

Factors affecting heat destruction of microorganisms

Several factors associated with microorganisms as well as their environment affect heat destruction of microorganisms.

Water: Heat resistance of microorganisms increases with decrease in moisture/ water activity and humidity. This is due to faster denaturation of protein in presence of water than air.

Fat: Heat resistance increases in presence of fat due to direct effect of fat on cell moisture. Heat protective effect of long chain fatty acids is better than short chain fatty acids.

Salts: Effect of salt in heat resistance of microorganisms is variable, and depends on type of salt, concentration used, and other factors. Some salts (sodium salts) have protective effect on microorganisms and others (Ca^{2+} and Mg^{2+}) make cells more sensitive. Some salts (Ca and Mg) increase water activity, while others (Na^+) decrease water activity there by affecting heat sensitivity.

Carbohydrates: Presence of sugars in suspending medium increases heat resistance of microorganisms due to decreased aw. Different sugars show varying effect. Heat resistance decreases in the order of; sucrose>glucose>sorbitol>fructose>glycerol.

pH: Microorganisms are most heat resistant to heat at their optimum pH for growth (about pH 7-0). Increase or decrease in pH reduces heat sensitivity. Thus, high acid foods require less heat processing than low acid foods.

Proteins: Proteins have protective effect on microorganisms. As a result high protein foods need a higher heat treatment than low protein foods to obtain similar results.

Number of microorganisms: Larger the number of microorganisms, higher the degree of heat resistance. This is due to the production of protective substance excreted by bacterial cells, and natural variations in a microbial population to heat resistance.

Age of microorganisms: Microorganisms are most resistant to heat in stationery growth and least in logarithmic growth phase. Also old bacterial spores are more resistant than young spores.

Growth temperature: Heat resistant of microorganisms increases with increase in incubation temperature, especially in spore formers. This is mainly related to genetic selection favoring growth of heat resistant forms. Cultures grown at 44°C are known to have three times more heat resistance than those grown at 35°C .

Inhibiting compounds: Heat resistance of most microorganisms decreases in the presence of heat resistant microbial inhibitor such as antibiotic (nisin), sulfur dioxide etc. Heat and inhibiting substances together are more effective in controlling spoilage of foods than either alone.

Time and temperature: Generally believed that the longer the heating time, greater the killing effect. But higher the temperature, greater will be the killing effect. Thus, as temperature increases, time necessary to achieve the same effect decreases. Also, the size and composition of containers affect heat penetration.