

Temperature Requirements

As with pH, all bacteria have an optimum temperature range for growth. Temperatures below and above the optimum for each group adversely affect the growth of the organism; all bacteria have a minimum and a maximum temperature below or above which the organism cannot grow. Bacterial groups bear names that indicate their relationships to temperature – psychrophile, psychrotroph, mesophile, thermophile.

The psychrophilic and psychrotrophic group

The terms psychrophile and psychrotroph are sometimes used interchangeably, but the groups are distinguished by their optimum growth temperatures and temperature ranges. Both psychrophiles and psychrotrophs grow over the temperature range of subzero to 68°F (20°C). True psychrophilic bacteria (“psychro” for “cold,” “phile” for “loving”) have an optimum temperature of 59°F (15°C) and cannot grow above 77°F (25°C). Psychrotrophic bacteria generally grow best at around 77°F (25°C), or even mesophilic temperatures (see below), but can grow slowly in or on food at refrigerator temperatures (around 40°F (4°C)). These organisms are primarily responsible for spoilage of refrigerated foods. *L. monocytogenes* and some strains of *C. botulinum* (*C. botulinum* type E and non-proteolytic strains of type B and F) are considered to be psychrotrophs. None of these bacteria – except perhaps the strains of *C. botulinum* – is of concern to low-acid or acidified canned foods.

The mesophilic group

Mesophilic bacteria grow best at temperatures of 86°F to 104°F (30°C to 40°C) (the normal range of warehouse temperatures, depending on geographic locations), although some mesophiles grow well at higher temperatures such as 116°F (46.7°C). All of the bacteria that affect food safety grow within this mesophilic temperature range, although some may be considered psychrotrophic as well. The sporeforming organism *C. botulinum* is a member of this group, although some strains are considered psychrotrophs (see above).

The thermophilic group

Thermophiles (“thermo” for heat, “phile” for loving) are bacteria that grow at high temperatures. Thermophilic bacteria are found in soil, manure, compost piles, and even hot springs. Many are sporeforming bacteria and are divided into two groups based on the temperature at which the spores will germinate and grow. If the spores will not germinate and grow below 122°F (50°C), the bacteria are called obligate thermophiles, i.e., the high growth temperature is an absolute

requirement. If growth occurs at thermophilic temperatures of 122° to 150°F (50°C to 66°C) and at lower temperatures – e.g., about 100°F (38°C) – the bacteria are called facultative thermophiles, meaning they have the ability to grow at both temperature ranges.

Some of the obligate thermophiles can grow at temperatures up to 170°F (77°C). Laboratory tests have indicated that the spores of these bacteria are so heat-resistant that they can survive for more than 60 minutes at temperatures of 250°F (121°C). Thermophilic bacteria are not pathogenic and do not produce toxins during spoilage of foods; therefore, they do not affect food safety.