

FOOD PATHOGEN CONTROL DATA SUMMARY

Microorganism	Contribution to Hazard Control Logic
<p>1. <i>Yersinia enterocolitica</i> Temperature range for growth = 29.3° - 111°F (-1.5° - 44°C) (Hudson et al., 1994; Sutherland and Varnham, 1977)</p> <p>pH range for growth = 4.6 - 9.0 (Stern et al., 1980)</p> <p>G [32°F (0°C)] = 53 hours (Hanna et al., 1977a) G [41°F (5°C)] = 17 hours in raw beef (Hanna et al., 1977a) G [77°F (25°C)] = 1.3 hours in cooked beef, after 6-24 hour lag period (Hanna et al., 1977a)</p> <p>D [145°F (62.8°C)] = 0.24 - 0.96 minutes (Lovett et al., 1982)</p> <p>2. <i>Listeria monocytogenes</i> Temperature range for growth = 29.3° to 112°F (-1.5° to 44°C) (Hudson et al., 1994; Grau and Vanderline, 1990; Khan et al., 1972; Lovett, 1989)</p> <p>pH range for growth = 4.5 - 9.5 (Lovett, 1989)</p> <p>G [32°F (0°C)] = 7.5 days on fatty tissue of beef ((Grau and Vanderline, 1990) G [95°F (35°C)] = 41 min. in skim, whole, chocolate milk and whipping cream (Rosenow and Marth, 1989)</p> <p>D [140°F (60°C)] = 2.85 minutes (USDA, FSIS. 1990)</p>	<p>1. & 2. <i>Yersinia enterocolitica</i> and <i>Listeria monocytogenes</i> are capable of multiplication at 29.3°F (-1.5°C). <i>Listeria monocytogenes</i> and <i>Yersinia enterocolitica</i> can multiply about 1 time every day at 40°F (4.4°C). Since this temperature is becoming the standard for refrigerated storage, in order to prevent growth of this pathogen to a hazardous level, there must also be a designated time for storing products at this temperature. The tolerance level of safety for pathogenic multiplication has been set by HITM at 5 generations (1:32). The 5 generation multiplication is selected because multiplication of 1 to 32 is a minimal threat with the normal level of food contamination and preventing multiplication at 40°F (4.4°C) is not possible. This generation time allows a holding time of 5 days at 41°F (5°C). During this time, most raw food will spoil (change in flavor and texture) due to the growth of psychrotrophic spoilage bacteria which multiply, perhaps, twice as fast. In actual practice, food pre-preparation should begin the day before it is served so that if the food is allowed to warm to 50°F (10°C) during pre-preparation, it may then be placed in a traditional, large tub in a refrigeration unit for 12 hours (over night) before it is used the next morning. During this refrigerated storage period it will cool only a few degrees, yet it will remain non-hazardous because there is not sufficient time for pathogens to double to hazardous levels. (This practice has been standard since the advent of refrigeration.) This means that if foods are stored in refrigeration units at temperatures at 41°F (5°C), they must be cooked or used within 5 days to assure that vegetative cells of pathogenic bacteria are in range that will not cause illness or disease. . If 10 <i>Listeria monocytogenes</i> / gram of food (a rather high contamination level) multiplied to 160 (4 generations) vegetative cells, the 7D <i>Salmonella</i> spp. pasteurization treatment is sufficient to effect inactivation of <i>Listeria monocytogenes</i> to a safe level. If raw foods (e.g. fruits and vegetables) with a moderate level of contamination are washed thoroughly prior to consumption pathogenic bacterial populations can be reduced from 100 / gram to 1 / gram. This level is below the 1,000 <i>Listeria monocytogenes</i> per gram that seems necessary to make healthy people ill</p>
<p>3. <i>Clostridium botulinum</i> - Type E an other non-proteolytic strains Temperature range for growth = 38° - 113°F (3.3° - 45°C) (Hauschild, 1989) pH range for growth = 5.0 - 9.0 (Hauschild, 1989)</p> <p>Minimal water activity (a_w) for growth = 0.97 (Hauschild, 1989)</p> <p><u>Spores</u> D [180°F (82.2°C)] = 0.49 - 0.74 min. (Lynt et al., 1982)</p> <p><u>Neurotoxin</u> D [185°F (85°C)] = 5 minutes for any botulin toxin (Woodburn, et al., 1979)</p>	<p>3. The fact that non-proteolytic types of <i>Clostridium botulinum</i> begin to multiply at 38°F (3.3°C) dictates that any pasteurized, chilled food to be stored longer than 5 days must be stored at temperatures below 38°F (3.3°C) for absolute safety. In order to inactivate the spores of type E and nonproteolytic strains of <i>Clostridium botulinum</i> food must be heated to 180°F (82.2°C) for 15 minutes. The toxin is destroyed by heating food to temperatures above 180°F (82.2°C) for a few minutes. If food preparers bring all food to a boil when preparing it for consumption, this pathogen becomes less of a hazard, because any pre-formed toxin is inactivated.</p>

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<p>4. <i>Bacillus cereus</i> Temperature range for growth = 39.2° - 122°F (4° - 50°C) (van Netten, et al., 1990; Kramer and Gilbert., 1989) pH range for growth = 4.3 - 9.0 (Kramer and Gilbert, 1989) Minimal water activity (a_w) for growth = 0.912 (Bryan et al., 1981) <u>Vegetative cells</u> G [86°F (30°C)] = 27 minutes in pasteurized milk (Wong et al., 1988) D [140°F (60°C)] = 1 minute (Kramer and Gilbert, 1979) <u>Spores</u> D [212°F (100°C)] = 2.7 - 3.1 minutes (Kramer and Gilbert, 1979) <u>Toxin destruction</u> Diarrheal: D [133°F (56.1°C)] = 5 min. (Kramer and Gilbert, 1979) Emetic: Stable at [249.8°F (121°C)] (Kramer and Gilbert, 1979)</p>	<p>4. <i>Bacillus cereus</i> spores are found in many foods (eg. milk, corn starch, rice, dried legumes, and spices). Vegetative cells of some strains of this microorganism begin to multiply at 39.2°F (4°C). There are also a number of other psychrophilic strains of <i>Bacillus</i> spp. (not <i>Bacillus cereus</i>) that will survive cooking and can multiply in food and cause spoilage in products at temperatures below 38°F (3.3°C). The foodborne illness produced by the growth of this pathogen in food is usually not life threatening, however its onset and duration are quite uncomfortable. Reheating leftover foods in which this bacteria may have grown and produced toxin does not insure its safety because the emetic toxin produced by <i>Bacillus cereus</i> is very heat stabile. The rule for holding food at 41°F (5°C) for < 5 days will control the <i>Bacillus cereus</i> hazard. For long term chilled food storage, pasteurized chilled food products must be stored at < 38°F (3.3°C). Note: Although the growth of <i>Bacillus cereus</i> was shown to occur at 131°F (55°C) in studies reported by Johnson et al. (1983), no other research has demonstrated growth at this temperature. Therefore, growth of <i>C. perfringens</i> at 127.5°F (52.3°C) will be used as the upper limit bench mark for pathogen growth.</p>
<p>5. <i>Salmonella</i> spp. Temperature range for growth = 41.5° - 114°F (5.5° -45.6°C) (Matches and Liston, 1968; Angelotti et al., 1961a) pH range for growth = 4.1 - 9.0 (Silliker, 1982) Minimal water activity (a_w) for growth = 0.95 (Sperber, 1983) G [104°F (40°C)] = 25 minutes in barbecued chicken (Pivnick et al., 1968) D[140°F (60°C)] = 1.73 minutes (9CFR 1987, 318.17)</p>	<p>5. A pH of 4.6 is not an adequate control in pasteurized food. Some <i>Salmonella</i> spp., can begin to multiply at 4.1 pH. If potentially hazardous egg supplies (whole shell eggs or unpasteurized liquid eggs) are used in the production dressings and sauces, the safe pH for salad dressings and pasteurized foods must be set at ph 4.1 or less, if they are to be displayed and dispensed at room temperature. Acetic acid (vinegar) and citric acid (lemon juice) are used to cause the destruction of vegetative cells of <i>Salmonella</i> when salad dressings and mayonnaise are prepared commercially. When the product pH is less than pH 4.1, due to the addition of vinegar (acetic acid), and the dressings and mayonnaise are held at room temperature for a few days, <i>Salmonella</i> spp. are inactivated (Smittle, 1977). Other organic acids do not function as effectively as acetic acid. The outside of many fruits such as melons can become contaminated with <i>Salmonella</i> during growing and distribution. The salmonellae will not multiply on the surface because of lack of nutrients and moisture, but will survive on the surface for 7 to 14 days. When the melons are cut, the salmonellae are spread to the interior of the melon and can multiply about as fast on the flesh of the melon as on meat. If the melons and other fruits are kept at 40° (4.4°C), there will be no multiplication of <i>Salmonella</i> spp. Because the thermal destruction <i>Salmonella</i> spp. is well defined, the $7D_{140°F} = 12.1$ minutes and $Z = 10°F$ values are used as the standards for pasteurization times and temperatures for pasteurized foods. While <i>Staphylococcus aureus</i> and <i>Listeria monocytogenes</i> are more resistant to thermal destruction, they are not used as the thermal destruction standard because people can consume larger numbers of these types of vegetative cells before becoming ill. It appears that <i>Salmonella</i> spp. must be reduced to < 1/25 grams of food in order to assure safety to immune-compromised people.</p>

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<p>6. <i>Vibrio parahaemolyticus</i> 41° - 109.4°F (5° - 43°C) (Twedt, 1989)</p> <p>pH range for growth = 4.5 - 11.0 (Twedt, 1989)</p> <p>Minimal water activity (a_w) for growth = 0.937 (Twedt, 1989)</p> <p>G [98.6°F (37°C)] = 7.6 minutes in squid (Lee, 1973; Aiso, 1967)</p> <p>D [116°F (47°C)] = 0.8 - 48 minutes (Beuchat and Worthington, 1976; Beuchat, 1982)</p>	<p>6. <i>Vibrio parahaemolyticus</i> is a pathogenic bacteria that is commonly present in raw fish and seafood. The hazard is that this bacteria can multiply once every 7 to 8 minutes under ideal conditions [95°F (35°C)] that occur in warm kitchens and street vending operations. Hence, it can multiply to a hazardous level in 2 to 3 hours at 90°F (32.2°C). It is easily destroyed by the 7D <i>Salmonella</i> destruction standard. Storing food at 40°F (4.4°C) or below prevents the multiplication of this pathogen.</p>
<p>7. <i>Staphylococcus aureus</i> Temperature range for growth = 43.8° - 122°F (6.5° - 50°C) (Halpin-Dohnalek and Marth, 1989b)</p> <p>pH range for growth = 4.5 - 9.3 (Bergdoll, 1989)</p> <p>Minimal water activity (a_w) for growth = 0.83 (Sperber, 1989)</p> <p><u>Vegetative cells</u> G [98.6°F (37°C)] = 18.8 minutes in skim milk (Halpin-Dohnalek and Marth, 1989a)</p> <p>D [140°F (60°C)] = 5.2 - 7.8 minutes (Angelotti et al., 1961b)</p> <p><u>Toxin production</u> Temp. range for toxin production = 50°F - 114°F (0° - 46°C) (Tatini, 1973)</p> <p>pH range for toxin production = 5.15 - 9.0 (Scheusner, et al., 1973)</p> <p>Minimal water activity (a_w) for toxin production = 0.86 (Tatini, 1973)</p> <p><u>Toxin destruction</u> D [210°F (98.9°C)] = 2 hours, 14.2 minutes (Read and Bradshaw, 1966)</p>	<p>7. <i>Staphylococcus aureus</i> is more resistant to thermal destruction than <i>Listeria monocytogenes</i>. It is commonly found in raw foods, at levels of 10 - 100 vegetative cells per gram. The absence or complete destruction of <i>Staphylococcus aureus</i> is a good indicator of an effective pasteurization process. The presence of this pathogen can also be used to indicate post-process contamination due to poor personal hygiene and hand washing, and cross-contamination from other raw animal products. <i>Staphylococcus aureus</i> dictates cold food mixing temperatures because it does not produce toxin below 50°F (10°C). Therefore, moderately large volumes of salads can be safely mixed with ungloved, clean hands (which may still be shedding <i>Staphylococcus aureus</i>), if the ingredients are pre-cooled to 40°F (4.4°C) prior to mixing, and if the product temperature is kept below 50°F (10°C) before it is returned to the refrigeration unit to re-cool to less than 41°F (5°C). The toxin produced by the growth of <i>Staphylococcus aureus</i> in foods, like the toxin produced by <i>Bacillus cereus</i>, is heat-stable. Reheating food to 165°F (73.9°C) can not be used as a hazard control for general food processes. The controls are correct cooking, cooling, and cold holding of food.</p>
<p>8. <i>Clostridium botulinum</i> - Type A and proteolytic B strains Temperature range for growth = 50° - 118°F (10° - 47.8°C) (Hauchild, 1989)</p> <p>G = [68°F (20°C)] = 1.2 hours in pork slurry (Type A) (Gibson et al., 1987)</p> <p>pH range for growth = 4.6 - 9.0 (Hauchild, 1989)</p> <p>Minimal water activity (a_w) for growth = 0.94 (Hauchild, 1989)</p> <p><u>Spores</u> D [250°F (121.1°C)] = 0.3 - 0.23 min. for A, B (proteolytic) (Lynt et al., 1982)</p> <p><u>Neurotoxin</u> D [185°F (85°C)] = 5 minutes for any botulin toxin (Woodburn et al., 1982)</p>	<p>8. Type A and type B proteolytic <i>Clostridium botulinum</i> begin to grow and produce toxin at 50°F (10°C). This fact demands that no food capable of containing this micro be stored or displayed in anaerobic conditions (an oxygen reduction potential of <+200 mv above 50°F (10°C)). This is particularly important for plastic wrapped vegetables which become anaerobic and where enough toxin can be formed in 2 or 3 days at 75°F (23.9°C) to kill a person. The toxins produced by both proteolytic and non-proteolytic strains of <i>Clostridium botulinum</i> are inactivated at boiling temperatures. When foods are brought to a boil [212°F (100°C)], the toxin is inactivated and the food becomes safe to consume.</p>

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<p>9. <i>Clostridium perfringens</i> Temperature range for growth = 59° - 127.5°F (15° - 52.3°C) (Labbe, 1989; Shoemaker and Pierson, 1976) pH range for growth = 5.0 - 9.0 (Fuchs and Bonde, 1957) Minimal water activity (a_w) for growth = 0.95 (Labbe, 1989)</p> <p><u>Vegetative cells</u> G [105.8°F (41°C)] = 7.0 minutes (Willardson, et al., 1978) D [138°F (59°C)] = 7.2 minutes (Roy, et al., 1981)</p> <p><u>Spores</u> D [210°F (98.9°C)] = 26-31 minutes (Bradshaw, et al., 1977)</p>	<p>9. <i>Clostridium perfringens</i> is important in determining hazard control standards for 3 reasons:</p> <ul style="list-style-type: none"> • It is the fastest multiplying pathogen to consider during heating of food products. Therefore it dictates the maximum slow rate of heating foods from 40°F to >130°F (4.4°C to >54.4°C) in < 6 hours. • Because the spores of <i>C. perfringens</i> are not inactivated in normal pasteurization, <i>C. perfringens</i> dictates the time for continuous cooling of food from 130°F to 45°F (54.4°C to 7.2°C) be within < 15 hours. [The FDA 1995 and 1997 Food Codes recommend a cooling time of 6 hours for cooling food to 41°F (5°C) [from 140°F to 70°F (60°C to 21°C) in 2 hours and 70°F to 41°F (21°C to 5°C) in 4 hours]. • <i>Clostridium perfringens</i> sets the high temperature growth control standard at 127.5°F (53°C) by virtue of the Phoenix phenomenon, whereby it can be grown in the laboratory up to this temperature.
<p>10. <i>Campylobacter jejuni</i> Temperature range for growth = 90° - 113°F (30° - 45°C) (Doyle and Roman, 1981) pH range for growth = 4.9 - 8.0 (Doyle and Roman, 1981) G [107.6°F (42°C)] = 50 minutes in egg yolk (Clark and Bueschkins, 1986) D [137°F (58.3°C)] = 12 - 21 seconds (Koidis and Doyle, 1983)</p>	<p>10. <i>Campylobacter jejuni</i> is easily inactivated by heating and it is doubtful that it will multiply in food. Yet, indications are that this microorganism is the leading cause of foodborne illness. The hazard is that a dose of < 500 vegetative cells can cause illness in a healthy person. This pathogen is often found to be present in poultry, frequently at levels of >10,000 /g. The incidence of this pathogen dictates the cleaning and sanitizing standard for food contact surfaces. Food contact surfaces are safe when the surfaces are cleaned and sanitized, reducing a population of 1,000,000 <i>Campylobacter jejuni</i> per 8 inches² to < 100 per 8 inches².</p>

References for Food Pathogen Control Data Summary

- Aiso, K. 1967 Generation time of *Vibrio parahaemolyticus* and the growth in contaminated foods. pp. 345-350 in *Vibrio parahaemolyticus* II. Fujino, T., and Fukumi, N. Tokyo, Japan.
- Angelotti, R., Foter, M.J., and Lewis, K.H. 1961a. Time-temperature effects on Salmonellae and Staphylococci in Foods. I. Behavior in refrigerated foods. II. Behavior at warm holding temperatures. Am J. Pub. Health 51: 83.
- Angelotti, R., Foter, M.J., and Lewis, K.H. 1961b. Time-temperature effects on Salmonellae and Staphylococci in Foods. III. Thermal death time studies. Appl. Microbiol. 9: 308-315.
- Bergdoll, M.D. 1989. *Staphylococcus aureus*. In Foodborne Bacterial Pathogens. Doyle, M.P. ed. pp. 463-523. Marcel Dekker. New York, NY.
- Beuchat, L.R. and Worthington, R.E. 1976. Relationship between heat resistance and phospholipid fatty acid composition of *Vibrio parahaemolyticus*: Appl. Environ. Microbiol. 31:80-83.
- Beuchat, L.R. 1982. *Vibrio parahaemolyticus*: Public health significance. Food Technol. 36(3); 80.
- Bradshaw, J.G., Peeler, J.T., Coorwing, J.J., Hunt, J.M., Tierney, J.T., Larken, E.P., and Twedt, R.M. 1985. Thermal resistance of *Listeria monocytogenes* in milk. J. Food Protect. 48:743-745.
- Bradshaw, J.G., Peeler, J.T., and Twedt, R.M. 1977. Thermal inactivation of ileal loop-reactive *Clostridium perfringens* type A strains in phosphate buffer and beef gravy. Appl. Environ. Microbiol. 34: 280-284.
- Bryan, F.L., Bartleson, C.A. and Christopherson, N. 1981. Hazard analyses, in reference to *Bacillus cereus*, of boiled and fried rice in Cantonese-Style restaurants. J. Food Protect. 44(7): 500:512.°
- Clark, A.G., and Bueschkins, D.H. 1986. Survival and growth of *Campylobacter jejuni* in egg yolk and albumen. J. Food Protect. 49: 135-144)
- Code of Federal Regulations (CFR) 9. 1987. 318.17 Requirements for the production of cooked beef, roast beef, roast beef, and cooked corned beef. Office of Federal Register National Archives and Records and Administration.
- Doyle, M.P. and Roman, D.J. 1981. Growth and survival of *Campylobacter fetus* subsp. *jejuni* as a function of temperature and pH. J. Food Protect. 44(8): 596-601

- Faber, J.M., Coates, F. and Daley, E. 1992. Minimum water activity requirements for the growth of *Listeria monocytogenes*. Letters in App. Microbiol. 15:103-105.
- FDA (Food and Drug Administration). 1995. Food Code. U.S. Public Health Service, U.S. Dept. of Commerce. Technology Administration, National Technical Information Service. Pub. No. PB95-265492CEH. Springfield, VA.
- FDA (Food and Drug Administration). 1997. Food Code. U.S. Public Health Service, U.S. Dept. of Health and Human Services. Pub. No. PB97-141204. Washington, D.C.
- Fuchs, A and Bonde, G.J. 1957. The nutritional requirements of *Clostridium perfringens*. J. Gen. Microbiol. 34: 280-284.
- Grau, F.H., and Vanderline, P.B. 1990. Growth of *Listeria monocytogenes* on vacuum packaged beef. J. Food Protect. 53(9): 452-459.
- Halpin-Dohnalek, M. I., and Marth, E.H. 1989a. Growth of *Staphylococcus aureus* in milks and cream with various amount of milk fat. J. Food Protect. 52(8):540-543.
- Halpin-Dohnalek, M.I., and Marth, E.H. 1989b. *Staphylococcus aureus*: Production of extracellular compounds and behavior in foods. - A review. J. Food Protect. 52(4): 267.
- Hanna, M.O., Stewart, J.C., Carpenter, Z.I., and Vanderzant, C. 1977a. Effect of heating, freezing, and pH on *Yersinia enterocolitica*-like organisms from meat. J. Food Protect. 40: 689-692.
- Hanna, M.O., Stewart, J.C., Carpenter, Z.I., and Vanderzant, C. 1977. Development of *Yersinia enterocolitica* on raw and cooked beef or pork at different temperatures. J. Food Sci. 42(5): 1180.
- Hauschild, A.H.W. 1989. *Clostridium botulinum*. In Foodborne Bacterial Pathogens. Doyle, M.P., ed., Marcel Dekker, Inc., New York, NY.
- Hudson, J.A., Mott, S.J., and Penney, N. 1994. Growth of *Listeria monocytogenes*, *Aeromonas hydrophila*, *Yersinia enterocolitica* on vacuum and saturated carbon dioxide controlled atmosphere-packaged sliced roast beef. J. Food Protect. 57 (3): 204-208.
- Johnson, K. M. 1986. Personal communication..
- Johnson, K. M., Nelson, C.L., and Busta, F.F. 1983. Influence of temperature on germination and growth of spores of emetic and diarrheal strains of *Bacillus cereus* in a growth medium and in rice. J. Food Sci. 48: 286.
- Khan, M.A., Palmas, C.V., Seaman, A., and Woodbine, M. 1972. Survival versus growth of a facultative psychrotroph. Acta Microbiol. Acad. Sci. Hung. 19: 357-362., as cited by Rosenow, E.M. and Marth, E.H. 1987. *Listeria*, listeriosis and dairy foods: a review. Cultured Dairy Products J. 22(4):13-17.
- Koidis, P. and Doyle, M.P. 1983. Survival of *Campylobacter jejuni* in fresh and heated red meat. J. Food Protect. 46: 771-774.
- Kramer, J.M., and Gilbert, R.J. 1989. *Bacillus cereus* and other Bacillus species. In Foodborne Bacterial Pathogens. Doyle, M.P., ed., Marcel Dekker, Inc., New York, NY.
- Labbe, R. 1989. *Clostridium perfringens*. In Foodborne Bacterial Pathogens. Doyle, M.P., ed., Marcel Dekker, Inc., New York, NY.
- Lee, J.S. 1973. What seafood processors should know about *Vibrio parahaemolyticus*. J. Milk Food Technol. 36(8): 485-488.
- Lovett, J., Bradshaw, J.G., and Peeler, J.T. 1982. Thermal inactivation of *Yersinia enterocolitica* in milk. Appl. Environ. Microbiol. 44: 517-519.
- Lovett, J., 1989. *Listeria monocytogenes*. In Foodborne Bacterial Pathogens. Doyle, M.P., ed. Marcel Dekker, Inc., New York, NY.
- Lynt, R.K., Kautter, D.A. and Solomon, H.M. 1982. Differences and similarities among proteolytic and nonproteolytic strains of *Clostridium botulinum* Types A,B, E, and F: A review. J. Food Protect. 42(4): 196-198.
- Matches, J.R. and Liston, J. 1968. Low temperature growth of *Salmonella*. J. Food Sci.33:641.
- Pivnick, H., Erdman, I.E., Manzatiuk, S., and Pommier, E. 1968 Growth of food poisoning bacterial on barbecued chicken. J. Milk Food Technol. 31:198-201.
- Read, R.B. and Bradshaw, J.G. 1966. Staphylococcal enterotoxin B thermal inactivation in milk. J. Dairy Science. 49(2): 202-203.
- Roberts, T. and van Ravenswaay, E. 1989. The economics of safe guarding the U.S. Food Supply. USDA Ag. Info. Bulletin No. 566: 1-8.
- Rosenow, E.M., and Marth, E.H. 1987. Growth of *Listeria Monocytogenes* in skim, whole and chocolate milk, and in whipping cream during incubation at 4°C, 8°C, 13°C, 21°C, and 35°C. J. Food Protect. 50: 452-459.
- Schneusner, D.L., Hood, L.L., and Harmon, L.G. 1973. Effect of temperature and pH on growth and enterotoxin production by *Staphylococcus aureus*. J. Milk Food Technol. 36: 249-252.
- Shoemaker, S.P. and Pierson, M.D. 1976. "Phoenix Phenomenon" in the growth of *Clostridium perfringens*. Appl. Microbiol. 32(6): 803-807.
- Silliker, J.H. 1982. *Salmonella* foodborne illness. In Microbiological Safety of Foods in Feeding Systems. A.B.M.P.S. Report 125. pp. 22-31.
- Smittle, R.B. 1977. Microbiology of mayonnaise and salad dressing: A review. J. Food Protect. 40: 415-422.

- Sperber, W.H. 1983. Influence of water activity on foodborne bacteria - A review. *J. Food Protect.* 46: 142-150
- Stern, N.J., Pierson, M.D., and Kotoula, A.W. 1980. Effects of pH and sodium chloride on *Yersinia enterocolitica* growth at room temperature and refrigeration temperatures. *J. Food Sci.* 45:64-67
- Sutherland, J.P. and Varnham, A. H. 1977. Methods of isolation and potential importance of *Yersinia enterocolitica* in foods stored at low temperatures. *J. Appl. Bacteriol.* 43:13.
- Tatini, S.R. 1973. Influence of food environments of growth of *Staphylococcus aureus* and production of various enterotoxins. *J. Milk Food Technol.* 36: 474.
- Twedt, R.M. 1989. *Vibrio parahaemolyticus*. In *Foodborne Bacterial Pathogens*. Doyle, M.P., ed. Marcel Dekker, Inc., New York, NY.
- USDA, FSIS. 1990. Recommendations of the National Advisory Committee on Microbiological Criteria for Foods for Refrigeration foods containing cooked, uncured meat or poultry products that are packaged for extended refrigerated shelf life and that are ready-to-eat or prepared with little or no additional heat treatment. USDA, FSIS, Washington D.C.
- van Netten, P., van de Moosdijk, A., van Hoensel, P., Mossel, D.A.A., and Perales, I. 1990. Psychrotrophic strains of *Bacillus cereus* producing enterotoxin. *J. Appl. Microbiol.* 69: 73-79.
- Willardsen, R.R., Busta, F.F. Allen, C.E., and Smith, L.B. 1977. Growth and survival of *Clostridium perfringens* during constantly rising temperatures. *J. Food Sci.* 43:470.
- Wong, H.C., Chen, Y.L., and Chen, C.L.F. 1988. Growth, germination and toxigenic activity of *Bacillus cereus* in milk products. *J. Food Protect.* 51 (9): 707.
- Woodburn, M.J., Somers, E., Rodriguez, J., and Shantz, E.J. 1979. Heat inactivation rates of botulism toxins A, B, E and F in some foods and buffers. *J. Food Sci.* 44: 1658-1661.