K-STATE Research and Extension

Hot-Fill-Hold Process for Acid and Acidified Foods

MU Extension University of Missouri

Food Safety Fact Sheet

The Hot-Fill-Hold method is used specifically for acid and acidified foods. In this method there is no need to apply pressure because the natural acidity and/or addition of acids lowers the pH and inhibits the growth of *Clostridium botulinum*. Unlike low-acid foods, which need high temperature (240° to 250°F) achieved under pressure to kill these bacteria, acid and acidified foods can be safely processed by heating them to temperatures above 180°F (82°C) or a combination of temperature and time as recommended by a Process Authority.

Acid and acidified foods have pH of less than 4.6. Their acidic nature kills any potential bacteria or spores, ensuring the food is safe to consume without the need for pressure canning. However, proper temperatures or hold times are necessary to ensure safety, shelf stability, and seal integrity of acid and acidified foods. Records of pH monitoring must be maintained for all products classified as acid or acidified.

The Hot-Fill-Hold process offers several benefits. It enhances food safety and ensures the product is safe for consumption. Additionally, it helps in extending the shelf life of products without the need for preservatives or refrigeration. Overall, it is a cost-effective and reliable method in food processing.

The Hot-Fill-Hold process is a step in the production of certain beverages and liquid products, aiming to ensure product safety by commercial sterilization. Below are the typical steps involved in the Hot-Fill-Hold process:

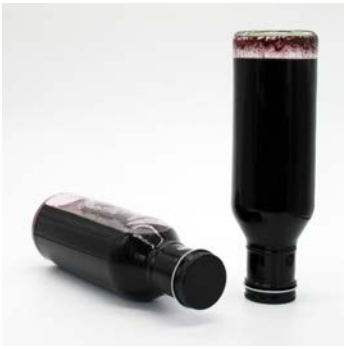
» The product is heated to a specific temperature, typically depending on the equilibrium pH of the product. The temperature is crucial for commercial sterilization, effectively destroying harmful microorganisms present in the product.

Hot-filling bottles.

Rob Wicks for UnSplash

» After heating, the product is promptly filled in precleaned and sanitized containers. The product is filled at a specific temperature, and the heated closure is applied using a steam capper or by hand.

» Once filled, the jar is inverted and held, allowing the hot product to come in contact with the headspace and inner surface of the cap or lid thus creating a safer shelf-stable product. Inversion helps in controlling long-term storage and potential growth of yeast and molds on the surface of the product. It is essential to maintain records of how long (minutes/seconds) the container was inverted and held, and the temperature after the inversion and holding.



Laid down and inverted jars

» Containers for acid and acidified foods should ensure a hermetic seal (seal that is airtight and watertight). The best container options are metal cans, glass jars, or bottles with metal caps lined with plastisol. These

closures create a strong vacuum, which indicates a hermetic seal and helps maintain the product's safety.

One-piece metal lids with safety buttons

» When using a Hot-Fill-Hold process, a lid with the safety-button indicates if your product has been properly processed and sealed. The button may take several minutes or even hours to activate because the product inside needs to cool for the vacuum seal to form. Typically, one-piece lids take a bit longer than two-piece lids to form a proper seal.

» After the Hot-Fill-Hold process is complete, the sealed containers are packaged for distribution. The final product is now shelf-stable, providing an extended shelf life while maintaining safety and quality.

Setting Processing Parameters

Specific parameters, such as heating temperatures, holding times, and inversion/laydown of container procedures, may vary based on the type of product being processed and food safety requirements. Manufacturers must adhere to these specific guidelines to ensure the effectiveness of the Hot-Fill-Hold process. These parameters will be verified by a process authority.

Minimum Hot-Fill-Hold times for acidified foods with different pH levels

Examples of temperature and time combinations for products with an equilibrium pH of 4.1 or below.

140˚F for 12.7 min.

141˚F for 11.3 min.

161˚F for 1.1 min.

180˚F for 0.1 min.

For more information, see page 271 of the research paper mentioned below.

Minimum Hot-Fill-Hold times for acidified foods with an equilibrium pH of 4.1 or below

F. Breidt, K.P. Sandeep, and F.M. Arritt. 2010. Use of linear models for thermal processing of acidified foods. Food Protection Trends 30:268-272. *https://www.foodprotection.org/members/fpt-archive-articles/2010-05use-of-linear-models-for-thermal-processing-of-acidified-foods/*

Examples of temperature and time combinations for products with an equilibrium pH of 4.1- 4.6.

141˚F for 77.8 min.

142˚F for 67.7 min.

179˚F for 0.4 min.

180˚F for 0.4 min.

For more information see page 137 of the research paper mentioned below.

Minimum Hot-Fill-Hold times for acidified foods with an equilibrium pH of 4.1 - 4.6

F. Breidt, K. Kay, J. Osborne, B. Ingham, and F. Arritt. 2014. Thermal processing of acidified foods with pH 4.1 to 4.6. Food Protection Trends 34:132-138. *https://www.foodprotection.org/files/food-protection-trends/May-Jun-14-Breidt.pdf*

These research papers provide detailed information on the required Hot-Fill-Hold times to ensure the safety of acidified foods with different pH levels.

Use of Plastic Containers

When handling acid or acidified foods, some plastic containers are not able to handle high temperatures during filling, therefore, alternative methods are necessary. If using plastic containers for Hot-Fill-Hold, it is important to know the manufacturer's specifications for the maximum temperature the container can withstand. The alternative methods are as follows:

1. It is crucial to kill any harmful bacteria by heating the product to temperatures and times provided by the process authority and then cooling the product before filling plastic containers. If heating the product isn't possible, another approach is to lower the pH to below 3.3 before filling. When stored at 75˚F for 24 hours, research indicates this acidity level can effectively eliminate vegetative cells of foodborne pathogens in the product.
2. Depending on the processing steps, preservatives like sodium benzoate and potassium sorbate may be added to prevent the growth of yeasts, molds, and other contaminants.

The above steps, along with maintaining strict sanitation, ensures the safety and quality of acid and acidified foods when processed in plastic containers, protecting against spoilage and maintaining product safety. These alternative methods need approval from a process authority.

Registering with the FDA for Acidified Foods

The Food and Drug Administration form FDA 2541e is required for manufacturers of acidified foods to register their food processes. It ensures compliance with safety standards to prevent contamination.

Food Process Filing for Acidified Method (Form FDA 2541e): *https://www.fda.gov/media/93939/download*

Instructions for Electronic submission of form FDA 2541e (Food Process Filing for Acidified Method): *https://www.fda.gov/media/89918/download*

Schematic Representation of Steps Involved in Hot-Fill-Hold for Sauce

Prepare Sauce: Weigh the ingredients and prepare the final product.

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Heat Sauce: Heat at specified temperature and time to effectively destroy all pathogens.

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Fill Containers: Carefully fill hot sauce, leaving an appropriate headspace into clean/sanitized containers.

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Cap Containers: Place a one-piece lid on the container with a clean rim.

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Inversion: Invert containers for a specified time to allow heating of the cap and headspace thus sterilizing the entire container and closure.

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Hold at Specified Temperature: Helps inhibit microbial growth and ensures sterility.

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Check for Proper Sealing of Containers: Seal to prevent recontamination.

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Label, Package, Store, and/or Distribute

References

1. Rushing, J., & Foegeding, J. Processing acid and acidified foods. *https://aggie-horticulture.tamu.edu/wp-content/uploads/sites/8/2012/03/ncsu-edu_foodscience_extension_program_documents_acid_acidified_foods.pdf*
Date Accessed April 10, 2024

2. Developing a hot-fill-hold process for acid or acidified foods *https://foodsafety.wisc.edu/wp-content/uploads/sites/1026/2024/01/Developing_HotFill.pdf*.
Date Accessed May 15, 2024.

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