



Limiting Conditions for Pathogen Growth
Guidance provided by:
EMSL Analytical, Inc

| Pathogens | Min. a_w | Min. pH | Max. pH | Max % salt | Min. Temp. (°C) | Max. Temp. | Oxygen Requirement |
|---|---------------------------|----------------|----------------|-------------------|------------------------|-------------------|---------------------------|
| <i>Campylobacter jejuni</i> | 0.99 | 4.9-5.5 | 8.0 | 1.5-2.0 | 30-32 | 42-45 | Micro-aerophilic |
| <i>Clostridium botulinum</i> type A, and proteolytic B and F | 0.93-0.96 | 4.7 | 9.0 | 10.0 | 10.0 | 48-50 | Anaerobe |
| <i>Clostridium botulinum</i> type E, and nonproteolytic B and F | 0.93-0.96 | 4.7-4.8 | 9.0 | 4.5-6.0 | 3.0 | 45 | Anaerobe |
| <i>E. coli</i> | 0.93-0.95 | 3.6-4.7 | 9.5 | 7.5-8.0 | 0.6-3.0 | 45 | Facultative anaerobe |
| <i>Listeria monocytogenes</i> | 0.92-0.95 | 4.8 | 9.6 | 8-12 | 0-2.0 | 45 | Facultative anaerobe |
| <i>Salmonella</i> spp. | 0.92 | 4.0 | 9.0 | 8.0 | 5.0 | 46-47 | Facultative anaerobe |
| <i>Shigella</i> spp. | 0.96 | 6.0 | 10.0 | 6.0 | 7.0 | 46 | Facultative anaerobe |
| <i>Staphylococcus aureus</i> | 0.85-0.86 | 4.0 | 10.0 | 18-20 | 5-6* | 45-45 | Facultative anaerobe |
| <i>Vibrio cholerae</i> | 0.95 | 3.6-6.0 | 9.6 | 6-8 | 8.0 | 42-46 | Facultative anaerobe |
| <i>Vibrio parahaemolyticus</i> | 0.94 | 4.8-5.0 | 9.6 | 8-10 | 5.0 | 43 | Facultative anaerobe |
| <i>Vibrio vulnificus</i> | 0.95 | 6.3 | 9.0 | 6.0 | 13.0 | 44 | Facultative anaerobe |
| <i>Yersinia enterocolitica</i> | 0.95-0.96 | 4.1-4.4 | 9.0 | 6-7 | -1.0 – 1 | 44 | Facultative anaerobe |

*Minimum temperature for toxin formation is 10°C

Micro-aerophilic: requires limited levels of oxygen Anaerobe: requires the absence of oxygen Facultative anaerobe: grows either with or without oxygen

EMSL Analytical is a full-service analytical laboratory. For more information please contact our St. Louis Laboratory
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