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Campylobacter: A Foodborne Pathogen

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A B S T R A C T

Campylobacter is one of the main causes of bacterial gastroenteritis in humans worldwide. The most frequent cause of food borne disease is diarrhoeal disease agents that account for more than half of the global burden of food borne diseases. *Campylobacter* species are widely spread in most warm-blooded animals. They are commonly established in food animals. Campylobacter colonizes the mucus that lines the epithelial cells mainly in the blind and small intestine, but it can also be seen in other parts of the intestine, the spleen and the liver. Virulence factors such as adhesion and invasion of epithelial cells, motility, serum resistance and resistance to bile salts etc are important. Different methods to reduce the burden of Campylobacter; the most common physical methods include cold water, hot water, and high pressure washing. Less common physical methods include steam and steam vacuum. Popular chemical methods include organic and inorganic acids and bases, and / or chlorine and related compounds.

Introduction

Campylobacter is one of the main cause of bacterial gastroenteritis in humans worldwide. Foodborne diseases cause serious public health problems that lead to morbidity and mortality, and a significant impediment to socioeconomic development worldwide. The most frequent cause of food borne disease is diarrhoeal disease agents that account for more than half of the global burden of food borne diseases, with 550 million people falling ill and 2,30,000 dying each year. Children are at particular risk of foodborne diarrhoeal diseases, with 96,000 deaths and 220 million falling sick each year. Diarrhoea is often caused by eating raw or undercooked meat, eggs, fresh produce and dairy products (WHO, 2016). Drinking contaminated water can also act as the source of *Campylobacter*.

Campylobacter was first identified by Theodor Escherich in 1886 who described the spiral form of bacteria in the children's diarrhoeic stool sample.

Campylobacter fetus was the first *Campylobacter* spp. isolated from the uterine mucosa of aborted sheep by McFadyean and Stockman in 1906. The genus *Campylobacter* was named for the first time in 1963 by Sebald and Veron (Silva *et al.*, 2011).

The majority of *Campylobacter* spp. have unique polar flagella in one or both ends, which confers a characteristic motility similar to a corkscrew. These are S-shaped or spiral curvilinear Gram negative rods, measuring 0.2 to 0.8 μm wide and 0.5 to 5 μm long (Park, 2002). *Campylobacter*'s require microaerophilic conditions (three to 15 percent oxygen) and capnophilic (five to 10 percent carbon dioxide) for their growth. They can grow between 37 °C and 42 °C, but cannot grow below 30 °C and above 48 °C. They are able to survive for a shorter time at the refrigeration temperature (Doyle *et al.*, 1992). The optimum pH for the growth of *C. jejuni* is in the range of 6.5-7.5, however all strains grow well at pH 5.5- 8.0. A minimum water activity of 0.987 is required for the growth of the organism *Campylobacter* spp. (Murphy *et al.*, 2006). It is extremely sensitive to acidic conditions, drying and to high relative humidity. *Campylobacter* does not ferment carbohydrates and requires complex growth media for isolation (blood based or carbon-based media). Most species are positive for oxidase and catalase and reduce nitrate, but only *C. jejuni* is positive hippurate hydrolysis test (Vandamme, 2000).

Campylobacter species are widely spread in most warm-blooded animals. They are commonly established in food animals such as poultry, pigs, cattle, sheep, cats and dogs. Bacteria have also been found in ostriches and seafood (WHO, 2016). *Campylobacter* normally lives in the intestinal tract of warm-blooded animals, mainly in poultry because of its high body temperature (41^0C) which is conducive to its growth making it an important reservoir. It is believed that consumption of contaminated, undercooked poultry is one of the main contributors to *Campylobacter* infection in humans. In chicken, *Campylobacter* colonizes the mucus that lines the epithelial cells mainly in the blind and small intestine, but it can also be seen in other parts of the intestine, the spleen and the liver. Contamination of meat occurs during de-feathering, evisceration and scalding during slaughter (Keener *et al.*, 2004).

The most frequently reported human and animal infections are caused by *C. jejuni* (subspecies *jejuni*) and *C. coli*. Other species such as *C. lari* and *C. upsaliensis* are reported less frequently (Vandamme, 2000 and Nachamkin *et al.*, 2000). Some strains of *C. jejuni* are highly infectious, and it is reported that the infectious dose is as low as 500 cells (Newell *et al.*, 2000 and Black *et al.*, 1988). More than 80 per cent of human infections are caused by *C. jejuni* and approximately 10 per cent of cases by *C. coli* (Skirrow and Blaser, 2000).

Several virulence factors are considered important for enteritis induced by *Campylobacter*, such as adhesion and invasion of epithelial cells, motility, serum resistance and resistance to bile salts, among which the invasion of epithelial cells and the production of Cytolethal Distending Toxins (CDT) are important bacterial virulence mechanisms that induce enterocolitis. Cell invasion could cause cell damage, which would reduce the absorption capacity of the intestine, while the production of CDT is important for the release of interleukin-8 (IL-8) by intestinal cells, which plays an important role in the inflammatory response of the host's mucosa. The incubation period is typically three to six days (Dasti *et al.*, 2010).

Each year, almost one in 10 people get sick and 33 million disability-adjusted life years is reported due to *Campylobacter*iosis. *Campylobacter* infections are generally self-limiting, but can be grave among very young children, immunosuppressed and elderly people (WHO, 2016). *Campylobacter*iosis is very important from a socio-economic point

of view because of high incidences of diarrhoea, as well as its duration and possible complications. In developing countries, children less than two years of age are more susceptible to *Campylobacter* infection and sometimes even causing death. The disease is characterized by diarrhoea (often with blood), abdominal pain, fever, and occasionally nausea and vomiting. More serious illnesses may occur, such as dehydration, septicaemia, and symptoms that mimic acute appendicitis or ulcerative colitis. In approximately one in 1,000 cases, the infection is followed two to three weeks later with Guillain-Barre syndrome (GBS), a debilitating inflammatory polyneuritis. Other possible autoimmune diseases of *Campylobacter* infections include reactive arthritis or Reiter's syndrome and Miller Fisher's syndrome (MFS) (Kneere *et al.*, 2004). The disease in animals is less common, occasionally an illness occurs, and the most common sign in animals is diarrhoea. The diagnosis can be made by culture-based techniques and also rapid culture independent tests such as antigen and / or nucleic acids tests are performed.

There are different methods to reduce the burden of *Campylobacter*; the most common physical methods include cold water, hot water, and high pressure washing. Less common physical methods include steam and steam vacuum.

Popular chemical methods include organic and inorganic acids and bases, and / or chlorine and related compounds. Irradiation is a less popular but effective method for bacterial reductions (Kneere *et al.*, 2004).

Control strategies have been improved in recent years, including on-farm techniques and methods during the processing of meat of food animals. However, these strategies still require significant improvements to completely eliminate or significantly reduce the threat of *Campylobacter* contamination into food products.

One health approach is needed to reduce *Campylobacter* infection in humans. The source of infection can be water, food, environment, close interaction with pets and livestock animals, therefore, the multiple disciplines that are in charge of all the above mentioned sectors must join and work together to protect humans from *Campylobacter* infection.

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