



# *Campylobacter jejuni* *Campylobacter coli*

*Campylobacter jejuni*, *Campylobacter coli*  
Family of *Campylobacteraceae*  
Genus *Campylobacter*  
Bacterium

## Characteristics and sources of *Campylobacter jejuni/coli*

### Main microbial characteristics

*Campylobacter jejuni* and *C. coli* are responsible for the vast majority of cases of foodborne human campylobacteriosis, following a unique system of pre-adhesion/colonisation/adhesion/invasion of the digestive tract, whose exact mechanism remains to be elucidated.

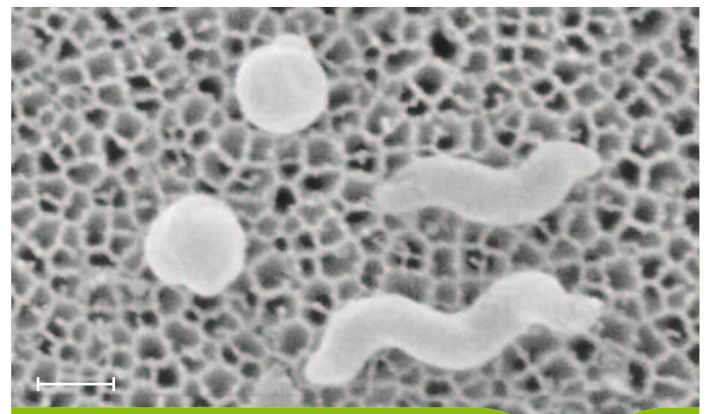
They are Gram-negative bacteria, helical or curved in shape, which can degenerate into a coccoid form (Figure). They are mesophilic and noted for their high motility, due to one or two polar flagella. The genus *Campylobacter* currently includes approximately twenty species, all of which grow at 37°C. Their growth is enhanced in an oxygen-limited atmosphere enriched with CO<sub>2</sub>. However, several species or subspecies of the genus *Campylobacter* (including those covered by this data sheet) are collectively known as thermotolerant *Campylobacter*, as they are also able to grow optimally at 41.5°C. These bacteria are asaccharolytic and do not form spores, and measure from 0.5 to 5 µm long and from 0.2 to 0.5 µm wide. The main features relating to growth conditions for these bacteria are summarised in Table 1.

Table 1. Growth characteristics of *Campylobacter jejuni/coli*

Parameters	Growth	
	Optimum	Extremes: growth inhibition
Température (°C)	41.5°C	30°C – 45°C
pH	6.5-7.5	4.9 – 9.0
a <sub>w</sub>	0.997	0.987
NaCl (%)	0.5%	2%
O <sub>2</sub>	3-5%	0 – 15 to 19%
CO <sub>2</sub>	10%	-

### Sources of the hazard

Wild and domestic birds are considered the main reservoirs of *Campylobacter jejuni* and, to a lesser extent, *C. coli*. However, other primary reservoirs have been described: cattle, swine (mostly for *C. coli*) and small ruminants, as well as pets (cats and dogs). These bacteria have a particular tropism for the digestive tract of animals, and their presence here means that droppings can contaminate soil and rivers. Despite the bacteria's survival being relatively low in this hydro-telluric environment,



Helical and coccoid forms of *C. jejuni* (SEM x 30,000)  
(SEM x 30,000) © UMR SECALIM, Nantes

the water of rivers, ponds and lakes may be a secondary reservoir. While some *Campylobacter* species are pathogenic to animals, in which they are implicated in infertility and abortions, it should be remembered that *Campylobacter jejuni* and *coli* are considered to be of low pathogenicity, or non-pathogenic to animals.

### Transmission routes

The primary route of transmission of *Campylobacter* to humans is indirect, by ingesting contaminated food, including drinking water contaminated as a result of various accidents reported in the literature (broken pipes, heavy rainfall, lack of treatment, etc.). Direct transmission from person to person or between an infected animal or contaminated animal carcass and a human, which is rarer, has also been described. It may occur more frequently in certain exposed populations (farmers, veterinarians, slaughterhouse workers, sewer workers, etc.). Pets, especially diarrhoeic puppies and kittens, are known to be vectors of transmission to humans. Because of this potential for direct or indirect transmission of these bacteria from animal reservoirs to humans, *Campylobacter jejuni* and *C. coli* should be considered as zoonotic agents<sup>(2)</sup>.

(1) Exposed population: people exposed to the hazard, either by their eating habits, or by contact with the agent (person-to-person contact, contact with animals or animal products, contact with contaminated material, etc.).

(2) Zoonoses: diseases, infections or infestations caused by transmissible agents (bacteria, viruses, parasites or prions) developing in at least two species of vertebrates including humans" (M. Savelly & B. Dufour (2004) Diversity of zoonoses. Definitions and consequences for surveillance and control. *Épidémiologie et santé animale* 46, 1-16).

### Recommendations for primary production

• Thus far there has been no satisfactory strategy for eradication of *Campylobacter* in farms. Nevertheless, good hygiene practices for husbandry and cleanout should be strictly applied. In addition, in the poultry sector, certain practices such as backwashing should be avoided.

## Human foodborne disease

### Nature of the disease (Table 2)

The most frequently observed human disease is acute enteritis caused by an intestinal infection, which may be complicated by bacteraemia, secondary locations and post-infective syndrome.

The frequency of bacteraemia and septicaemia detected in cases of enteritis caused by thermotolerant *Campylobacter*, and especially by *C. jejuni*, remains very low (less than 1%). However, *C. jejuni* can cause post-infective syndromes such as arthritis, liver or kidney inflammation, and particularly Guillain-Barré syndrome which is characterised by temporary paralysis of the peripheral nervous system. This syndrome is considered very severe, with a mortality rate as high as 2-3%, and major neurological sequelae in 15 to 22% of cases. Guillain-Barré syndrome appears to be more common in serogroup O19 (1/150). Uncertainties remain however on this estimate.

**Susceptible population groups<sup>(3)</sup>:** any individual may develop an infection with *Campylobacter*. However, some people are more likely to develop more severe forms: the elderly, alcoholics, people with a history of gastrointestinal surgery, kidney failure treated by peritoneal dialysis, immunosuppressive therapy, or HIV infection.

### Dose-effect<sup>(4)</sup> and dose-response<sup>(5)</sup> relationships

The dose-response relationship is poorly understood, and depends on host susceptibility, including in particular their immune status, the characteristics of the contaminated food ingested, and the strains' potential for colonisation and virulence. The only two experiments, which were on human volunteers, determining the dose-response effect in *C. jejuni* infection, suggest that a low dose (890 and 500 cells absorbed in milk, respectively) has a high probability of causing illness or onset of symptoms.

## Epidemiology

Since the early 2000s, the annual incidence per 100,000 inhabitants of human campylobacteriosis in the European Union has regularly been over 40 cases. In France, the incidence of cases reported to the National Centre of Reference (NCR) was 6.2 per 100,000 inhabitants in 2009. This incidence is underestimated because of the limited coverage of the surveillance network. It is recognised that cases are most frequent during the summer months.

Table 2. Disease characteristics

Mean incubation period	Target population	Main symptoms	Duration of symptoms	Duration of infectious period (shedding)	Complications	Asymptomatic forms
2-5 days (from 1 to 8 days)	Cosmopolitan, all age groups	Diarrhoea: 85% (52 - 100) Abdominal pains: 79% (56 - 99) Bloody stools: 15% (0.5 - 32) Fever: 50% (6 - 75) Headaches: 41% (6 - 69) Vomiting: 15% (1 - 42) Acute enteritis self-limiting in 80% of cases	3-4 jours	38 days on average (max 69 days)	Bacteraemia and septicaemia: <1% Post-infective syndrome: including Guillain-Barré syndrome: 0.1% Complications rarely described: appendicitis, peritonitis, cholecystitis Lethality: <0.1% of cases	Yes in some patients previously suffering from campylobacteriosis

Most cases described are sporadic. With regard to food poisoning outbreaks related to *Campylobacter*, consumption of contaminated water, raw milk or poultry meat is often mentioned. Consumption of inadequately cooked, contaminated poultry meat is also a clearly highlighted risk factor in all case-control studies. Similarly, the transfer of contamination during handling of fresh poultry or consumption of undercooked meat appears to be a risk factor.

## Role of food

### Main foods to consider

Because of both the existence of animal reservoirs and the numerous opportunities for transfer of contamination, many categories of foods (including water) may potentially be contaminated, although meat and meat products are the most likely sources. During the processing, transport and distribution of food, the number of viable thermotolerant *Campylobacter* tends to decrease. In general, freezing stops the growth of these bacteria and probably destroys a small proportion of the bacterial population, particularly in a liquid medium. However, these bacteria survive well at refrigeration temperatures (0-10°C), but are very sensitive to heat and it can be assumed that heat treatments above 65°C destroy them regardless of the medium (liquid or solid). Note finally that these bacteria do not exhibit any particular resistance to salt or acid.

## Inactivation treatments in industrial environment

Table 3. Inactivation in an industrial environment

Disinfectants	Effects of temperature
Phenolic compounds, iodophors, quaternary ammonium, alcohol at 70%, and glutaraldehyde applied at the usual concentrations lead to a more than 7-log <sub>10</sub> reduction in <i>Campylobacter</i> in less than 1 minute	D <sub>50°C</sub> * = 1 – 6.3 min; D <sub>55°C</sub> = 0.6 – 2.3 min; D <sub>60°C</sub> = 0.2 – 0.3 min (phosphate buffer) D <sub>48°C</sub> = 7.2 – 12.8 min; D <sub>55°C</sub> = 0.74 – 1 min (skimmed milk) D <sub>49°C</sub> = 20 min; D <sub>57°C</sub> = 0.75 min (poultry meat)
High pressure	Irradiation
400 MPa, 10 min, 20°C or 37°C, pH 5.6 or 7: • over 7-log <sub>10</sub> reduction (2 strains)	D <sub>10</sub> -value (depending on T°C)** = 0.56 kGy (0.25 – 0.77)
300 MPa, 10 min, 20°C: • 3-log <sub>10</sub> reduction at pH 7; 6-log <sub>10</sub> reduction at pH 5.6	Treatments greater than 1 kGy can control <i>Campylobacter</i>

\* D is the time required to divide by 10 the population of the initially present microbiological hazard.

\*\* D<sub>10</sub> – value: dose of radiation required to reduce the viability of a population by 90% (1 log<sub>10</sub> cycle) under the stated conditions.

(3) Susceptible population groups: people with a higher than average probability of developing symptoms of the disease, or severe forms of the disease, after exposure to a foodborne hazard [definition used for the ANSES data sheets].

(4) The relationship between the dose (the amount of microbial cells ingested during a meal) and the effect on an individual.

(5) For a given effect, the relationship between the dose and the response, i.e., the probability of this effect appearing in the population.

Regarding the public water distribution system, it should be noted that the behaviour of *Campylobacter* does not differ from that of the faecal indicators commonly used to assess the microbiological quality of drinking water. The usual water purification treatments are effective against this bacterium.

## Monitoring in food

Screening for *Campylobacter* spp. in food is not so far subject to special regulations, including in the recent EU legislation.

Two standard methods are now available for screening (NF EN ISO 10272-1<sup>(6)</sup>) or counting (ISO/TS 10272-2<sup>(7)</sup>) *Campylobacter* in foods. There is also a method for detecting these organisms in water: ISO 17995:2005<sup>(8)</sup>. These methods are considered as references, and are continually improving, but are still tedious. Faster alternative methods (ELISA, PCR, etc.) have also been described, some of which are being standardised (real-time PCR).

### Recommendations for operators

Operators' attention should be drawn to:

- the microbiological quality of raw materials, especially poultry meat;
- vigilance with respect to potential transfer of contamination and the importance of following good hygiene practices at all stages of the food production chain, as this bacteria has an animal reservoir;
- the prolonged shedding period in operators with campylobacteriosis (38 days on average);
- the effectiveness of heat treatments on the bacteria (> 65°C) and of the curing process.

## Domestic hygiene

It is recognised that contaminated poultry products (carcasses, cuts of meat) are the main source of introduction of *Campylobacter* spp. in kitchens. There are many opportunities for transfer of contamination between these sources and other foods consumed raw, through handling, equipment and surfaces. The following recommendations are therefore of particular importance:

### Recommendations to consumers

- Hands must be washed thoroughly after handling raw meats, and the use of several dedicated chopping boards (wood or plastic), should be recommended.
- In all cases, they must be rigorously maintained (cleaning, disinfecting, scraping).
- Ensure thorough cooking (> 65°C internal temperature) of poultry and other meat, and in particular ensure good hygiene conditions when handling meat during preparation and consumption of such foods. Barbecuing is a known risk factor involved in sporadic cases of campylobacteriosis and particular attention must be paid to ensuring adequate cooking, especially of chicken leg/thigh joints which should not be pink or have traces of blood, and to general hygiene concerning preparation of meat for the barbecue. In particular the dish and utensils used in the seasoning and preparation of raw meat should be thoroughly cleaned before being reused for cooked meat.
- Finally, the consumption of raw poultry meat ("carpaccio" style) should be avoided.

## References and links

### General references

- AFSSA. 2004. Appréciation des risques alimentaires liés aux campylobacters. Application au couple poulet/ *Campylobacter jejuni*. [Assessment of the foodborne risks associated with *Campylobacter*. Application to the combination chicken/*Campylobacter jejuni*] 96 pages.
- InVS 2004. Morbidité et mortalité dues aux maladies infectieuses d'origine alimentaires en France [Morbidity and mortality from foodborne diseases in France], 192 pages.
- *Campylobacter*. Third edition. 2009. Nachamkin I. et al. (eds.), ASM Press, Washington DC, 716 pages.

### Useful links

- National Centre of Reference for *Campylobacter* and Helicobacter: Bacteriology Laboratory, Victor Segalen University - Bordeaux 2, 146, rue Léo Saignat, 33076 Bordeaux cedex, France.
- National Reference Laboratory for *Campylobacter* sp.: ANSES Ploufragan - Plouzané Laboratory.
- European Union Reference Laboratory for *Campylobacter*: Statens Veterinärmedicinska Anstalt (SVA), S-751 89 Uppsala, Sweden.

(6) NF EN ISO 10272-1 April 2006 Microbiology of food and animal feeding stuffs - Horizontal method for detection and enumeration of *Campylobacter* spp. Part 1: Detection method.

(7) ISO/TS 10272-2:2006. January 2006. Microbiology of food and animal feeding stuffs -- Horizontal method for detection and enumeration of *Campylobacter* spp. -- Part 2: Colony-count technique.

(8) ISO 17995:2005 June 2005. Water quality - Detection and enumeration of thermotolerant *Campylobacter* species.