

## Chapter 11: *Campylobacter* spp.

Updated:

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- [Potential Food Safety Hazard](#)
  - [Control Measures](#)
  - [FDA Guidelines](#)
  - [Growth](#)
  - [Heat Resistance](#)
  - [Analytical Procedures](#)
    - [Food sampling and preparation of sample homogenate](#) (USFDA)
    - [Definition of Terms; Collection of Samples; Supplement to all Methods in the HC Compendium](#) (HC)
    - [Isolation of \*Campylobacter\* species from food and water](#) (USFDA)
    - [Isolation of \*Campylobacter\* from foods](#) (HC)
  - [Commercial Test Products](#)
  - [References](#)
- 

### Potential Food Safety Hazard

[Top](#)

The following information on potential food safety hazards from *Campylobacter* is taken from Hunt et al., 1998.

*Campylobacter* is considered by many to be the leading cause of enteric illness in the United States (Nachamkin et al., 1992; Tauxe et al., 1988). *Campylobacter* species can cause mild to severe diarrhea, with loose, watery stools often followed by bloody diarrhea (Butzler, 1984; Nachamkin et al., 1992). *C. jejuni*, *C. coli*, and *C. lari* account for more than 99% of the human isolates (*C. jejuni* 90%). Other species have been associated with human illness in recent years (Butzler, 1984; Klein et al., 1986; Linton et al., 1996; Patton et al., 1989; Tauxe et al., 1988; Tee et al., 1987).

*Campylobacter* species are highly infective. The infective dose of *C. jejuni* ranges from 500 to 10,000 cells, depending on the strain, damage to cells from environmental stresses, and the susceptibility of the host (Black et al., 1988; Blaser et al., 1986; Butzler, 1984; Nachamkin et al., 1992; Tee et al., 1987). Only the mesophilic *C. fetus* is normally invasive. Thermophilic species (optimum 42°C) such as *C. jejuni* are occasionally invasive. The infections are manifested as meningitis, pneumonia, miscarriage, and a severe form of Guillain-Barré syndrome (Blaser et al., 1986; Nachamkin et al., 1992). Thermotolerant strains of *C. fetus* that grow at 42°C have been isolated from patients (Klein et al., 1986).

Campylobacters are carried in the intestinal tract of a wide variety of wild and domestic animals, especially birds. They can establish a temporary asymptomatic carrier state, as well as illness, in humans. This is especially prevalent in developing countries (Nachamkin et al., 1992).

Consumption of food and water contaminated with untreated animal or human waste accounts for 70% of *Campylobacter*-related illnesses each year. The foods include unpasteurized milk, meats, poultry, shellfish, fruits, and vegetables, (Abeyta and Kaysner, 1987; Abeyta, 1998; Castillo and Escartin, 1994; Clark and Bueschkens, 1986; Doyle and Schoeni, 1986; Fricker and Park, 1989; Klein et al., 1986; Mathewson et al., 1983; Nachamkin et al., 1992; Park and Sanders, 1992; Stern and Bolton, 1994; Tauxe et al., 1988).

*C. jejuni* can survive 2-4 weeks under moist, reduced-oxygen conditions at 4°C, often outlasting the shelf life of the product (except in raw milk products). They can also survive 2-5 months at -20°C, but only a few days at room temperature (Blaser et al., 1980; Castillo and Escartin, 1994; Clark and Bueschkens, 1986; Doyle and Schoeni, 1986; Fricker and Park, 1989; Nachamkin et al., 1992). Environmental stresses, such as exposure to air, drying, low pH, heating, freezing, and prolonged storage, damage cells and hinder recovery to a greater degree than for most bacteria. Older and stressed organisms gradually become coccoidal and increasingly difficult to culture (Blaser et al., 1980; Nachamkin et al., 1992). Oxygen quenching agents in media such as haemin and charcoal as well as a microaerobic atmosphere and preenrichment can significantly improve recovery (Bark et al., 1996; Humphrey, 1986; Hunt et al., 1985; Hutchinson and Bolton, 1984; Park and Sanders, 1989; Stern and Bolton, 1994; Tran and Yin, 1997).

Campylobacters are microaerophilic, very small, curved, thin, Gram-negative rods (1.5-5 µm), with corkscrew motility. They often join to form zigzag shapes (Nachamkin et al., 1992; Smibert, 1984). *Campylobacter* spp. are currently identified by tests described by Harvey (1980) and Barret et al. (1988). PCR genus and species identification methods have been published (Harmon et al., 1997; Linton et al., 1996; Winters and Slavik, 1995).

For additional information contact Jan Hunt or Carlos Abeyta, FDA, P.O. Box 3012, Bothell, WA 98041-3012. Phone numbers: (425) 402-3171 (Hunt) or 483-4870 (Abeyta); e-mail: [jhunt2@ora.fda.gov](mailto:jhunt2@ora.fda.gov) and [cabeyta@ora.fda.gov](mailto:cabeyta@ora.fda.gov). Tony Tran can be contacted at CFSAN, 200 C St., SW, Washington, DC 20204; phone no. is (202) 205-5253 and the e-mail address is [TTT@cfsan.fda.gov](mailto:TTT@cfsan.fda.gov).

## Control Measures

[Top](#)

Hazards from *C. jejuni* can be controlled by thoroughly cooking seafood and by stressing the importance of proper (and frequent) hand and equipment washing and sanitary food-handling practices. Since the infective dose of *C. jejuni* is thought to be small, time/temperature abuse of food products could result in this illness (Ward et al., 1997).

## FDA Guidelines

[Top](#)

FDA to assess situations on a case by case basis.

## Growth

[Top](#)

[Table A-1](#). Limiting conditions for pathogen growth.

# Heat Resistance

[Top](#)

## Heat resistance of *Campylobacter*.

| Temperature |       | D-Value<br>(min.) | Medium      | Reference              |
|-------------|-------|-------------------|-------------|------------------------|
| (°C)        | (°F)  |                   |             |                        |
| 48          | 118.4 | 12.8              | Skim milk   | Doyle and Roman, 1981  |
| 50          | 122   | 4.4               | Skim milk   | Doyle and Roman, 1981  |
| 50          | 122   | 6.28              | Ground beef | Koidis and Doyle, 1983 |
| 50          | 122   | 13.3              | Lamb meat   | Koidis and Doyle, 1983 |
| 53          | 127.4 | 1.56              | Skim milk   | Doyle and Roman, 1981  |
| 55          | 131   | 1.00              | Skim milk   | Doyle and Roman, 1981  |
| 55          | 131   | 1.23              | Lamb meat   | Koidis and Doyle, 1983 |
| 56          | 132.8 | 0.96              | Ground beef | Koidis and Doyle, 1983 |
| 58          | 136.4 | 0.35              | Ground beef | Koidis and Doyle, 1983 |
| 60          | 140   | 0.26              | Lamb meat   | Koidis and Doyle, 1983 |

## Analytical Procedures

[Top](#)

[Food sampling and preparation of sample homogenate](#) (USFDA)

[Top](#)

[Definition of Terms](#) (HC Appendix A); [Collection of samples](#) (HC Appendix B); [Supplement to All Methods in the HC Compendium: General Microbiological Guidance](#) (HC Appendix I) [General Microbiological guidance on Pre-warming of Broths in All Qualitative Methods in the \[HC\] Compendium](#) (HC Supplement to Appendix I)

[Top](#)

[Isolation of \*Campylobacter\* species from food and water](#) (USFDA)

[Top](#)

[Isolation of \*Campylobacter\* from foods](#) (HC MFLP-46)

[Top](#)

## Commercial Test Products

[Top](#)

Commercial test products for *Campylobacter* spp.

| Test | Analytical Technique | Approx. Total Test Time <sup>1</sup> | Supplier |
|------|----------------------|--------------------------------------|----------|
|------|----------------------|--------------------------------------|----------|

|  |  |         |  |
|--|--|---------|--|
| AccuPROBE® <i>Campylobacter</i> Culture Identification Test                    | Nucleic acid hybridization                       | 16-24 h | Gen-Probe<br>Contact: Vivian Jonas<br>10210 Genetic Center Dr.<br>San Diego, CA 92121<br>Phone: 619/410-8828<br>E-mail: <a href="mailto:vivianj@gen-probe.com">vivianj@gen-probe.com</a><br>Web: <a href="http://www.gen-probe.com">www.gen-probe.com</a>              |
| Alert® for <i>Campylobacter</i>  |  |         | Neogen Corporation<br>620 Lesher Pl.<br>Lansing, MI 48912<br>Phone: 517/372-9200<br>E-mail: <a href="mailto:NeogenCorp@aol.com">NeogenCorp@aol.com</a><br>Web: <a href="http://www.neogen.com/alertcampy.htm">www.neogen.com/alertcampy.htm</a>                        |
| API Campy  | Biochemical reactions                            | 24 h    | bioMérieux Inc.<br>Contact: bioMérieux Industry<br>595 Anglum Rd.<br>Hazelwood, MO 63042<br>Phone: 314/731-8500<br>E-mail: <a href="mailto:usa@na.biomerieux.com">usa@na.biomerieux.com</a><br>Web: <a href="http://www.biomerieux.com">www.biomerieux.com</a>         |
| EIAFoss <i>Campylobacter</i>   | Combination ELISA and Immuno Magnetic Separation | 48 h    | Foss North America, Inc.<br>7682 Executive Dr.<br>Eden Prairie, MN 55344<br>Phone: 612/974-9892<br>E-mail: <a href="mailto:sales@fossnorthamerica.com">sales@fossnorthamerica.com</a><br>Web: <a href="http://www.fossnorthamerica.com">www.fossnorthamerica.com</a>   |
| GENE-TRAK <i>Campylobacter</i> Assay   | Nucleic acid hybridization                       | 50 h    | Neogen Corporation<br>620 Lesher Pl.<br>Lansing, MI 48912<br>Phone: 517/372-9200<br>E-mail: <a href="mailto:NeogenCorp@aol.com">NeogenCorp@aol.com</a><br>Web: <a href="http://www.neogen.com">www.neogen.com</a>  |
| Probelia PCR System<br>[Used to identify <i>C. jejuni</i> and <i>C. coli</i> ] | Polymerase chain reaction                        | 24 h    | BioControl Systems, Inc.<br>Contact: Robin Forgey<br>12822 SE 32nd St.<br>Bellevue, WA 98005<br>Phone: 425/603-1123<br>E-mail: <a href="mailto:info@rapidmethods.com">info@rapidmethods.com</a><br>Web: <a href="http://www.rapidmethods.com">www.rapidmethods.com</a> |
| Transia Plate <i>Campylobacter</i>   | ELISA  | 46 h    | Diffchamb AB<br>FO Petersons Gata 32<br>SE-421 31 Västra Frölunda,<br>Sweden<br>Phone: +46 -31-742 33 50<br>E-mail: <a href="mailto:market.dept@diffchamb.se">market.dept@diffchamb.se</a><br>Web: <a href="http://www.diffchamb.se">www.diffchamb.se</a>              |
| Vidas CAM  | Enzyme linked fluorescent assay                  | 48 h    | bioMérieux Inc.<br>Contact: bioMérieux Industry<br>595 Anglum Rd.<br>Hazelwood, MO 63042   |

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|  |  | Phone: 314/731-8500<br>E-mail: <a href="mailto:usa@na.biomerieux.com">usa@na.biomerieux.com</a><br>Web: <a href="http://www.biomerieux.com">www.biomerieux.com</a> |
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<sup>1</sup>Includes enrichment

## References

[Top](#)

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