

Environmental Affects on Microbial Growth
Submitted by Lisa Janke

Objective: Develop background information on environmental conditions for microbial growth and relate to food preservation.

Outline: Environmental Growth Conditions for Microbial Growth

Microorganisms grow in a wide range of environments. Some like it hot while others like it cold. Some are acidic loving. Some require high moisture. Others do not. Some can tolerate high-salt (saline) environments. Many require the presence of oxygen, but some do not. [Discuss and ask for examples of methods of food processing and packaging].

A. Oxygen

1. Aerobic organisms-organisms that require gaseous oxygen
 - humans and animals
 - most microorganism
 - food may be coated in wax (ex: cheeses) or vacuum packaged in oxygen impermeable film

2. Anaerobic organisms-organisms that do not require gaseous oxygen
 - many bacteria live in oxygen-poor environments: ocean bottoms, sulfur-rich puddles in marshes and in sedimentation tanks of sewage-treatment plants
 - *clostridium botulinum* (botulism) improperly home-canned foods (low-acid, especially vulnerable)

B. Temperature Requirements

Different microorganisms grow at different ranges of temperatures. Many human-disease-causing microbes have an optimum temperature of 37°C (98.6°F). Many species of bacteria do not grow well at temperatures higher than 45°C. Some species can grow in hot springs and even at high temperature under conditions of high pressure. At the other extreme are microbes that can survive at 0°C or lower (inside your freezer). In general, a given species will have an optimum growth temperature and a range of temperatures under which it is capable of growth. Those organisms with a range from 0-25°C are called **psychrophiles**. Those with a range from 10-45°C are called **mesophiles** and those with a range of 25-80°C and above are called **thermophiles**.

- canning, freezing, refrigeration are all methods to control microorganisms

C. Moisture

Water is required to dissolve most cell substances that microorganisms use: minerals, ions, gases and numerous organic compounds. Some bacteria can survive under extremely dry conditions by forming spores.

- dehydration is a method to decrease water content (ex: jerky)

Formula used to determine amount of free water:

$$a_w = \text{water activity} = \frac{\text{vapor pressure of food}}{\text{vapor pressure of water}}$$

- a_w below 0.70 greatly reduces microbial growth
- Most bacteria grow at a_w 0.85-1.0.
- Many molds are osmotically tolerant and can grow at a a_w value of 0.6. This is why molds typically spoil cereal grains rather than bacteria.

D. Salt/Sugar Concentrations

Most microbes cannot survive environments in which there are such high concentrations of salt or sugar. Certain foods have long been preserved from spoilage by adding lots of salt and sugar to them. Salt and sugar tie up the water effectively reducing the a_w ; salt-cured ham and candied fruits are examples.

E. pH

A measure of the concentration of hydrogen ions in a solution is pH. The more hydrogen ions that a substance releases in a solution, the lower the pH of the solution, and the more acidic the solution. The values for pH range from 0-14, with 0 being the most acid and 14 being the most alkaline. The midpoint of the scale, 7, is referred to as neutral pH. Pure water has a pH of 7.

Most microorganisms grow best in a pH range between 6 and 8. Too much acid or base disrupts cellular activities. Therefore lowering the pH of processed food products is one method of preventing microbial growth.

ASSIGNMENT: Select a food and research a method of preserving that food choice. Write a detailed report on the steps of preserving the food. Carry out the selected preservation process on your food. Label food and store appropriately. Save it for use in later activity. This assignment is due at end of unit one.