FOOD PRESERVATION METHODS

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A food entrepreneur should have a basic understanding of the variables that impact food safety and stability. Understanding the impact of these variables in product or process design is crucial to delivering a food safe product with the desired shelf life. The glossary below provides a brief description of common preservation methods, followed by an overview of food safety concerns and associated mitigation strategies.

GLOSSARY: COMMON SCIENTIFIC TERMS ASSOCIATED WITH FOOD PRESERVATION

- **Ambient temperature**: Current environmental air temperature, also known as room temperature.
- **Anaerobic**: Absence of oxygen.
- **Clostridium Botulinum** (C. bot): A pathogenic bacterium that grows in anaerobic (absence of oxygen) environments and produces the neurotoxin that causes botulism. [4]
- **Modified Atmosphere Packaging (MAP)**: A packaging system that involves changing the gaseous atmosphere surrounding a food product inside a pack and using packaging materials and formats with an appropriate gas barrier to maintain the changed atmosphere inside the food package. [3]
- **Pasteurization:** A food processing method where a heat treatment is applied to a food to kill harmful (pathogenic) or spoilage microorganisms and extend shelf-life. [5] There are several types of pasteurization methods involving different time and temperature combinations which can vary by the type of food or beverage being processed. Common methods include:
    - Vat (Batch), with a typical time / temperature combination of 63oC (145oF) for 30 minute
    - Flash or High Temperature Short Time (HTST), with a typical time / temperature combination of 72oC (161oF) for 15 seconds. [10]
- **Pathogenic microorganisms (or Pathogens)**: Microorganisms (typically bacteria) that, when consumed, cause foodborne illness, via infection or intoxication. Common examples include Salmonella, Listeria, Escherichia Coli (E. Coli), and Clostridium Botulinum. [9]
- **pH**: A measure of the acidity of a food, scaling from 0-14. Foods with a pH < 7.0 are acidic, foods with a pH > 7.0 are basic or alkaline, and foods with a pH of approximately 7.0 are neutral.
- **Shelf Life**: “The time period during which a food manufacturer expects the product will deliver the desired experience to the consumer.” [6]
- **Spoilage microorganisms**: Microorganisms (bacteria, yeasts, molds) that cause food quality to deteriorate, resulting in unpleasant odors, flavors, textures, and appearances.
- **Thermal Process**: A commercial technique of applying heat to a food product to destroy pathogenic and spoilage-inducing microorganisms. When used as a preservation technique to achieve shelf stability, the process must be documented and approved by a qualified process authority.
- **UHT or Ultra High Temperature Processing**: Used for low acid food products with a pH > 4.6 and involves heating the product to over 135oC (275oF) for a few seconds to destroy all microorganisms, resulting in a commercially sterile product suitable for ambient distribution. [7]
- **Validated, Validation or Process Validation**: A scientific evaluation providing documented evidence that a particular process (e.g., cooking, frying, extrusion, etc.) is capable of consistently delivering a desired effect to ensure the destruction of pathogenic microorganisms. [8]
- **Water Activity (commonly abbreviated to Aw or aw)**: A measure of the amount of unbound water in a food, describing the energy status of the water. Water not bound to ingredients can be used by microorganisms, leading to pathogenic or spoilage-inducing microorganism growth. Water activity is measured on a scale that runs from 0.0 to 1.0. It is related to, but not the same as, the water content in a food.

FOOD	USUAL PRESERVATION SYSTEM [1,2]
Raw Meat	Chilling reduces microbial growth rate. Vacuum/modified atmosphere packaging (MAP) can extend shelf life but increases risk of anaerobic pathogen growth (e.g., Clostridium botulinum, or C. bot).
Raw Vegetables/Salad/Sprouted Seeds	Chilled storage will extend shelf life. May be packaged in MAP to extend shelf life, but increases risk of anaerobic pathogen growth (e.g., C. bot).
Fruit and Fruit Juices	Low pH and chilled storage will extend shelf life.
Dairy Products	Pasteurization and chilling extend shelf life. Ultra-high temperature processing (UHT) will deliver a long ambient/room temp shelf life.
Processed Foods (Ready-to-eat [RTE] or to be re-heated)	Chilling will extend shelf life. This will act in concert with other factors such as salt level, pH, preservatives, and packaging to give a unique, though short, shelf life. This must be validated as being safe for each product.
Heat treated, low pH (< 4.6) or intermediate moisture foods	A combination of low pH, high sugar, salt and thermal processing will extend shelf life. Must be validated to ensure food safety. Examples include cured meats, products in oil, pickles, sauces, jams
Intermediate Moisture Foods	Foods with an Aw between 0.60 and 0.85 do not require refrigeration or another barrier to control pathogen growth but may have limited shelf life due to spoilage, mainly from yeasts and molds. Heat treatment or pasteurization immediately before packing may prevent spoilage. Preservatives may be considered to extend shelf-life. Examples include jams, some bakery items or granola bars, dried fruit, soy sauce.
Canned, pouched, or bottled food	Thermal process designed to deliver extended ambient/room temp shelf life by destroying resident microbiological flora. Must be validated as food safe.
Bakery Products	Baking reduces Aw, giving a short ambient/room temp shelf life. Baked products may be packed in MAP to further extend shelf life but increases the risk of anaerobic pathogen growth (e.g., C. bot).
Dried Food (including raw, heat processed and those to be cooked)	Low Aw (< 0.60) limits the growth of microbes, delivering a long ambient/room temp shelf life. Examples include nuts, fruit, rice/pasta, breakfast cereals, herbs/spices, and confectionery.
Non-Dairy fats and oils	Long ambient/room temp shelf life is possible if processed, packaged and stored under appropriate conditions.
Soft and alcoholic drinks	Low pH is the primary method of soft drink preservation in combination with carbonation and preservatives such as benzoates and sorbates typically deliver extended soft drink ambient/room temp shelf life. Alcoholic drinks are preserved by presence of alcohol and other preservative compounds. Either may be pasteurized to improve safety and further extend shelf life.

For a more detailed description regarding how variables including water activity, pH, thermal processing, and distribution or storage temperature can prevent or delay spoilage and/or create a shelf-stable product that does not require refrigerated storage, refer to this resource from Purdue University Extension.

REFERENCES:

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