FOOD SCIENCE
FACT SHEET

Institute of Food Science + Technology



SHEET NUMBER 10

This Food Science Fact Sheet is one of a series compiled by Institute of Food Science and Technology, providing clear, concise and scientifically reliable information on key food science topics for consumers.

Food Preservation

Why are foods preserved?

To ensure it is safe to consume - food in long-term storage is at serious risk of growth of pathogenic microorganisms such as E.coli and Salmonella. If consumed these pathogens, or the toxins they produce, can cause food poisoning

To maintain quality - the taste, texture, appearance and nutritional value of food can deteriorate over time and reach a point where it is unacceptable for human consumption. Preservation can help retain some of these qualities

To reduce waste - there are financial and environmental costs associated with food waste. Preserving foods can increase shelf life and offers the opportunity to have a wide variety of foods all year-round

To impart a new flavour or texture - some preservation methods impart a desirable taste (e.g. smoked meats/gherkins) or texture (e.g. freeze-dried raspberries)

What causes food to spoil?

Microorganisms - bacteria, yeasts, moulds and fungi can grow in food and affect the appearance, odour, taste and texture. They require time and optimum temperatures to grow and reproduce. Pathogenic microorganisms, that cause food borne illness, may grow in foods without any noticeable changes. Many food preservation methods act to remove, kill or inhibit the growth of microorganisms

Enzymes - naturally present in foods, such as fruit and vegetables, are responsible for the ripening process and can impact colour, texture and flavour (e.g. colour change of bananas from yellow to brown; apples browning once cut)

Oxidation - occurs when food interacts with air, resulting in undesirable changes in colour, flavour and nutritional content. It also causes rancidity in fats

Light - can cause colour and vitamin losses and contribute to the oxidation of fats

Physical damage - bruises and cracks on raw produce, and damaged or poorly sealed packaging, can allow microorganisms, air and pests to enter

Pests - insects, rodents and parasites can damage food, making it vulnerable to further deterioration. They can also carry microorganisms and cause physical contamination

What are the common methods?

Chilling/refrigeration - low temperatures slow down the growth and reproduction of microorganisms and reduce enzyme action. Most harmful bacteria grow between 8 and 63°C, known as the 'danger zone' for microbial growth, hence domestic fridges operate between 0 and 5°C

Freezing - very low temperatures halt most microbial growth as water is locked away as ice, so oxidation and enzyme action are slowed down. Domestic freezers operate at minus 18°C. Commercial methods generally freeze foods very quickly to preserve nutrients, and so ice crystals do not have time to grow which could damage the food's structure. Examples include blast freezing (using high velocity cold air) and cryogenic freezing (immersion or spraying with refrigerant, e.g. liquid nitrogen)

Canning - foods are heated in sealed containers to kill microorganisms. The seal needs to be completely airtight to avoid re-entry of microbes e.g. baked beans

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Drying - removes moisture from food so bacteria, yeasts and moulds cannot grow, for example:

- **Oven/sun drying -** water evaporates in warm conditions e.g. sun-dried tomatoes
- **Drum drying -** wet foods are spread in a thin layer on the surface of heated rotating cylinders. Water evaporates from the food which is then removed from the cylinder and milled into flakes or powder e.g. instant mashed potato
- **Freeze drying -** food is frozen at low temperatures then placed in a vacuum. The low pressure vaporises the ice causing it to transition directly from a solid into a gas (sublimation) e.g. coffee powder, strawberry pieces

- **Spray drying -** liquid foods are dispersed using a spray nozzle, or atomiser, into a current of hot air. This causes water to evaporate producing a dry powder e.g. milk powder

Pasteurisation - a heat treatment process used for liquid foods, such as milk which is heated at 72°C for at least 15 seconds. Temperatures used are not high enough to kill bacterial spores and therefore the products still require refrigeration

Ultra-heat treatment (UHT) - liquid food (e.g. milk) is heated to 138 -150°C for one or two seconds, to destroy any microorganisms or spores that may be present. Packaged in sterile, hermetically sealed containers, UHT foods may be stored without refrigeration for months

Filtration - food is passed through a filter or membrane which removes microorganisms e.g. milk

Sugaring - a high-sugar environment stops bacterial growth by reducing the water content e.g. jams, jellies

Salting - high-salt concentrations draw water from food (e.g. fish) and stop microbial growth

Curing - the addition (to meat and fish) of a combination of sugar, salt (sodium chloride), nitrates and/or nitrites. The latter prevent the growth of pathogenic organisms, such as Clostridium botulinum, and produce a characteristic flavour and pink or red colour e.g. ham, bacon

Smoking - inhibits microorganisms by exposing the food to chemicals present in wood smoke and removing moisture needed for their growth e.g. salmon, kippers

Pickling - immersion of food in an acidic or salt solution (brine) to inhibit microorganisms e.g. onions

Fermentation - in the absence of oxygen, certain bacteria produce acid as a by-product which prevents the growth of pathogens e.g. sauerkraut, kimchi

Irradiation - food (e.g. herbs, spices) is passed through ionising radiation which kills microorganisms, such as bacteria and moulds, and insect pests

Chemical preservatives - can be incorporated as food additives, such as antioxidants used to prevent wine oxidation (e.g. sulphites) and fat rancidity (e.g. rosemary extracts)

Vacuum packing - keeps food (e.g. nuts) in oxygen-free conditions to inhibit microbial growth

Modified atmosphere packaging (MAP) - alters the proportions of oxygen in the pack (e.g. beef mince) by replacing with inert gases, such as nitrogen, to inhibit microbial growth

Important considerations

Packaging - controls the immediate environment of a food product. It can protect food from damage, during transportation and storage, and provide a barrier to spoilage and disease-causing microorganisms and pests, as well as protecting from oxygen, moisture, strong odours and light

Combined methods - e.g. preserving fruit by making jam involves: boiling to reduce the moisture content, inactivate enzymes and kill bacteria; sugaring to prevent their re-growth; sealing, in an airtight jar, to prevent recontamination

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