

Table 8. Interactions

Substrate/ medium	% NaCl	pH	a_w	Temp. (°C)	Death (log/10 d)*	No. of strains	Ref.
Rice	0	5.0	1.0	30	1.03.2	2	1
Rice	7.5	6.8	0.965	30	>5.3->6.5	2	1
Rice	7.9	5.2	0.960	30	>5.3->6.5	2	1
Meat	0.0	4.4	1.0	30	4.4-5.8	2	1
Meat	5.6	4.4	0.975	30	>5.4->6.0	2	1
Meat	10.1	4.4	0.935	30	5.4->6.0	2	1
Meat	4.1	6.1	0.980	30	0.0-0.1	2	1
Meat	9.6	6.1	0.940	30	>5.4->6.0	2	1
Meat	4.6	7.9	0.980	30	1.1-1.8	2	1
Meat	8.8	7.9	0.950	30	>5.4->6.0	2	1
BHI	0	4.6	—	30	4.9-8.0**	5	1
BHI	2.5	4.6	—	30	6.9-8.0**	5	1
BHI	5.0	4.6	—	30	6.8-8.0**	5	1
BHI	10.0	4.6	—	30	7.1->8.0**	5	1
BHI	2.5	6.1	—	30	0.3-1.0**	5	1
BHI	5.0	6.1	—	30	2.0-8.0**	5	1
BHI	10.0	6.1	—	30	7.0->8.0**	5	1
BHI	2.5	7.5	—	30	0-1.0**	5	1
BHI	5.0	7.5	—	30	2.0-7.2**	5	1
BHI	10.0	7.5	—	30	7.5->8.0**	5	1
BHI	0	8.8	—	30	0.5-1.2**	5	1
BHI	2.5	8.8	—	30	1.2->8.0**	5	1
BHI	5.0	8.8	—	30	6.5->8.0**	5	1
BHI	7.5	8.8	—	30	>8.0**	5	1

* \log_{10} decrease in numbers over 10 days

** Approx. death rate from published data

BHI, Brain Heart Infusion broth

1. Raevuori and Genigeorgis (1975)

References

- Asplund, K., Nurmi, E., Hill, P. and Hirn, J. (1988) 'The inhibition of the growth of *Bacillus cereus* in liver sausage', *International Journal of Food Microbiology* 7:349-52.
- Beuchat, L.R., Ma-Lin, C.F.A. and Carpenter, F.A. (1980) 'Growth of *Bacillus cereus* in media containing plant seed materials and ingredients used in Chinese cookery', *Journal of Applied Bacteriology* 48:397-407.
- Blakey, L.J. and Priest, F.G. (1980) 'The occurrence of *Bacillus cereus* in some dried foods including pulses and cereals', *Journal of Applied Bacteriology* 48:297-302.
- Bradshaw, J.G., Peeler, J.T. and Twedt, R.M. (1975) 'Heat resistance of ileal loop reactive *B. cereus* strains isolated from commercially canned food', *Applied Microbiology* 30:943-5.
- Briggs, A. (1966) 'The resistance of spores of the genus *Bacillus* to phenol, heat and radiation', *Journal of Applied Bacteriology* 29:490-504.
- Broadwater, W.T., Hoehn, R.C. and King, P.H. (1973) 'Sensitivity of three selected bacterial species to ozone', *Applied Microbiology* 26:391-3.
- Christiansson, A., Satyanarayan Naidu, A., Nilsson, I., Wadström, T. and Pettersson, H.-E. (1989) 'Toxin production by *Bacillus cereus* dairy isolates in milk at low temperatures', *Applied Environmental Microbiology* 55:2595-600.
- Chung, K.-T. and Sun, H.-L. (1986) 'Distribution and characteristics of *Bacillus cereus* isolated from rice in Taiwan', *Journal of Food Science* 51:1208-12.
- Cousins, C.M. and Allan, C.D. (1967) 'Sporicidal properties of some halogens', *Journal of Applied Bacteriology* 30:168-74.
- Enfors, S.-O. and Motin, G. (1980) 'Effect of high concentrations of carbon dioxide on growth rate of *Pseudomonas fragi*, *Bacillus cereus* and *Streptococcus cremoris*', *Journal of Applied Bacteriology* 48:409-16.
- Ezepchuk, V.V. and Fluer, F.S. (1973) 'The enterotoxin effect.' *Modern Medicine* 3:20-5.
- Garcia-Arribas, M.L. and Barrett, E.L. (1990) 'The effect of glucose, starch, and pH on growth, enterotoxin and haemolysin production by strains of *Bacillus cereus* associated with food poisoning and non-gastrointestinal infection', *International Journal of Food Microbiology* 11:21-34.
- Gilbert, R.J. and Parry, J.M. (1977) 'Serotypes of *Bacillus cereus* from outbreaks of food poisoning and from routine foods', *Journal of Hygiene* (Camb.) 78:69-74.
- Gilbert, R.J., Stringer, M.F. and Peace, T.C. (1974) 'The survival and growth of *Bacillus cereus* in boiled and fried rice in relation to outbreaks of food poisoning', *Journal of Hygiene* (Camb.) 73:433-44.
- Gilbert, R.J., Turnball, P.C.B., Parry, J.M. and Kramer, J.M. (1981) 'Bacillus cereus and other *Bacillus* species: Their part in food poisoning and other clinical infections', in R.C.W. Berkely and M. Goodfellow (eds) *The Aerobic Endospore-forming Bacteria*, New York: Academic Press: 297-314.
- Glatz, B.A., Spira, W.M. and Goepfert, J.M. (1974) 'Alteration of vascular permeability in rabbits by culture filtrates of *Bacillus cereus* and related species', *Infect. Immun.* 10:299-303.
- Goepfert, J.M. (1974) 'Monkey-feeding trials in the investigation of the nature of *Bacillus cereus* food poisoning', *Proceedings of the IV International Congress of Food Science and Technology* 3:178-81.
- Goepfert, J.M. and Kim, H.U. (1975) 'Behaviour of selected food-borne pathogens in raw ground beef', *Journal of Milk and Food Technology* 38:449-52.
- Goepfert, J.M., Spira, W.M. and Kim, H.U. (1972) '*Bacillus cereus*: food poisoning organism. A review', *Journal of Milk and Food Technology* 35:213-27.
- Gorina, L.G., Fluer, F.S., Olovnikov, A.M. and Ezepchuk, Y.V. (1975) 'Use of the aggregate-hemagglutination technique for determining exo-enterotoxin of *Bacillus cereus*', *Applied Microbiology* 29:201-4.
- Griffiths, M.W. (1990) 'Toxin production by psychrotrophic *Bacillus* spp. present in milk', *Journal of Food Protection* 53:790-2.
- Hashisaka, A.E., Matches, T.R., Batters, Y., Hungate, F.P. and Dong, F.M. (1990) 'Effects of gamma irradiation at -78°C on microbial populations in dairy products', *Journal of Dairy Science* 55:1284-9.
- Hauge, S. (1950) 'Matforgiftninger fremkalt av *Bacillus cereus*', *Nordisk Hygienisk Tidsskrift* 31:189-206 (*Biol. Abstr.* 35:1063, 1951).
- Hauge, S. (1955) 'Food poisoning caused by aerobic spore-forming bacilli', *Journal of Applied Bacteriology* 18:591-5.
- Helmy, Z.A., Abd-El-Bakey, A. and Mohamed, E.I. (1984) 'Factors affecting germination and death of *Bacillus cereus* spores in milk', *Zentralblatt für Mikrobiologie* 139:135-41.
- Hobbs, B.C. and Gilbert, R.J. (1974) 'Microbiological counts in relation to food poisoning', *Proceedings of the IV International Congress of Food Science Technology* 3:159.
- Holbrook, R. and Anderson, J.M. (1980) 'An improved selective and diagnostic medium for the isolation and enumeration of *Bacillus cereus* in foods', *Canadian Journal of Microbiology* 26:753-9.
- Jakobsen, M. and Murrell, W.G. (1977) 'The effect of water activity and a_w -controlling solute on sporulation of *Bacillus cereus* T', *Journal of Applied Bacteriology* 43:239-45.
- Jakobsen, M., Filtenborg, O. and Bramsnaes, F. (1972) 'Germination and outgrowth of bacterial spores in the presence of different solutes', *Lebensmittel-Wissenschaftliche Technologie* 5:159-62.
- Johnson, K.M. (1984) '*Bacillus cereus* foodborne illness - An update', *Journal of Food Protection* 47:145-53.
- Johnson, K.M., Nelson, C.L. and Busta, F.F. (1982) 'Germination and heat resistance of *Bacillus cereus* spores from strains associated with diarrhoeal and emetic food-borne illnesses', *Journal of Food Science* 47:1268-71.
- Johnson, K.M., Nelson, C.L. and Busta, F.F. (1983) 'Influence of temperature on germination and growth of spores of emetic and diarrhoeal strains of *Bacillus cereus* in a broth medium and in rice', *Journal of Food Science* 48:286-7.
- Kaur, P. (1986) 'Survival and growth of *Bacillus cereus* in bread', *Journal of Applied Bacteriology* 60:513-16.
- Kim, H.U. and Goepfert, J.M. (1971) 'Enumeration and identification of *Bacillus cereus* in foods. I. 24 hour presumptive test medium', *Applied Microbiology* 22:581-7.
- Kozasa, M., Wake, M. and Azuma, R. (1977) 'Taxonomic studies on *Bacillus cereus* T-7112: 1. Biotype', *Annual Report Tokyo Veterinary Animal Science* 25:38-42.
- Kramer, J.M. and Gilbert, R.J. (1989) '*Bacillus cereus* and other *Bacillus* species', in M.P. Doyle (ed.) *Foodborne Bacterial Pathogens*, New York: Marcel Dekker: 21-70.
- Kramer, J.M., Turnbull, P.C.B., Munshi, G. and Gilbert, R.J. (1982) 'Identification and characterization of *Bacillus*

- cereus* and other *Bacillus* species associated with foods and food poisoning', in J.E.L. Corry, D. Roberts and F.A. Skinner (eds), *Isolation and Identification Methods for Food Poisoning Organisms*, New York: Academic Press: 261-86.
- Lancette, G.A. and Harmon, S.M. (1980) 'Enumeration and confirmation of *Bacillus cereus* in foods: collaborative study', *Journal of the Association of Official Analytical Chemists* 63:581-6.
- Marshall, B.J., Ohye, D.F. and Christian, J.H.B. (1971) 'Tolerance of bacteria to high concentrations of NaCl and glycerol in the growth medium', *Applied Microbiology* 21:363-4.
- Measures, J. (1975) 'Role of amino-acids in osmo regulation of nonhalophilic bacteria', *Nature (Lond.)* 257 (5525):398-9.
- Melling, J. and Capel, B.J. (1978) 'Characteristics of *Bacillus cereus* emetic toxin', *FEMS Microbiology Letters* 4:133-5.
- Mikolajcik, E.M., Kearney, J.W. and Kristoffersson, T. (1973) 'Fate of *Bacillus cereus* in cultured and direct acidified skim milk and Cheddar cheese'. *Journal of Milk and Food Technology* 36:317-20.
- Mol, J.H.H. (1957) 'Temperature characteristics of spore germination and growth of *Bacillus cereus*', *Journal of Applied Bacteriology* 20:454-9.
- Molin, N. and Snygg, B.G. (1967) Effect of lipid materials on heat resistance of bacterial spores. *Applied Microbiology* 15:1422-1426.
- Morita, T.N. and Woodburn, M.F. (1977) 'Stimulation of *Bacillus cereus* growth by protein in cooked rice combinations', *Journal of Food Science* 42:1232-5.
- Mossel, D.A.A., Koopman, M.J. and Jongerius, E. (1967) 'Enumeration of *Bacillus cereus* in foods', *Applied Microbiology* 15:650-3.
- Nygren, B. (1962) 'Phospholipase C-producing bacteria and food poisoning', *Acta Pathologica Microbiologica (Scand. Suppl.)* 160:1-89.
- Parry, J.M. and Gilbert, R.J. (1980) 'Studies on the heat resistance of *Bacillus cereus* spores and growth of the organism in boiled rice', *Journal of Hygiene (Camb.)* 84:77-82.
- Patil, R.A., Singh, R.S. and Ghodekar, D. (1988) 'Effect of chemical sterilants on aseptic packaging and dairy products', *New Zealand Journal of Dairy Science and Technology* 23:175-83.
- Raevuori, M. (1976) 'Effect of sorbic acid and potassium sorbate on growth of *Bacillus cereus* and *Bacillus subtilis* in rice filling of Karelian pastry', *European Journal of Applied Microbiology* 2:205-13.
- Raevuori, M. and Genigeorgis, C. (1975) 'Effect of pH and sodium chloride on growth of *Bacillus cereus* in laboratory media and certain foods', *Applied Microbiology* 29:68-73.
- Rajkowsky, K.T. and Mikolajcik, E.M. (1987), 'Characteristics of selected strains of *Bacillus cereus*', *Journal of Food Protection* 50:199-205.
- Rodriguez, M.H. and Barrett, E.L. (1986) 'Changes in microbial population and growth of *Bacillus cereus* during storage of reconstituted dry milk', *Journal of Food Protection* 49:680-6.
- Shehata, T.E. and Collins, E.B. (1972) 'Sporulation and heat resistance of psychrophilic strains of *Bacillus*', *Journal of Dairy Science* 55:1405-9.
- Shelief, L.A. and Liang, P. (1982) 'Antibacterial effects of butylated hydroxyanisole (BHA) against *Bacillus* species', *Journal of Food Science* 47:796-9.
- Shinagawa, K. (1990) 'Analytical methods for *Bacillus cereus* and other *Bacillus* species', *International Journal of Food Microbiology* 10:125-42.
- Smith, N.R., Gordon, R.E. and Clark, F.E. (1946) 'Aerobic mesophilic sporeforming bacteria', *USDA Miscellaneous Publications No. 559*.
- Smith, N.R., Gordon, R.E. and Clark, F.E. (1952) 'Aerobic sporeforming bacteria', *USDA Monograph No. 16*.
- Spira, W.M. and Goepfert, J.M. (1972) 'Bacillus cereus-induced fluid accumulation in rabbit ileal loops', *Applied Microbiology* 24:341-8.
- Spira, W.M. and Goepfert, J.M. (1975) 'Biological characteristics of an enterotoxin produced by *Bacillus cereus*', *Canadian Journal of Microbiology* 21:1236-46.
- Stadhouders, F., Hyp, G. and Langeveld, L.P.M. (1980) 'Some observations on the germination, heat resistance, and outgrowth of fast-germinating and slow germinating spores of *Bacillus cereus* in pasteurized milk', *Netherlands Milk and Diary Journal* 34:215-28.
- Stockinger, H., Bohm, R. and Strauch, D. (1989) 'Comparative testing of two different disinfectants with regard to their sporicidal effects in a model experiment using spores of pathogenic and apathogenic clostridia as well as of *Bacillus cereus* (in German)', *Zentralblatt für Hygiene und Umweltmedizin* 188(1-2):166-78.
- Taylor, A.J. and Gilbert, R.J. (1975) 'Bacillus cereus food poisoning: A provisional serotyping scheme', *Journal of Medical Microbiology* 8:543-50.
- Thompson, N.E., Ketterhagen, M.J., Bergdoll, M.S. and Schantz, E.J. (1984) 'Isolation and some properties of an enterotoxin produced by *Bacillus cereus*', *Infection and Immunity* 43:887-94.
- Turnbull, P.C.B. (1981) 'Bacillus cereus toxins', *Pharmacology and Therapeutics* 13:453-505.
- Turnbull, P.C.B., Kramer, J.M., Jorgensen, K., Gilbert, R.J. and Melling, J. (1979) 'Properties and production characteristics of vomiting, diarrhoeal, and necrotizing toxins of *Bacillus cereus*', *American Journal of Clinical Nutrition* 32:219-28.
- Ueda, S., Katsume, S. and Kuwabara, Y. (1986) 'Studies on the ecology of *Bacillus cereus* (I). The biochemical characteristics of *B. cereus* strains isolated from food, food poisoning outbreaks and environment', *Journal of Antibacterial Antifungal Agents* 13:547-54.
- 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', *Journal of Applied Bacteriology* 69:73-9.
- Wang, M.Y., Collins, E.B. and Lobben, J.C. (1973) 'Destruction of psychrophilic strains of *Bacillus* by chlorine'. *Journal of Dairy Science* 56:1253-7.
- Wong, H.C. and Chen, Y.-L. (1988) 'Effects of lactic acid bacteria and organic acids on growth and germination of *Bacillus cereus*', *Applied Environmental Microbiology* 54:2179-84.
- Wong, H.C., Chen, Y.L. and Chen, C.L.F. (1988) 'Growth, germination and toxigenic activity of *Bacillus cereus* in milk products', *Journal of Food Protection* 51:707-10.
- Wyatt, C.J. and Guy, V.H. (1981) 'Incidence and growth of *Bacillus cereus* in retail pumpkin pies', *Journal of Food Protection* 44:422-4, 429.