

Acid, Low acid, and Acidified Foods

What is The Difference ?

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Reference used: FDA DHRD Training



Introduction to acid, acidified and low acid foods: Microorganisms

- Microorganisms are found everywhere including soil, water, raw foods, humans etc. many are essential to life few are pathogenic.
- Pathogens of concern in acidified and LACF are bacteria, Molds and yeast indirectly affect safety.
- Infection is caused by the growth of pathogens in the host, symptoms can be delayed, intoxication is from the consumption of foods containing toxins from growth, symptoms often immediate.
- Useful microorganisms can ferment foods, produce enzymes, antibiotics, alcohol and break down organic matter.

Microorganisms continued

- Molds are larger than bacteria, multicellular, widely found in nature, survive on many substances and have economic rather than pathogenic significance in foods.
- Molds generally not heat tolerant but spores may be, need O₂ food and moisture. Can grow in pH of 3.0 and can consume acids.
- Molds can ripen cheese, produce enzymes, antibiotics and breakdown organic matter.



Microorganisms: Yeasts

- Unicellular, smaller than molds larger than bacteria, widely found in nature and pose no direct threat in processed foods.
- Low temperature resistance, alcohol and CO₂ are by products of yeast growth.
- Commonly associated with liquids containing sugars and acids and can grow at pH as low as 3.0



Microorganisms: bacteria

- Single cell, many shapes and forms, can excrete enzymes or toxins, some can form spores, pathogenic ones can be spore or non spore forming.
- Smallest living organism, 500 thousand billion=1 pound, 5 billion cells in a pint visible turbidity.
- Reproduce by dividing, optimum conditions every 20 minutes, 75,000 on a conveyor=300,000 after an hour.
- Spores are resistant to heat, cold, chemicals and drying. Vegetative cells are sensitive to temperature extremes, chemicals and drying.



Microorganisms: bacteria

- Bacteria need food, moisture, O₂, temperature and pH to grow.
- Sugars, carbohydrates proteins commonly utilized as food.
- Nutrients have to be in water soluble form to enter cell walls.
- Aerobes need O₂, anaerobes can't grow in O₂ facultative anaerobes can grow with or without, E. coli, Listeria, S. Aureus
- Temperature optimum for mesophiles 86-98 degrees F



Effects of pH on bacterial growth

- High acid concentrations and low pH denature proteins and thus inhibit or destroy bacteria by denaturing cell walls.
- Most bacteria have a narrow growth range that is optimum at pH near 7.0.
- Some groups of bacteria will grow at pH below 4.6 but none are a public health threat.



Botulism

- Illness caused by *Clostridium botulinum*.
- *C. botulinum* produces a deadly toxin.
- Several types found in soil and water.
- Some consume proteins (proteolytic), and are putrefactive (sulfide stinkers).
- Some consume carbohydrates (sugars) and produce no odors.



Clostridium botulinum

- Only the vegetative cells produce toxin, the spores are dormant. Vegetative cells are destroyed by heat treatment.
- Some spores can survive for 5-10 hours in boiling water.
- *C. botulinum* toxin is not heat resistant.



Clostridium Botulinum

- Various types and strains; proteolytic types includes A, and strains of B, and F. Non –proteolytic types include E and strains of B and F.
- All types are anaerobic spore formers.
- All C. botulinum spores survive the heat treatment of acidified food processing.



Effect of pH on Clostridium botulinum spores

- Spores of Clostridium botulinum will not germinate in foods with a finished equilibrium pH at or below 4.6.
- Equilibrium pH is the point at which the solid and liquid parts of a product have the same pH.
- C-botulinum type E and non-proteolytic B & F are mesophiles but can grow and produce toxins as low as 38 degrees F.



Microorganisms: Preservatives and Water Activity

- Salting oldest food preservation method but some bacteria salt tolerant, but those salt tolerant ones don't grow in low pH.
- Salt reduces water activity (binds water) so it is unavailable to microorganisms, salt may inhibit molds at 5-10% concentration.
- Water activity is measure of free moisture in product (available for growth) availability measured by water activity and is affected by binding ingredients like salt and sugars.
- All C-botulinum spores inhibited by W_a lower than 0.86
- Staph aureus growth & toxin formation inhibited by W_a lower than 0.86

Acid, Low Acid, Acidified Foods

- Acid foods are those which have a natural pH of 4.6 or less (fruits, tomato etc.).
- Natural pH prior to processing (less than 4.6).
- Acid foods may become low acid foods during processing.
- Examples, lye peeled tomatoes or fermented products where salt is removed.



Acid Foods

- Acid foods may become low acid foods during processing.
- If the pH of acid foods or fermented foods is increased during production and acid is added to lower the pH to 4.6 or below, product is an acidified food.



Fermented Foods

- Are low acid foods subjected to the action of certain microorganisms which produce acid during their growth reducing the pH of the food to 4.6 or below.
- They may be partially desalted, processed, or preserved in the original salt brine or in a new brine/vinegar solution with other ingredients.



Fermented Foods

- Fermentation is accomplished in a salt brine. Most cases, more salt, longer time to reduce the pH.
- Examples: most green olives, sauerkraut, some types of pickles, specifically cucumbers which are packed and held in a salt brine only.



What Is A Low Acid Canned Food

Has the following characteristics:

- Equilibrium pH value greater than 4.6 and water activity greater than 0.85.
- Sealed in a hermetic (air tight) container (secure against the entry of microorganisms).
- Receives a heat treatment for the purpose of achieving commercial sterility.
- Normally stored and distributed non-refrigerated.
- Highly regulated, requires a scheduled process and registration. 21 CFR 114, 108.



Acidified Foods

- Low acid foods have a pH greater than 4.6, aw greater than 0.85 to which acid or acid foods are added.
- Finished product equilibrium pH of 4.6 or below
- Water activity greater than 0.85



Not Acidified By Interpretation

- Repacked acidified or fermented foods.
- Received in bulk.
- Repacked in fresh brine.
- Packer does nothing to raise the pH above 4.6.



Not Low Acid Foods

- Alcoholic beverages
- Tomatoes and tomato products with finished equilibrium pH less than 4.7
- Tomatoes and tomato products exempt from regulations, tomato sauce, paste, ketchup and tomato juice.



Not Acidified Foods Exempt From AF & LACF Regulations

- By definition:
- Carbonated Beverages.
- Jams, jellies, preserves.
- Refrigerated foods, ***must be appropriately labeled***.
- Water activity 0.85 or below.
- Acid foods, pH 4.6 and below.
- Fermented foods, pH reduced by bacteria, not addition of acid or acid foods.



Jams and Jellies exempt From Regulation

- Jams and jellies exempt from AF LACF regulation if they meet definition of a standardized food in 21 CFR 150
- Pepper jelly not a standardized food but may have a low water activity 0.85 or below.
- Jams and jellies with artificial sweeteners are required to have acid added to replace that lost from the natural fruit.



Not Acidified Foods (By Definition)

- Acid foods that may contain small amounts of low acid foods and have a resultant finished equilibrium pH that does not differ from that of the predominant acid or acid food (example salsa).
- SMALL AMOUNTS, rule of thumb less than 10% (CFR interpretation).
- Predominant acid or acid food determined by quantity/amount of acidity, ingredient characterizes food.



pH Values of Common Foods

- 3.0 to 4.6: berries, sauerkraut, plums, cherries, pineapple, pears, apricots, tomatoes.
- 4.6 to 7.0: fish, corn, meat, peas, asparagus, spinach, green beans, beets, carrots.



IS IT ACID LACF OR AF DETERMINATION

- Food Mfg responsible for determining and should have products evaluated to determine the status and have info on hand.
- Some cases may require FDA to determine, imports & small manufacturers
- Product name may provide indication, pickled, marinated, preserved, sour, sauce may indicate an acidified food.



IS IT LACF OR ACIDIFIED DETERMINATION

- Salted, preserved, sweet, in syrup may indicate an aw controlled product.
- Preserved, pickles or pickled could mean a fermented product.
- Product name, general conclusions:
- A drink will usually have a high aw.
- A paste will usually have a low aw.
- A sauce will usually have a higher aw.
- A concentrate will usually have a low aw.
- A pate will usually have a low aw.



IS IT LACF OR AF DETERMINATIONS

- Containers, cans usually hold LACF products, jars usually hold acidified foods, pouches usually hold LACF, paper board (juice boxes) usually hold LACF or acid foods.
- Vegetable products; tubers stems, leaves, seeds, nuts are usually low acid and may be LACF, AF or fermented.
- Fruits such as citrus, berries and apples are usually acid.



More LACF AF Determinations

- Tropical fruits like litchees, longans, papaya, jackfruit and bananas are often low acid and may be LACF or AF.
- Fragile veggies like peppers, cucumbers, cabbage, artichokes, onions, eggplant are usually AF or fermented
- Sauces are usually AF or formulated acid.
- Low acid foods packed in acid are usually LACF (sardines in tomato sauce).



Some Problem Products

- ***Caviar***, fish product, pH 5.7-6.0, canned shelf stable product, $W_a = .92$, not an LACF if shipped stored and held under refrigeration.
- ***Soy sauce***, pH 4.4-5.4, salt or low salt, W_a usually between 0.80 to less than 0.85
- ***Anchovies***, fish product, packed in cans, pH 6.5 this is a fermented product using saturated salt with a normal W_a of 0.75 shelf stable no thermal process..



More Examples

- ***Cucumber pickles***, packed in glass jars/cans/pouches/shelf stable. Fresh pack dills are acidified. Some may be packed in salt and fully fermented. Sweet pickles usually made from fermented pickles.
- ***Hot sauces***, no clear definition, may consist of several LA ingredients with vinegar or other acids. May have a low pH. May need case by case determination.



More Examples: Olives

- *Green olives*, harvested when green to straw color, olives turning color: rose, wine, brown, not fully ripe.
- *Black olives*, fully ripe or near, color reddish black, violet black, deep chestnut.
- *Styles of processing: American*, not ripe treated with lye to remove bitterness, turn black through oxidation (usually lacc).
- *Spanish*: yellow green treated with lye but keep color (fermented after treatment).
- *Greek*: naturally black, de-bittered with salt or brine (fermented or salt cured).

Example: shelf stable cherry pie filling, one acid food one acidified

- Cherries pH of 3.3, cherry juice 3.4 pH, starch pH greater than 4.6, Corn sweetener 4.0 pH, finished pH 3.5.
- Starch, pH >4.6, color pH > 4.6, artificial cherry flavor >4.6 pH, + citric acid=finished pH of 3.8, no characterizing ingredients, this is an acidified food product.

