid tang desired). Note: While most summer sausages today are fermented or acidified, this is not a requirement for these products. Some summer sausages are just made just as cooked sausages with summer sausage seasoning. Such sausages will not have an acid tang, but that is desired by some consumers.

**Temperatures**
It is extremely important to maintain proper refrigeration (40°F or lower) of your raw materials and product throughout processing, and on the finished product. Prolonged temperature abuse during manufacture can permit growth of undesirable microorganisms, leading to product spoilage or food-borne illness.

During heating of cooked sausages, temperature of the product should pass rapidly through the temperature zone of 50-140°F which favors rapid bacteria growth. Most cooked sausages are heated to a final internal temperature of at least 160°F. There are some alternative holding time and internal product temperature combinations which will also insure an adequate kill of disease-causing (pathogenic) bacteria. These include:

<table>
<thead>
<tr>
<th>Product internal temperature</th>
<th>Minimum holding time at internal temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>145 °F</td>
<td>10 minutes</td>
</tr>
<tr>
<td>150 °F</td>
<td>3 minutes</td>
</tr>
<tr>
<td>155 °F</td>
<td>1 minute</td>
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</tbody>
</table>

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If product is being cooked in water, the water temperature should be in the range of 160-180°F. If being heated in a smokehouse or grill, an air temperature of 160 to 200°F is desirable. When cooked by dry heat, pans of water can be placed near the product to provide some humidity to reduce drying of the sausage.

Products should be adequately cooled after cooking. While adequate cooking will destroy all vegetative cells of disease-causing bacteria, several pathogens can form spores which will survive normal cooking procedures. If sausages are cooled too slowly, the spores may revert to the vegetative form and begin to grow. Commercial processors meet the following internal temperature cooling guidelines:

**Uncured products (no nitrite):**
- from 130°F to 80°F in less than 1.5 hours
- from 80°F to 40°F in less than 5 hours

**Cured products (nitrite present):**
- from 130°F to 80°F in less than 5 hours
- from 80°F to 45°F in less than 10 hours

**Casings**
Home sausage makers often inquire about where they can buy sausage casings. Usually a small supply of natural and synthetic casings can be purchased from local meat processors, who use these casings in the manufacture of their own line of sausages. If local processors do not have extra casings to sell, they could direct you to their casing suppliers or from the internet. Most casings used in sausage making are natural, collagen or synthetic. Natural casings are from the G.I. tract of animals. Most fresh bratwurst are in pork casings. Natural casing wiensers and some breakfast sausages are in lamb casings. Ring bolognas are typically in beef casings. Natural casings always have a natural "curve" to them and a very desirable “snap”.

Collagen casings are derived from animal protein, often extracted from beef hides, and manufactured into an edible casing (collagen is also the main protein present in natural casings). Collagen casings are used on some breakfast links, bratwurst (especially pre-cooked bratwurst and other types of linked sausages. Collagen casings provide straight sausage links (no curve).

Synthetic casings come in a variety of forms. "Skinless" hot dogs are manufactured in cellulose casings (made from inedible plant and tree fibers), which allow smoke to penetrate and moisture to escape during cooking. After skinless franks are cooked and cooled, the cellulose casings are peeled off and discarded, producing "skinless" products. Larger size cellulose casings have paper fibers added for strength, and are termed "fibrous" casings. They are used for summer sausage and larger diameter slicing products.

**Equipment**
All equipment, as well as utensils, used for sausage manufacturing should be clean and in good working order. Minimum equipment is needed for manufacturing most sausages but
at a minimum includes accurate scales, a grinder and a stuffer. A silent cutter, consisting of high-speed rotating knives within a revolving metal bowl, is used for production of fine textured sausages. Sausage texture (coarse vs. fine) can also be affected by the size of the holes in the grinder plate, and the number of passes of the meat through the grinder. Grinder knives must be kept very sharp and the meat kept very cold (32°F) to prevent product smearing. The cooking of sausages may be accomplished in smokehouses, covered grills or water baths.

**Thermometers**

You need an accurate meat thermometer that can measure the coldness of your raw materials and the final internal temperature of cooked sausages. This is essential to produce safe, high quality products. A thermometer with a temperature range of 30°–200°F is required. You also need an oven thermometer to check the smokehouse or oven temperature. Digital thermometers are typically preferred over dial versions due to better accuracy and reliability.

**Trichinosis**

This is an illness which can be contracted by ingesting raw meat products containing pork which is infected with the parasite Trichinella spiralis. Although very few pigs today carry this parasite in their muscle, government regulations specify all pork containing products which might be eaten without further cooking must be heated to an internal temperature of at least 145°F as a precautionary measure. Alternatively, if pork is frozen at 0°F or lower for 20 days or more, it can be safely used in products which are not heated above 140°F. This frozen product is called "certified pork."

### III. Sausage Recipes and Procedures

The following pages list recipes and procedures for the sausages listed below. Each recipe is based upon a batch size of 10 pounds of meat. These are recipes used at the University of Wisconsin Meat Science Laboratory as well as those collected from a number of other sources.

Meat types are suggested for each sausage. However, substitutions of other meats of similar fat content can be made with only minor flavor effects on the product. For example, lean venison could be substituted for the lean meats in any of the recipes. Often pork or beef containing some fat are included with venison to enhance eating quality. The composition of the sausages is really up to the producers' preferences.

**FRESH PORK SAUSAGE**

Fresh pork sausage is a mixture of pork meats, salt and spices which has been ground or chopped with no added water or extenders. Fat content usually ranges from 30 to 50% depending upon individual preference.

10.0 lbs. pork trimmings (20-50% lean)
A. Mild
3.0 oz. salt
0.7 oz. sugar
0.5 oz. white pepper
0.2 oz. ginger
0.15 oz. rubbed sage

B. Spicy or Hot (red pepper may vary depending on taste)
3.2 oz. salt
0.8 oz. monosodium glutamate
0.6 oz. sugar
0.6 oz. white pepper
0.15 oz. rubbed sage
0.15 oz. ginger
0.4 oz. mace
0.4 oz. thyme
0.4 oz. red pepper

Processing Schedule:
1. Grind through a ½ inch or 3/8 inch plate.
2. Mix spices with trimmings for 3-5 minutes or until tacky.
3. Regrind then through 3/16 inch plate.
4. Package and keep refrigerated below 40°F or freeze.
5. Use in bulk form, stuff in natural hog casings or collagen casings.

ITALIAN STYLE PORK SAUSAGE
This is a coarse ground fresh sausage which is normally pan-fried or broiled. The most popular style is broiled in a large spiral roll (snail like) on a grill until tender.

10.0 lbs. lean pork trimmings (70% lean)
2.4 oz. salt
0.4 oz. fennel seed
0.4 oz. crushed red pepper
0.4 chopped fresh parsley (optional)
0.2 oz. ground black pepper
0.2 oz. white pepper
0.2 oz. paprika
0.2 oz. coriander (optional)
2 garlic cloves, minced (optional)

Processing Schedule:
1. Grind the pork trimmings through a 1/2 inch or 3/8 inch plate.
2. Mix the seasoning with the trimmings for 3-5 minutes or until tacky.
3. Regrind through a ¼ inch or 3/8 inch plate.
4. Stuff in natural hog casings or collagen casings.
5. Package and keep refrigerated below 40°F or freeze.

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BRATWURST
7.5 lbs. pork trim
2.5 lbs. beef trim

or
10.0 lbs. pork trim (80% lean)
3.2 oz. salt
0.8 oz. sugar
8.0 oz. crushed ice
3.2 oz. non-fat dry milk
2.0 oz. fresh chopped onion
0.5 oz. ground white pepper
0.15 oz. lemon juice
0.013 oz. ground allspice (.04 gm)
0.1 oz. ground celery seed

Processing Schedule:
1. Grind beef and pork separately through 3/8 inch plate.
2. Regrind beef with onions and half the ice through 1/8 inch plate.
3. Mix all remaining ingredients and remaining ice with ground beef and onion.
4. Add pork and mix thoroughly.
5. Regrind through 3/16 inch plate.
6. Stuff into 32-35 mm hog casings and link.
7. Cook in 170°F water until an internal temperature of at least 160°F is reached.
8. Place in cooler and cool until internal temperature of 40°F or below is reached.

NURNBERGER BRATWURST
This is a bratwurst still very common in Nurnberg, West Germany. It is usually grilled and served 8 to 10 per serving. It goes well with German (hot) potato salad or raw sauerkraut.

5.5 lbs. regular pork trim (50% lean)
4.5 lbs. lean pork (80% lean)
3.2 oz. salt
1.4 lbs. ice
0.4 oz. white pepper
0.1 oz. mace
0.2 oz. marjoram
0.05 oz. dried shredded lemon peel

Processing Schedule:
1. Grind meat through 1/2 inch plate.
2. Blend ice and spices in mixer for 30 seconds.
3. Add meat and mix until all ingredients are well distributed.
4. Chop to a coarse texture (rice kernel size particles) in a silent cutter, or alternatively grind through a 1/4 inch plate.

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5. Stuff into 15 mm sheep casings and link every 2 1/2 to 3 inches.
6. Package and keep refrigerated below 40°F or freeze.

**POLISH SAUSAGE**

Polish sausage is made of coarsely-ground lean pork with some added beef. The basic spice characteristics for this well known sausage are garlic and marjoram.

- 9.0 lbs. boneless pork shoulders (80% lean)
- 1.0 lb. beef trimmings
- 4.8 oz. shaved ice
- 3.6 oz. salt
- 1.6 oz. dextrose
- 0.5 oz. white pepper
- 0.3 oz. mustard seed
- 0.2 oz. marjoram (leaf)
- 0.2 oz. monosodium glutamate
- 0.2 oz. nutmeg
- 0.1 oz. granulated garlic

**Processing Schedule:**

1. Grind the pork trimmings through a 1/2 inch or 3/8 inch plate.
2. Mix the seasoning with the trimmings for 3-5 minutes or until tacky.
3. Stuff in natural hog casings or collagen casings.
4. If smoking and cooking is desired, sodium nitrite may be added (refer to previous discussion "Curing Ingredients: Nitrites and Nitrates" for proper use of nitrite)
5. If cooking is desired, cook until an internal temperature of 160°F is reached.
6. Place in cooler and cool until internal temperature of 40°F or below is reached.
7. Package and keep refrigerated below 40°F or freeze.

**SMOKED KIELBASA**

- 4.0 lbs. lean pork trimmings (85% lean)
- 3.0 lbs. lean beef trimmings (90% lean)
- 3.0 lbs. regular pork trimmings (50% lean)
- 1.0 lb. shaved ice
- \( \times \) curing ingredient (*see previous discussion for correct type and amount)

**Processing Schedule:**

1. Use the same spices as for Polish Sausage.
2. Grind lean beef through 1/8 inch plate and pork trimmings through 3/16 inch plate.
3. Add cure, seasonings and ice and mix thoroughly for 3-5 minutes or until tacky.
4. Stuff in natural hog casings or collagen casings.
5. Hang overnight in a cooler that is less the 40°F.
6. Cook until an internal temperature of 160°F is reached.
7. Place in cooler and cool until internal temperature of 40°F or below is reached.
8. Package and keep refrigerated below 40°F or freeze.

**COARSE GROUND BOLOGNA**

Bologna is named after the city of Bologna, Italy, where it was first produced. It is normally stuffed into large diameter cellulose or fibrous casings and natural beef middle or beef bung casings. The following formulas may be changed in meat content depending upon meats available.

**Meat Formula No. 1:**

- 3.2 lbs. regular pork trimmings (60/40 lean/fat)
- 3.2 lbs. lean pork trimmings (85/15)
- 3.6 lbs. lean beef trimmings (85/15)
- 6.4 oz. dried skim milk (optional)

**Meat Formula No. 2:**

- 8.0 lbs. lean beef chuck meat
- 2.0 lbs. regular pork trimmings

**Ingredients:**

- 2.0 lbs. ice
- 4.4 oz. salt
- 2.4 oz. onion, fresh grated
- 0.8 oz. sugar
- 0.4 oz. ground white pepper
- 0.1 oz. coriander
- 0.1 oz. mace
- 0.1 oz. grated garlic (optional ingredients)
- X curing ingredient (*see previous discussion for correct type and amount)

**Processing Schedule:**

1. Grind meat through a 1/2 inch or 3/8 inch plate.
2. Add seasonings, curing ingredient and ice to meat and mix thoroughly for 3-5 minutes or until tacky.
3. Regrind through a 1/4 inch plate.
4. Stuff mix into casings of type and size desired
5. Hang overnight in a cooler that is less the 40°F.
6. The bologna is then cooked in the smokehouse by gradually raising the smokehouse temperature to 165-175°F and cooking until an internal temperature of at least 160°F is reached.
7. The product may be water cooked after smoking by placing the bologna in a water bath at 170-155°F and cooking until an internal temperature of at least 160°F is obtained.

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8. After cooking, the bologna should be placed in a cold water bath for 12 or 15 minutes or until the internal temperature is reduced to 90-100°F.
9. Place the product under refrigeration until used.
10. Place in cooler and cool until internal temperature of 40°F or below is reached.
11. Package and keep refrigerated below 40°F or freeze.

FRANKFURTERS

6.0 lbs. beef
4.0 lbs. pork
2.5 lbs. ice
3.2 oz. salt
0.7 oz. sugar
0.5 oz. ground white pepper
0.3 oz. ground coriander
0.2 oz. ground nutmeg
0.1 oz. ground mustard
X curing ingredient (*see previous discussion for correct type and amount)

Processing Schedule:
1. Grind beef and pork through a 1/4 inch plate. If a silent cutter is available, chop the beef with the salt, nitrite, and half the ice to a temperature of 45°F.
2. Add the pork, spices and remaining ice, and chop until proper texture is achieved, but not beyond a temperature of 58°F in the meat mixture. If a silent cutter is not available, a coarser textured product can be made by grinding the beef through a 1/8 inch plate and mixing thoroughly with the ice, cure, salt and spices.
3. Grind the pork through a 1/8 inch plate and add to mixture.
4. Blend until a uniform and tacky consistency is achieved.
5. Stuff into natural lamb casings or cellulose casings and hold over night in a cooler that is less the 40°F.
6. Wieners are cooked in the smokehouse by slowly increasing the temperature from 130-170°F. Smoke may be applied during all or part of the cooking period.
7. Cook until an internal temperature of 160°F is reached.
8. Place in cooler and cool until internal temperature of 40°F or below is reached.
9. Package and keep refrigerated below 40°F or freeze.

COOKED SALAMI
This is a cooked, mildly flavored Italian salami with a characteristic flavor. It is made of coarsely chopped pork, chopped beef and pork trimmings, flavored with garlic and stuffed into large diameter casings.

4.0 lbs. lean beef trimmings
3.0 lbs. extra lean pork
3.0 lbs. regular pork trimmings

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4.8 oz. salt
0.8 oz. sugar
0.6 oz. cracked black pepper
0.2 oz. fresh garlic (to taste)
0.1 oz. ground cardamom
0.1 oz. garlic powder
X curing ingredient (*see previous discussion for correct type and amount)

Processing Schedule:
1. Grind the lean beef through 3/8 inch plate and then through 1/4 inch plate.
2. Grind extra lean pork and regular pork trimmings through 1/2 inch plate and then through 3/16 inch plate.
3. Place all meat in the mixer, add curing ingredient and seasoning and mix well.
4. Stuff into 4-6 inch (diameter) fibrous casings and hang over night in a cooler that is less the 40°F.
5. Cook in a smokehouse by slowly increasing the temperature from 130-170°F. Smoke may be applied during all or part of the cooking period.
6. Cook until an internal temperature of at least 160°F is reached.
7. Place in cooler and cool until internal temperature of 40°F or below is reached.
8. Package and keep refrigerated below 40°F or freeze.

SUMMER SAUSAGE

Formula No. 11:
6.0 lbs. lean pork trimmings
4.0 lbs. beef trimmings (sinews removed)
4.8 oz. salt
0.8 oz. sugar
0.4 oz. ground black pepper
0.5 oz. vinegar
0.2 oz. starter culture (optional)
0.2 oz. coriander
0.05 oz. garlic powder (optional)
X curing ingredient (*see previous discussion for correct type and amount)

Formula No. 22:
6.0 lbs. pork trim
4.0 lbs. beef trim
4.8 oz. salt
3.2 oz. sugar
0.6 oz. coarse ground black pepper
0.1 oz. whole mustard seed
0.2 oz. ground coriander
0.05 oz. ground nutmeg (1.4 mg)
0.05 oz. ground allspice (1.4 gm)

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0.1 - 0.2 oz. garlic powder [or equivalent in fresh garlic (optional)]
0.2 oz. starter culture (optional)
X curing ingredient (see previous discussion for correct type and amount)

Processing Schedule:
1. Grind trimmings through ½ inch or a 3/8 inch plate.
2. Mix the ground materials with the seasonings and curing ingredient for 1-2
minutes.
3. Regrind through 1/8” plate and stuff in fibrous casings (2” or 2 ½” in diameter) ca
4. If starter culture was added, place in a smokehouse set at 90-110°F for 9 to 12
hours. (A fermented aroma should be present during this step. If not present after
2-3 hours, stop fermentation, and raise the smokehouse temperature according to
step #5.
5. After fermentation (step #4 is complete), raise the smokehouse temperature
gradually to 165-170°F and cook until the internal temperature reaches at least
160°F.
6. Place in cooler and cool until internal temperature of at least 40°F is reached.
7. Package and keep refrigerated below 40°F or freeze.

**DRY BEEF SALAMI**

9.0 lbs. beef trimmings (lean, 85%)
1.0 lb. pork fat or beef kidney fat
5.0 oz. salt
1.2 oz. sugar
1.0 oz. white pepper or black pepper
0.1 oz. mace
0.1 oz. ginger
X Starter culture (optional)
X curing ingredient (*see previous discussion for correct type and amount)

Processing Schedule:
1. Grind beef through an 1/8 inch plate and fat through 1/4 inch plate.
2. Mix all the ingredients for 3 to 5 minutes or until a good distribution of the fat and
lean is apparent.
3. Stuff into 5 inch diameter fibrous casings, sewed bungs or suitable sized collagen
casings.
4. Hold stuffed product for 9 to 11 days at below 40°F and 60% relative humidity.
5. This product may be cooked to internal temperature of at least 160°F.
6. Place in cooler and cool until internal temperature of at least 40°F is reached.
7. Package and keep refrigerated below 40°F or freeze.

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HONEY LOAF

8.0 lbs. regular pork trim (60% lean)
2.0 lbs. beef trim (85% lean)
2.0 lbs. water or ice
0.5 lbs. honey
0.25 lbs. salt
0.2 lbs. non-fat dry milk
0.1 lb. corn syrup solids
0.4 oz. monosodium glutamate (optional)
0.4 oz. onion powder
0.4 oz. white pepper
0.2 oz. celery powder
2.5 gr. sodium erythorbate
X curing ingredient (*see previous discussion for correct type and amount)

Processing Schedule:
1. Grind beef and pork (separately) through 1/8" plate. Keep at or below 30°F.
2. Chop beef with ice (water), salt, curing ingredient and sodium erythorbate to 40°F. (may also be mixed for 3 to 5 minutes instead)
3. Add pork and remaining ingredients and chop to 55 F. (or mix additional 3 minutes)
4. Pack into greased loaf pans or stuff into large diameter casings.
5. Product may be smoked and cooked or oven baked to at least 160°F internal.
6. Place in cooler and cool until internal temperature of at least 40°F is reached.
7. Package and keep refrigerated below 40°F or freeze.

SPICED LUNCHEON LOAF
This is an excellent all meat loaf for use as a cold cut or sandwich meat.

10.0 lbs. extra lean pork trimmings (85% lean)
1.2 oz. clear corn syrup
4.4 oz. salt
0.6 oz. white pepper
0.2 oz. mace
0.1 oz. nutmeg
X curing ingredient (*see previous discussion for correct type and amount)

Processing Schedule:
1. Grind pork trimmings through 1/4 inch plate.
2. Place in mixer, add balance of ingredients and mix thoroughly.
3. Fill in molds or loaf pans or stuff into large diameter (5-6") fibrous casings and hold overnight in a below 40°F cooler to cure.
4. Water cook at 170-175°F until an internal temperature of at least 160°F is reached. Molds or loaf pans may be oven cooked at 250-275°F until internal temperature of at least 160°F is reached.
5. Place in cooler and cool until internal temperature of at least 40°F is reached.
6. Package and keep refrigerated below 40°F or freeze.

**FAMILY LOAF**

8.0 lbs. pork trim (80% lean)
2.0 lbs. lean beef trim (90% lean)
2.0 lbs. water or ice
1.0 lb. corn syrup
8.0 oz. dried skim milk
0.8 oz. dried onion
4.0 oz. salt
8.0 oz. tomato juice
0.5 oz. white pepper
X curing ingredient (*see previous discussion for correct type and amount)

**Processing Schedule:**
1. Grind pork through 3/16 inch plate.
2. Chop beef and other ingredients for 2 minutes in a silent cutter. (or mix for 3 to 5 minutes instead)
3. Add the dried milk and chop (or mix) for 3 more minutes. (Alternatively, grind beef through 5/8 inch plate - mix thoroughly with remaining ingredients and grind through 1/8 inch plate.)
4. Add ground pork and mix for 4 minutes.
5. Cure for 24 hours in a cooler held below 40°F.
6. Remix and pack in loaf pans.
7. Product may be smoked and cooked or baked at 250°F to an internal temperature of at least 160°F.
8. Place in cooler and cool until internal temperature of at least 40°F is reached.
9. Package and keep refrigerated below 40°F or freeze.
MEAT MATTERS
COMMON INGREDIENTS IN PROCESSED MEAT PRODUCTS

Helpful Links

Food and Drug Administration
Center for Food Safety and Applied Nutrition
www.cfsan.fda.gov

U.S. Department of Agriculture
Food Safety and Inspection Service
www.fsis.usda.gov
1-888-MPHotline (consumer inquiries)

Code of Federal Regulations - Title 9 Section 424.21
"Use of food ingredients and sources of radiation."
http://www.gpoaccess.gov/cfr/retrieve.html

U.S. Department of Agriculture
Food Safety and Inspection Service
Directive 7120.1
Safe and Suitable Ingredients Used in the Production of Meat and Poultry Products (see latest revision)
Processed and cured meats are among America's most popular meat and poultry products. From hot dogs to smoked turkey, pastrami, hams and salamis, processed and cured meats offer excellent nutrition and unique taste. But sometimes the ingredients can be confusing to those unfamiliar with how these products are made.

Many different ingredients, including spices, flavorings, preservatives, binders and additives, are used to give these varied meat products their distinctive taste and texture. In addition to the cuts of meat and poultry used to make these products, other ingredients can add flavor, prevent quality loss during shelf life and delay spoilage.

Any non-meat ingredient included in a meat product must be approved by the Food and Drug Administration (FDA) and accepted by the U.S. Department of Agriculture, which regulates and inspects meat and poultry products. Approximately 2,800 food additives have been FDA-approved after a thorough review of their safety. Only a fraction of approved additives are commonly used in processed products. The additives that are used perform important functions like “curing” meat products and preventing bacterial growth.

All ingredients in processed products must be clearly detailed on the product ingredient statements, from the greatest amount to the least. Following is a guide to ingredients commonly found in processed and cured meat products.

Processed and cured meats have unique characteristics and flavor profiles. A host of ingredients are used to give them their distinct tastes:

**Ascorbic acid/Sodium ascorbate** – also known as Vitamin C, prevents oxidation that causes color change and spoilage. Ascorbic acid is commonly added to cured meats when nitrite is also used.

**BHA, BHT** – antioxidants that protect natural nutrients like Vitamin A and prevent the fat in meat from developing off flavors and odors, commonly referred to as being “rancid.” Rancidity develops when fats come in contact with oxygen. BHA and BHT also keep snack foods, cereals and crackers fresh during storage.

**Carrageenan** – a gelatin-like extract of red seaweed that is sometimes used as a binder or a fat substitute.

**Dextrose** – a sugar sweetener that enhances flavor and browning during cooking.

**Gelatin** – derived from collagen, gelatin is used as a thickener and in some canned ham and jellied meat products.

**Hydrolyzed vegetable protein** – a protein produced by boiling and breaking down cereals or legumes, such as soy, corn, or wheat, in hydrochloric acid into their component amino acids. Hydrolyzed vegetable protein is a flavor enhancer.

**Hydrolyzed milk protein** – a flavor enhancer derived from milk protein that has been broken into its component amino acids.

**Lactate/diacetate** – salts derived from organic acids that inhibit growth of bacteria and enhance safety. Lactate is made in our bodies as part of normal metabolism. As an ingredient, it is manufactured from corn by fermentation. Diacetate is a form of vinegar which is also manufactured by fermentation.

**Modified food starch** – a starch that has been separated from its protein source. Modified food starch is used as a thickener.

**Monosodium glutamate (MSG)** – a flavor enhancer that comes from an amino acid called glutamic acid. It must be declared as MSG on meat and poultry labels.

**Phosphates** – maintain moisture in products to enhance juiciness and tenderness and prevent off flavors from developing in fat.

**Salt** – mined from the earth or obtained from sea water, salt is an essential ingredient in processed and cured meat products that adds flavor, texture, protects against bacteria and extends shelf life. Before refrigeration, salting of meat was essential in preventing spoilage.

**Smoke flavoring** – a condensed form of smoke, smoke flavoring is an alternative to natural wood smoking. Smoke flavoring gives products a smoky taste without a grill.

**Sodium erythorbate** – derived from Vitamin C, erythorbate is an antioxidant that maintains the color of processed meats.

In contrast to a popular urban legend, erythorbate is NOT made from earthworms, though the U.S. Department of Agriculture reports receiving many inquiries about erythorbate's source. It is speculated that the similarity in the spelling of the words “erythorbate” and “earthworms” has led to this confusion.

**Sodium nitrite** – a curing ingredient and anti-oxidant that gives cured meats their characteristic pink color and their taste. While the closely related “sodium nitrate” was commonly used in the decades past, today, nitrite is used almost exclusively to cure meats. Nitrite used in cured meats is extremely effective in preventing the deadly disease botulism.

Interestingly, although consumers commonly think cured meats are the major source of nitrite in the diet, in reality, 93 percent of daily nitrite intake comes from vegetables and from saliva. Sodium nitrite is part of the normal nitrogen cycle in humans and the body actually produces and recirculates nitrate, which is converted to nitrite in our saliva. Scientists now think that humans may make nitrite as part of its bodily defenses.

In some cases, processed products labeled “uncured” contain celery juice or other nitrate-containing ingredients as a substitute for sodium nitrite.

**Spices** – a variety of plant-derived spices are commonly added to processed meat products. The most common spices used include red, white and black pepper, garlic, coriander, cinnamon, cumin, nutmeg and allspice.

**Sugar and corn syrup** – sweeteners that add flavor and promote browning.

**Tocopherol** – a form of Vitamin E that prevents fat in meat and poultry from becoming rancid.

**Xanthan gum** – derived from corn sugar, xanthan gum is a thickening agent used in some products. It can be used as an alternative to gelatin and provides a “fat feel” in low-fat and fat-free products.

**Whey** – a protein that remains after milk is made into cheese. Whey can be used as a “binder” in meat products to hold them together. Whey has the highest “biological value” of any known protein – even higher than egg whites.
RESTRICTED INGREDIENTS CALCULATIONS

**Sodium Ascorbate, Phosphates, etc. – Comminuted**

ppm in product = \( \frac{(\text{lb. nitrite})(1,000,000)}{\text{green weight of meat block}} \)

lbs. of sodium nitrite to add = \( \frac{(\text{ppm} / 1,000,000)\text{(meat block)}}{1,000,000} \)

**Sodium Ascorbate, Phosphates, etc. – Injection**

ppm in product = \( \frac{(\text{lb. nitrite})(\% \text{ injection})(1,000,000)}{\text{total lbs. of brine}} \)

lbs. of sodium nitrite to add = \( \frac{[(\text{ppm} / 1,000,000)(\text{total lbs. of brine})]}{\% \text{ injection}} \)

**Curing Salt (6.25% sodium nitrite) – Comminuted**

ppm in product = \( \frac{(\text{lb. curing salt})(0.0625)(1,000,000)}{\text{green weight of meat block}} \)

lbs. of curing salt to add = \( \frac{[(\text{ppm} / 1,000,000)(\text{meat block})]}{0.0625} \)

**Curing Salt (6.25% sodium nitrite) – Injection**

ppm in product = \( \frac{[(\text{lbs. of curing salt})(0.0625)(\% \text{ injection})(1,000,000)]}{\text{lbs. of total brine}} \)

lbs. of curing salt to add = \( \frac{\text{ppm} / 1,000,000}{\% \text{ injection}} = \frac{X}{[(X)(\text{lbs. of total brine})]/.0625} \)
**SAUSAGE MAKER’S SQUARE**

The sausage maker’s square (also known as Pearson Square Method) is a simple procedure that has been used in the meat industry for many years. This method can be used to determine the proportion of two meats with different levels of fat to produce a batter with a desired fat content. Probably the most important number in the square is the number in the middle (see Figure 1). The number represents the target fat level for the product.

\[
\begin{align*}
\text{% Fat in Meat A} (A) & \quad \text{Difference between B and C (D)} = \frac{D}{F} = \text{Proportion of Meat A} \\
\text{Desired % Fat in Batter (C)} & \\
\text{% Fat in Meat B} (B) & \quad \text{Difference between A and C (E)} = \frac{E}{F} = \text{Proportion of Meat B} \\
\text{Sum of D and E (F)} &
\end{align*}
\]

**Figure 1. Sausage maker’s square (Pearson square)**
In order to make the square work consistently, there are three very important considerations:

1. The value in the middle of the square must be intermediate between the two values that are used on the left side of the square.
2. Disregard any negative numbers that are generated on the right side of the square. Be concerned only with the numerical differences between the desired percent fat in the batter (C) and the level of the fat of the meats (A and B).
3. Subtract the percentage of fat in the meat (A or B) from the percent fat in the batter on the diagonal and arrive at a numerical value entitled difference (D and E). By summing those parts and dividing by the total, you can determine the percent of the meat that each meat ingredient should represent in order to provide a specific fat level. Always subtract on the diagonal within the square in order to determine parts. Always double check calculations to make sure that you did not have a mathematical error.

The following example will help to clarify the calculations (figure 2):
We have 90/10 beef and 50/50 pork, and we a final product with a fat target level of 28%. Using the sausage maker square we obtain the following numbers.

55% of the 90/10 and 45% of 50/50 pork is needed to obtain a product with 28% fat.

\[ 12\% \text{ Fat} \hspace{1cm} 54\% \text{ Fat} \]
\[ (90/10 \text{ beef}) \hspace{1cm} (50/50 \text{ pork}) \]

\[ \begin{array}{c}
28\% \\
\text{Fat}
\end{array} \]

\[ \frac{26}{42} \hspace{1cm} \frac{16}{42} \]

\[ 0.62 \times 100 = 62\% \text{ 90/10 Beef} \hspace{1cm} 0.38 \times 100 = 38\% \text{ 50/50 Pork} \]

Figure 2. Example sausage maker’s square (Pearson square)
Basics of Safe Food Handling

Bacteria that contaminate food and cause foodborne illnesses are everywhere. Follow these four basic safety tips to keep your food safe.

- Wash hands and surfaces often.
- Don’t cross-contaminate.
- Keep foods out of the temperature “Danger Zone.”
- Cook foods thoroughly.

KEEP HANDS AND SURFACES CLEAN
Bacteria like *Staphylococci* are found on hair, skin, mouth, nose and throat. A cough or sneeze can transmit thousands of microorganisms that may cause disease. The best prevention is to keep yourself and your kitchen clean.

Keep Your Hands Clean: Wash your hands! Hands become the most potentially dangerous when seemingly innocent acts like scratching the scalp, running fingers through hair, or touching a pimple become the cause for contaminating foods. Follow the following steps to wash your hands:

Step 1. Wet hands thoroughly with warm water.
Step 2. Apply soap generously.
Step 3. Rub hands for at least 20 seconds.
Step 4. Scrub under nails with a clean nailbrush.
Step 5. Rinse hands well with warm water.
Step 6. Dry hands using a clean paper towel.

Keep Counters and Equipment Clean: Wash counters and equipment with soap and water immediately after use. Sanitize with a chlorine solution of 1 teaspoon liquid household bleach per quart of water, especially after contact with raw meats.

Use a bleach solution to sanitize the kitchen drain and disposal as well. Food particles get trapped and the moist environment is ideal for bacterial growth.

Dishes and other utensils should be washed immediately in hot, soapy water and then air-dried, or cleaned in an automatic dishwasher.

Bacteria can live in kitchen towels, sponges and cloths. Wash kitchen towels and cloths before reusing them, or use paper towels and throw them away. Replace sponges every few weeks.

Keep Cutting Boards Clean: Use plastic or glass surfaces for cutting raw meat and poultry. Wooden cutting boards used exclusively for raw meat and poultry are acceptable but not recommended.

Recent studies by the Food and Drug Administration’s Center for Food Safety and Applied Nutrition found that microorganisms become trapped in wood surfaces and are difficult to dislodge by rinsing. Once trapped, bacteria survive in a dormant stage for long periods of time. The next time the cutting board is used, these bacteria could contaminate other foods, potentially causing foodborne illness. On the other hand, the study found that microorganisms are easily washed off plastic surfaces.

USDA researchers studied how easily bacteria can be removed from cutting boards. After they were inoculated with bacteria, the cutting boards were cleaned in different ways. The researchers found that washing by all the methods they used removed virtually all the bacteria on both types of boards, but results were more reliable with the plastic.

If using a wooden cutting board, it is recommended that a different board be used for cutting other foods such as produce and bread. This will prevent bacteria from a meat or poultry product from contaminating another food.
Wash All Cutting Boards Thoroughly: To keep all cutting boards clean wash them with hot, soapy water after each use, then rinse and air-dry or pat dry with fresh paper towels. Non-porous acrylic, plastic or glass boards and solid wood boards can be washed in an automatic dishwasher. Laminated boards may crack and split.

Sanitize Cutting Boards Occasionally: Both wooden and plastic cutting boards can be sanitized with a solution of 1 teaspoon liquid chlorine bleach per quart of water. Flood the surface with the bleach solution and allow it to stand for several minutes, then rinse and air dry or pat dry with fresh paper towels.

Replace Battered Cutting Boards: Even plastic boards wear out over time. Once cutting boards become excessively worn or develop hard-to-clean grooves, they should be discarded.

PREVENT CROSS-CONTAMINATION
Cross-contamination is the transportation of harmful substances to food by

- Hands that touch raw foods, such as raw meat, then touch food that will not be cooked, like salad ingredients.
- Surfaces or cleaning cloths that touch raw foods, are not cleaned and sanitized, then touch ready-to-eat food.
- Raw meat, raw poultry and raw seafood that touch or drip fluids on cooked or ready-to-eat foods.

KEEP FOODS OUT OF THE “DANGER ZONE”

Safely Store Perishable Foods: Refrigerate or freeze foods that will spoil at room temperature. Keep your refrigerator between 34 °F and 40 °F and your freezer temperature at or below 0 °F. The “Danger Zone” for most foods is between 40 °F and 140 °F. Bacteria grow most rapidly in this range of temperatures, doubling in number in as little as 20 minutes. Discard any perishable food left out at room temperature for more than two hours. See the table, “Recommended Times for Refrigerator and Freezer Storage” for specific storage suggestions.

Safely Thaw Foods: Thaw and marinate foods in the refrigerator, never on the counter. If thawed at room temperature, bacteria can grow in the outer layers of the food before the inside thaws. Proper thawing is essential to maintaining the safety, taste and texture of frozen foods. It affects the juiciness of meats, the texture and flavor of vegetables and fruits, and moisture level of baked goods.

- Thick meat cuts should be thawed before cooking to retain juiciness. Cuts such as chops, patties and steaks that will be prepared by flouring or breading should be thawed before baking.
- Broccoli, cauliflower and greens are more flavorful if partially thawed before cooking.
- Thawing foods should be placed in a shallow pan to catch drippings so that other refrigerated foods will not be contaminated with raw food juices.
- Never thaw foods at or above room temperature (except breads and other baked goods). Remember food spoilage bacteria multiply most rapidly at temperatures between 40 °F and 140 °F.
- Thaw frozen fruits, vegetables or meat in the refrigerator overnight, in a sealed freezer container. Foods may be thawed more quickly by immersing the sealed freezer container into cold water and changing the water frequently until food is thawed. Foods may also be thawed in the microwave using the defrost setting.
- If thawed in the microwave or in cold water in the sink, food must be cooked immediately after thawing. DO NOT thaw a food and then refrigerate to cook later.
- When you have defrosted food for use, keep in mind that thawed frozen food is more perishable than fresh food.
- Thawed foods that have been at room temperature for over two hours should be discarded.
- Foods thawed in the refrigerator may be refrozen IF they still contain ice crystals. Immediately remove only the amount needed from the freezer container, remove air, reseal and return remaining food to the freezer.
- Thawed meats and poultry kept in the refrigerator should be used within two to three days. Thawed seafood kept in the refrigerator should be used within one to two days.
- Thaw bread and baked goods at room temperature in sealed freezer containers or original wrapping to avoid moisture loss.
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<th>REFRIGERATOR</th>
<th>FREEZER</th>
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<td><strong>DAIRY</strong></td>
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<tr>
<td>Fresh milk</td>
<td>5-7 days</td>
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<td>Buttermilk</td>
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<td>Yogurt, cottage cheese</td>
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<td>Hard cheese</td>
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<td>Ice cream</td>
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</tr>
<tr>
<td>Beef roasts, steaks</td>
<td>3-5 days</td>
<td>6-12 months</td>
</tr>
<tr>
<td>Ground beef or stew</td>
<td>1-2 days</td>
<td>3-4 months</td>
</tr>
<tr>
<td>Pork roasts, chops</td>
<td>3-5 days</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Sausage</td>
<td>1-2 days</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Chicken or turkey</td>
<td>1-2 days</td>
<td>9-12 months</td>
</tr>
<tr>
<td><strong>MEATS, COOKED</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoked Sausage, whole ham (fully cooked)</td>
<td>7 days</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Ham slices (fully cooked)</td>
<td>3-4 days</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Hotdogs, luncheon meats (unopened)</td>
<td>2 weeks</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Hotdogs, luncheon meats (opened)</td>
<td>3-7 days</td>
<td>1-2 months</td>
</tr>
<tr>
<td>Leftover meat, cooked</td>
<td>3-4 days</td>
<td>2-3 months</td>
</tr>
<tr>
<td>Leftover gravy and meat broth</td>
<td>1-2 days</td>
<td>2-3 months</td>
</tr>
<tr>
<td>Leftover poultry, cooked</td>
<td>3-4 days</td>
<td>4-6 months</td>
</tr>
<tr>
<td><strong>SEAFOOD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh lean fish: cod, flounder, trout,</td>
<td>1-2 days</td>
<td>4-6 months</td>
</tr>
<tr>
<td>haddock, halibut, pollack, perch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh fatty fish: mullet, smelt, salmon,</td>
<td>1-2 days</td>
<td>2-3 months</td>
</tr>
<tr>
<td>mackerel, bluefish, tuna, swordfish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live crabs and lobster</td>
<td>same day purchased</td>
<td>*</td>
</tr>
<tr>
<td>Live mussels and clams</td>
<td>2-3 days</td>
<td>*</td>
</tr>
<tr>
<td>Live oysters</td>
<td>7-10 days</td>
<td>*</td>
</tr>
<tr>
<td>Freshly shucked oysters</td>
<td>5-7 days</td>
<td>3-4 months</td>
</tr>
<tr>
<td>Scallops, shrimp, shucked mussels and clams</td>
<td>2-3 days</td>
<td>3-4 months</td>
</tr>
<tr>
<td><strong>FRUITS AND VEGETABLES (FRESH)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td>1 month</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Apricots, avocados, grapes, peaches, pears, plums</td>
<td>3-5 days</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Berries, cherries</td>
<td>2-3 days</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Grapefruit, lemons, limes, oranges</td>
<td>2 weeks</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Pineapple</td>
<td>2-3 days</td>
<td>4-6 months</td>
</tr>
<tr>
<td>Beets, carrots</td>
<td>2 weeks</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Beans, broccoli, greens, peas, summer squash</td>
<td>3-5 days</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Celery, cabbage, chilies, lettuce, peppers, tomatoes</td>
<td>1 week</td>
<td>8-12 months</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>1-2 days</td>
<td>8-12 months</td>
</tr>
<tr>
<td><strong>PIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiffon pie, pumpkin pie</td>
<td>1-2 days</td>
<td>1 month</td>
</tr>
<tr>
<td>Fruit pie</td>
<td>1-2 days</td>
<td>1 year</td>
</tr>
</tbody>
</table>

* Storage not recommended due to safety or quality issues
<table>
<thead>
<tr>
<th>Raw Food</th>
<th>Internal Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Products</td>
<td></td>
</tr>
<tr>
<td>Hamburger</td>
<td>160 °F</td>
</tr>
<tr>
<td>Beef, veal, lamb, pork</td>
<td>160 °F</td>
</tr>
<tr>
<td>Chicken, turkey</td>
<td>165 °F</td>
</tr>
<tr>
<td>Beef, Veal, Lamb</td>
<td></td>
</tr>
<tr>
<td>Roasts and Steaks</td>
<td></td>
</tr>
<tr>
<td><em>medium-rare</em></td>
<td>145 °F</td>
</tr>
<tr>
<td><em>medium</em></td>
<td>160 °F</td>
</tr>
<tr>
<td><em>well-done</em></td>
<td>170 °F</td>
</tr>
<tr>
<td>Pork</td>
<td></td>
</tr>
<tr>
<td>Chops, roasts, ribs</td>
<td></td>
</tr>
<tr>
<td><em>medium</em></td>
<td>160 °F</td>
</tr>
<tr>
<td><em>well-done</em></td>
<td>170 °F</td>
</tr>
<tr>
<td>Ham, fresh</td>
<td>160 °F</td>
</tr>
<tr>
<td>Sausage, fresh</td>
<td>160 °F</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
</tr>
<tr>
<td>Chicken, whole and pieces</td>
<td>180 °F</td>
</tr>
<tr>
<td>Duck</td>
<td>180 °F</td>
</tr>
<tr>
<td>Turkey (unstuffed)</td>
<td>180 °F</td>
</tr>
<tr>
<td>Whole</td>
<td>180 °F</td>
</tr>
<tr>
<td>Breast</td>
<td>170 °F</td>
</tr>
<tr>
<td>Dark meat</td>
<td>180 °F</td>
</tr>
<tr>
<td>Stuffing (cook separately)</td>
<td>165 °F</td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
</tr>
<tr>
<td>Fried, poached</td>
<td>Yolk and white are firm</td>
</tr>
<tr>
<td>Casseroles</td>
<td>160 °F</td>
</tr>
<tr>
<td>Sauces, custards</td>
<td>160 °F</td>
</tr>
</tbody>
</table>

**COOK FOODS THOROUGHLY**

Using a thermometer is the only reliable way to ensure safety and to determine the “doneness” of meat and egg dishes. To be safe, these foods must be cooked to an internal temperature high enough to destroy any harmful bacteria that may have been in the food. Color changes in meat are no longer considered reliable proof that all bacteria have been destroyed. Use the temperature chart to determine if foods have been cooked thoroughly.

**SAFELY HANDLE LEFTOVERS**

Divide large amounts of hot leftovers directly into small, shallow containers for quick cooling, and place directly in the refrigerator. Discard food that has been left standing at room temperature for more than two hours.

Date leftovers so they can be used within a safe time. Most foods remain safe when refrigerated for three to five days, although ground meats and meat gravies should be kept for only one to two days. If in doubt, throw it out rather than risk a foodborne illness. Never taste food that looks or smells strange to see if you can still use it. Even a small amount of contaminated food can cause illness.

**SOURCES:**

2. USDA and FDA. Four Simple Steps to Fight BAC! URL: [http://www.fightbac.org/steps.html](http://www.fightbac.org/steps.html)

This information has been reviewed and adapted for use in South Carolina by P.H. Schmutz, HGIC Information Specialist and E.H. Hoyle, Extension Food Safety Specialist, Clemson University.

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