

INTRODUCTION

The purpose of this course is to provide you with detailed information on shelf-stable products – the various types of products, their microbiology, how they are produced, and the principles for controlling the food safety hazards specific to these products. The key goals of this training are to:

- Provide technical and practical information for assessing product production.
- Outline manufacturing processes and the equipment involved.
- Provide information that will allow you to review HACCP plans for shelf-stable products.

The objectives for this section are for you to be able to:

1. Identify shelf-stable products.
2. Distinguish shelf-stable products from other types of meat and poultry products.

Types of Products

First we must define what we mean by shelf-stable products and distinguish them from non-shelf-stable products. Non-shelf-stable products must be refrigerated (or frozen) until consumption to prevent the growth of both pathogenic and spoilage microorganisms. Shelf-stable products, on the other hand, can be stored under ambient temperature and humidity conditions and, if the package integrity is maintained during storage, shipping, display at retail, and in the home, will not spoil or become unsafe throughout the manufacturer's specified shelf-life. Ready-to-eat shelf-stable products can be stored unrefrigerated (e.g., at temperatures over 50°F or 10°C) and are safe to eat without additional preparation.

Products can be made shelf-stable in a variety of ways. In very broad terms, meat and poultry products are made shelf-stable either by “canning” or by “drying.” Within the two broad categories there are numerous variations on how shelf-stability is achieved.

► Canned products

FSIS defines a canned product as “a meat or poultry food product with a water activity above 0.85 which receives a thermal process either before or after being packed in a hermetically sealed container” (9 CFR 318.300 (d) and 9 CFR 381.300 (d)). These products will remain stable and retain their organoleptic

quality for several years, even when held at room temperature. When most products are “canned,” they are treated with heat to make them shelf-stable or, to use another term, commercially sterile. FSIS considers shelf-stability and commercial sterility to be the same with respect to canning and canned products. The FSIS canning regulations define shelf-stability as “the condition achieved by application of heat, sufficient, alone or in combination with other ingredients and/or treatments, to render the product free of microorganisms capable of growing in the product at non-refrigerated conditions (over 50°F or 10°C) at which the product is intended to be held during distribution and storage. Shelf-stability and shelf-stable are synonymous with commercial sterility and commercially sterile, respectively” (9 CFR 318.300 (u) and 9 CFR 381.300 (u)).

Canned products are often referred to as “low-acid canned foods” (LACF) or “acidified low-acid foods,” depending on whether the pH is above 4.6 (for LACF) or is 4.6 or below (for acidified foods). An acidified low-acid food is a canned product that has been formulated or treated (by addition of an acid or acid food) so that every component has a pH of 4.6 or below within 24 hours after the completion of the thermal process. (A third category of products not applicable to meat and poultry products is acid foods, which have a natural pH ≤ 4.6.)

Although we refer to these commercially sterile products as “canned,” as you will see, the products may be in cans, glass jars, plastic containers, laminated pouches, paperboard containers, etc., that are sealed to prevent the entry of microorganisms. These products may be made commercially sterile by placing them in the container, sealing it, and treating the product with high heat under pressure using a retort, or pressure vessel. However, if the pH of the product is low enough (at or below 4.6), the thermal process may be delivered with lower heat and no pressure (e.g., in an atmospheric cooker or pasteurizer). You will learn about the types of retorts that are used for meat and poultry products in a later section. You will learn about the role pH plays in how products are made commercially sterile when we further discuss acidified versus low-acid products in another module. You will also learn about how curing agents impact thermal processes.

Commercially sterile uncured meat and poultry products include canned beef stew, whole chicken, chili, meat sauces and gravies, meat spreads, soups containing meat and poultry, baby and toddler foods, and even entrees such as chicken with noodles. Some of these, such as spaghetti sauce with meat, may be acidified products. Commercially sterile cured products include Vienna sausages, canned hams (not perishable), and canned luncheon meats.

The process of placing food in a container and heating it to make the product commercially sterile is known as conventional canning. There is another method of producing commercially sterile products known as aseptic processing. This method involves sterilizing the food and the container separately and filling and

sealing the container in an aseptic (i.e., sterile) environment. This means of manufacturing commercially sterile products is not widely used for meat and poultry products in the U.S. at this time, although it is a proven technology.

► Dried products

The major categories of dried meats are dry and semi-dry sausages, dried (i.e., dry cured) whole muscle meats, and dried whole muscle meat snacks. Dry and semi-dry sausages (e.g., pepperoni, hard salami, Summer Sausage) are probably the largest group of dried products. These products may be further broken down into fermented products, those acidified with chemical acidulants, and non-acidified cooked products. FSIS guidelines (Standards and Labeling Policy Book) specify that shelf-stable dry sausage must have a Moisture Protein Ratio (MPR) $\leq 1.9:1$ and semi-dry sausage must have an MPR $\leq 3.1:1$ with a pH ≤ 5.0 , or be commercially sterilized (unless another MPR is specified for a product). Alternatively, non-refrigerated, semi-dry shelf-stable sausages are those that are fermented to a pH of 4.5 or lower (or pH 4.6 if combined with a water activity (a_w) of less than 0.91); are in an intact form or, if sliced, are vacuum packed; have an internal brine concentration of no less than 5%; are cured with nitrite or nitrate; and are smoked with wood. These guidelines are standards of identity; they were not developed for safety.

Dried (mostly dry cured) whole muscle products such as Prosciutto, Parma and Country Hams are treated with salt or salt brines to achieve shelf-stability. Dried whole muscle meat snacks such as beef jerky products are brine cured and dried to a low water activity or MPR. The water activity (available moisture) of the product is the primary factor effecting shelf-stability in salt-cured dried products

► Other shelf-stable products

There are additional shelf-stable products that do not fit easily into the two broad classifications of canned or dried. Some products found in cans or jars are neither conventionally canned nor aseptically packed. For example, some products such as pickled pigs' feet and vinegar-pickled sausages rely primarily on pH control and, although they may be cooked, they are not heated in the container. The shelf-stability of pH-controlled products is due to a combination of the low pH, the use of acetic acid as the acidulant, control of fermentable carbohydrate, and packaging in an airtight container. Other products, such as sliced dried beef packed in jars or sausages covered with lard packed in cans, do not receive a heat treatment in the container and are primarily a_w -controlled. (Dried beef and sausages are addressed in the "dried" category; the only distinction here is that the type of packaging is similar to that of commercially sterile product.) The a_w -controlled products rely primarily on the high brine

levels, but this may be combined with other factors. FSIS guidelines specify that sausages such as chorizos packed hot in lard have an MPR of 1.8:1 and a pH of 5.5 or less, or, alternatively, an a_w of 0.92. Sliced dried beef is shelf-stable if packaged under vacuum, as in a glass jar, with a brine concentration of 16% or greater or an a_w of 0.86 or below. Microbial spoilage due to micrococci can occur if the vacuum is inadequate, the brine level is low or if residual nitrite is inadequate.

Shelf-stable bacon can also be found in cans (e.g., canned pre-fried bacon) or jars (e.g., bacon bits). The product is shelf-stable if the a_w is ≤ 0.86 and it is packed under vacuum. Several processes may be used. One involves cooking bacon and filling it into the container, whereas another process involves heating the bacon in the container to an internal temperature of 156°F (68.9°C) to pasteurize the product; both rely on high brine concentration for stability. FSIS specifies that canned pasteurized bacon have a brine concentration of 7%. Canned pre-fried bacon must have an M/SP (moisture divided by salt times protein) index of 0.4 or more, a brine ratio (moisture/salt) of 9.0 or less and a brine concentration (salt/moisture + salt) of 10% or more.

Shelf-stable products may also include freeze dried or dehydrated meat and poultry products (such as beef gravy mix and foods for camping) and snack foods such as fried pork skins and pork cracklings. These products are cooked (which destroys pathogens) and then dried to a level that does not support microbial growth. Meat base (beef, pork, ham) is shelf-stable primarily because of high salt content (30-40%), as is beef concentrate and salt, which is made from cooked beef broth that is evaporated and then salted. We will not cover these products in detail in this course.

Terminology

For this course we will utilize the terms commercial sterility or commercially sterile for “canned” products and use shelf-stable to refer to the dried products. Nevertheless, it should be recognized that all of these products are shelf-stable, i.e., they can be held safely without temperature control.