Principles of preservation

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Food deteriorates due to environmental conditions, physical damage and the action of enzymes, growth and multiplication of microorganisms. Principles of preservation are derived from knowing the conditions required by these spoilage agents (micro-organisms) for their action, growth and multiplication . The principles are based on striving to make these conditions unfavourable for the spoilage agents. This involves:

- Prevention or delay of microbial decomposition through sterile handling, filtration, drying, freezing or heating.
- Prevention or delay of self-decomposition of the product, e.g. by blanching, use of anti-oxidants.
- Prevent damage caused by poor handling, insects etc.

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Spoilage Agents

Enzymes
Enzymes are complex chemical substances, protein in nature and are found in all living organisms and tissues. They act as means of increasing chemical reactions and are responsible for changes that occur during ripening. For example, pectin is changed to pectic acid in overripe fruits. Action of enzymes also causes the cut surface of some vegetables and fruits to turn brown when exposed to air (enzymatic oxidation). Avocado is a good example of a fruit that turns brown when its cut surface is exposed to air.

Enzymes require moderate temperatures for their action. Extremely cold temperatures prevent their action temporarily but once the temperature is allowed to rise, they become active again. They are inactivated by high temperature.

3
Micro-organisms
Microorganisms responsible for food spoilage include bacteria, yeasts and moulds. They all need **food**, favourable **moisture** content and favourable **temperature** in order to grow and multiply. Most of them also require **air.**

Bacteria
These are single-celled organisms that grow and multiply best at temperatures between 20-40°C and 20-30% moisture content. Some types of bacteria produce desirable substances that improve flavour and keeping quality of the product. An example is lactic acid in sour milk. Others cause spoilage of food or produce highly toxic substances.

Examples of bacteria associated with food spoilage are salmonella, shigella, staphylococcus, bacillus and clostridium. Most bacteria are destroyed by high temperatures normally near boiling point of water (100°C) apart from those producing resistant spores. Such require temperatures in the region of 115°C. In this case a pressure cooker is required. Refrigeration slows down the rate of growth or makes them dormant but once the temperature rises to favourable conditions, they start growing again. Other conditions unfavourable for bacteria are high concentrations of salt, sugar and acids.

Yeasts
These are one-celled plants usually aerobic (require oxygen to survive). They grow well in acidic conditions and temperatures between 20-30°C. They are both useful and harmful in food. A useful role is fermentation in which enzymes produced by yeast cells convert sugar into alcohol and carbon dioxide. These are desirable in brewing and baking respectively. Yeasts are undesirable when they ferment fruits, fruit juices, honey etc. Yeasts are easily destroyed by temperature above 60°C.

Moulds or fungi
Moulds are multi-cellular fungi with filaments, which give them a fuzzy appearance when they are growing on food. They may appear white, dark or of various colours. They are aerobic and can grow in wide range of pH, from quite acidic to fairly alkaline (2.0-8.5). They grow most rapidly at temperatures of 20-35°C and in a moist, still atmosphere. They may grow with very little moisture.

Freezing temperatures arrest their growth but they will begin to grow when temperature rises during thawing of the food. Moulds are destroyed at temperatures slightly below boiling point (71-82°C). Since moulds are more adaptable to many conditions of acidity they are involved more in spoilage of preserved products if the products not properly stored.

Therefore, preservation methods are based on four main principles.

4
Moisture extraction
This is achieved through drying or dehydration either by solar heat or artificial heat. At village level, solar drying is normally practised. As much water as possible must be extracted so that the microorganisms are not able to grow or multiply inside the food during storage.

Temperature control
Cold temperatures inhibit growth and high temperatures destroy the spoilage agents and inactivate enzymes. At household level, this is achieved by use of a refrigerator or boiling.

Creating unfavourable environment
This is achieved by use of chemical substances such as salt, acid and sugar, smoke and other permitted additives. These are used either alone or in combination. This principle is used in preparation of jam, juice, syrups, sauces, chutneys, pickles, etc.

Air removal
This is achieved during processing when jars containing the food to be preserved are boiled. The water vapour produced during boiling pushes the air out since jars lids partly unscrewed during the boiling. Since the microorganisms are destroyed during the boiling process and air is pushed out, the preserved food can remain good for a long time.

Preservation in glass jars is not very practical at household level since the glass jars required are expensive and one would require many of them to do substantial preservation. Cheaper packaging material would have to be sought.