

Acidified Foods

Formulating Dressings, Sauces and Marinades

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Some products such as salad dressings, sauces, marinades and similar foods depend on the presence of acids to prevent spoilage. This acid may be naturally occurring from foods such as fruit juices or tomatoes, or the food may be formulated by combining acid foods with other foods to achieve the desired acidity. Some foods such as vinegar and certain pickled vegetables may have developed acidity from microbial fermentation.

Since microorganisms which cause foodborne illness may grow in foods without adequate acidity, government regulations address the manufacture of these products. Title 21 of the Code of Federal Regulations, Parts 114 and 108 (21CFR114 & 21CFR108) regulate acidified foods.

Categories of Foods Preserved by Acids

Naturally acidic and fermented foods, along with jams, jellies, preserves and certain dressings and sauces, are exempted from the provisions of 21CFR114. Generally, if a food is formulated from predominantly acid foods it meets the exemptions. If, however the food contains a mixture of acid and low acid foods, it falls under the regulation.

Acidity and pH

Food scientists measure the acidity of a food based on its pH value. The pH scale ranges from 0 to 14 with pH 7 being neutral. Any pH below pH 7 is considered in the acid range, while those above pH 7 are considered in the basic range. The lower the pH value, the more acidic the food.

Foods preserved with acids are required to have a pH of 4.6 or below. At these levels, the production of toxins by the deadly organism causing botulism is inhibited. We refer to foods that have readings greater than pH 4.6 as low-acid foods. Most vegetables and meats fall into this category. Most fruits and tomatoes have pH values lower than 4.6 and are considered acid foods. Table 1 lists the pH of some representative foods.

Table 1. Acidity Levels of Selected Canned Foods

Acidity Classification	pH Value	Food Item
Low Acid	7.0	lye hominy
		ripe olives, crabmeat, eggs, oysters, milk, corn, duck, chicken, codfish, beef, sardines
	6.0	corned beef, lima beans, peas, carrots, beets, asparagus, potatoes
	5.0	figs, tomato soup
MEDIUM ACID	4.5	ravioli, pimentos
ACID		potato salad
		tomatoes, pears, apricots, peaches, oranges
	3.7	sauerkraut, pineapple, apple, strawberry, grapefruit
HIGH ACID	3.0	pickles, relish, cranberry juice, lemon juice, lime juice
	2.0	



Formulation of Acidified Foods

Acid foods depend on one or more food acids such as citric, malic or acetic acid to achieve stability. Most acidified foods, including dressings and sauces use vinegar (acetic acid) to produce the desired acidity. Vinegar is used because it is an effective source of food acid, and it is familiar to both processors and consumers.

When low-acid foods are used in formulations, it is important that they are properly acidified before they have a chance to spoil. They must reach equilibrium pH within an adequate time. The rate of uptake of acid by low acid foods can be influenced by factors such as piece size or the presence of a waxy peel. These factors can often be overcome by reducing the piece size of the low acid food. It is important that piece size be strictly controlled to achieve uniform acid uptake. When oil is used in the formulation, the low acid components should reach an equilibrium pH below 4.6 before adding oil.

Most foods have a chemical property called buffering capacity that allows them to resist changes in pH. Greater amounts of acids must be added to the foods at certain pH levels to continue to achieve a reduction of pH. Buffering can be a useful property to prevent changes in pH with minor variations in added acid.

Determination of pH

The pH of a food is usually determined using a pH meter. Electrodes from the meter are inserted into the solution to measure the pH electronically. A variety of pH meters are available from scientific equipment suppliers. Prices range from less than \$100 to over \$1,000, depending on the type and the features of the meter.



Figure 1. Hand held and bench model pH meters.

Estimation of pH can also be obtained colorimetrically using pH test papers. These papers, available from scientific supply houses, can be purchased for a few dollars. Regulations allow the colorimetric monitoring of pH for foods with pH levels below 4.0. To have a built-in safety factor, acid and acidified foods are normally formulated to pH well below 4.6. As Table 1 shows, most acidified foods have a pH below 4.0.

Measuring the pH of a Food

To measure the pH of a food, the food should be liquid or prepared as a puree in a blender. Distilled water may be added to thoroughly mix the components. Be sure to test a sample representative of the whole product. Any oil layer may need to be removed by decanting to get a measurement of the non-oil phase. To measure the equilibrium pH of a low acid food, separate the low acid portion from the acidifying portion and prepare and measure the two samples individually.

When measuring the pH of a prepared sample, follow the instructions of the pH meter manufacturer carefully. In any case, follow these guidelines:

- Calibrate the pH meter using two buffers, usually pH 4 and pH 7.
- Make sure the temperature compensation is properly set.
- Rinse the electrodes with distilled water between readings. Pat dry with tissue. **CAUTION: DO NOT RUB THE ELECTRODES WITH THE TISSUE AS THIS WILL PRODUCE A STATIC CHARGE AND RESULT IN IMPROPER READINGS.**
- Stir samples while measuring. Record pH only after readings stabilize.
- Products that have a high oil content may clog the electrodes. After testing such products, clean electrodes in alcohol or as recommended by the manufacturer.
- Store the electrodes with tips submerged in distilled water or buffer as directed by the manufacturer.

Controlling Spoilage

Properly acidifying to pH 4.6 or below will inhibit the growth and formation of toxins from the bacteria that causes botulism. Acidification cannot replace proper sanitation and care in manufacturing. The manufacturer must, therefore, adhere to the highest standards of cleanliness and protection of the product. These standards are covered under another regulation, 21CFR110, often called Good Manufacturing Practices.

When manufactured under proper conditions of acidification and sanitation, a food product may still be spoiled by yeasts and molds. To prevent this, acid and acidified foods are usually heated to kill yeast and mold spores in the products. They are then packaged hot to kill contaminants in the container. The amount of heat required to sterilize the product is dependent on the pH of the product. The minimum fill temperatures needed to sterilize products with different pH values are shown in Table 2. Products with a lower pH require a lower fill temperature since yeasts and molds are more susceptible to heat under acid conditions. The product should be cooled before placing in cardboard cases to avoid "stack burn."

Some products should not be heated. In these cases, preservation is achieved by increasing the levels of acid and/or the use of chemical preservatives. Sodium benzoate and potassium sorbate are often used for this purpose. They are often used together to take advantage of their combined effects.

Table 2. Effect of pH on fill temperature.

pH	Minimum fill temperature °F
3.9	185
4.1	190
4.2	195
4.3	205

Other Requirements

The potential for improper formulation in the manufacturing of acidified foods has been determined to be a public health hazard. To reduce the likelihood of foodborne illness, the acidified foods regulation requires plant registration and a scheduled process for each product must be filed with the FDA. The information filed must come from a recognized process authority who is qualified by training and experience. In addition, persons supervising the manufacturing of acidified foods must attend an approved school and earn certification as a supervisor for acidified foods. The regulation also addresses other important aspects of manufacturing such as monitoring and record keeping.

Labeling the Food

Regulations dealing with the food label are extensive and complicated. Before purchasing any labels, consult with regulatory authorities.

Where to Get Help

The Cooperative Extension Service, University of Arkansas, has an office in every county in the state. Faculty in these offices can help you obtain necessary information to get started processing acidified foods.

The Institute of Food Science and Engineering (IFSE), University of Arkansas, has processing authorities that can provide help in product formulation and processing procedures. In addition, they offer an approved certification course for supervisors of low acid processing facilities. For more information on services available from IFSE, contact your county Extension office or contact IFSE at:

272 Young Ave.
Fayetteville, AR 72703
Phone: 501-575-4040

The Arkansas Department of Health (ADH) has several requirements that affect the processing of acidified foods. For information on these, contact your County Sanitarian. Sanitarians are located in County Health Units, listed under the County Government section in most local phone books. If you are unable to reach your local sanitarian or if you need additional assistance beyond what they can supply, contact the Central Office, Division of Environmental Protection, Arkansas Department of Health, Little Rock (phone: 501-661-2171).

For information on process registration and filing processes, contact:

The Food and Drug Administration
LACF Registration Coordinator
Center for Food Safety and Applied Nutrition
200 C Street, S.W.
Washington, D.C. 20204

Suggested Reading

Acidified and Fermented Foods, Ralph Costilow. Pickle Packers International, Inc., St. Charles, IL 60174.

Canned Foods, Food Processors Institute, 1401 New York Ave. N.W., Suite 400, Washington D.C.

A Complete Course In Canning, A. Lopez. The Canning Trade, Inc., Baltimore, MD 21218-4576.

Guide to Formulating Acidified Foods

- Produce the foods using Good Manufacturing Practices.
- Carefully formulate to assure that sufficient acid is added to reach the desired pH below 4.6.
- Eliminate mold and yeast spoilage with “hot filling” and/or by using chemical preservatives.
- Register and properly file the scheduled process with FDA under the guidance of a recognized process authority.
- Monitor the pH and formulation carefully. Keep good records on each lot produced.

For additional information, contact your county Extension agent or:

Institute of Food Science and Engineering
272 Young Avenue
Fayetteville, AR 72704
501-575-4040 Fax 501-575-2165

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