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Review Article

Growing Role of Arcobacters as an Emerging Potential Pathogen of Humans and Animals

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Abstract

Arcobacters are recognized as emerging pathogens, and are reported from many countries of the world. In diverse parts of the world, Arcobacters have been found in domestic animals (cattle, pigs, sheep, horses, and dogs), reptiles (lizards, snakes), meat (poultry, pork, goat, lamb, beef, and rabbit), vegetables, and humans. *Arcobacter* infections are spread generally through the contaminated food and water. *Arcobacters* have been related to human bacteremia, endocarditis, peritonitis, gastroenteritis, and diarrhea, as well as animal diarrhea, mastitis, and miscarriage. Clinical disorders are mostly related with three species namely *A. butzleri*, *A. cryaerophilus*, and *A. skirrowii*. The infection can take two forms: sporadic and epidemic. Exogenous infection is the predominant method of transmission, with ingestion as the primary source of infection. The laboratory help is required to establish the diagnosis of infection. Strategies should be planned to prevent the infection in humans as well as animals.

Keywords: Animals; Arcobacters; Bacteria; Emerging Pathogen; Food; Humans

Introduction

Since the creation in 1991 of the genus *Arcobacter* as a second genus within the family *Campylobacteraceae*, 13 species have been characterized [1]. At present, six species are associated with humans and animals, whereas the others seem to be more environmentally related one health emerging food-borne and water-borne enteropathogen. Because of its ubiquity and potential as a human health danger, *Arcobacter butzleri* has received a lot of attention around the world. Food-borne diseases are becoming more important as a result of the rise in the frequency of outbreaks in recent years around the world [2].

In humans, *Arcobacter butzleri* has been identified primarily from individuals with enteritis and, on rare occasions, septicemia. Infection probably occurs through the consumption of contaminated drinking water and food, in particular pork, beef and poultry products [3]. Other risk factors are contact with pets and person-to-person contact. In animals, *Arcobacters* are linked to diarrhea, abortion, and mastitis, whereas in people, they are associated with gastroenteritis, diarrhea, bacteremia, peritonitis, and endocarditis. *Arcobacter butzleri*, *Arcobacter cryaerophilus*, and *Arcobacter skirrowii* are the most usually connected *Arcobacter* species with clinical disorders. It is mentioned that poultry serve as a key reservoir for *Arcobacters* and a major source of infection transmission [4].

Increased infections of this food-borne disease in the human community are caused by contamination of food samples and changing patterns in human dietary habits. In an Italian nursery and primary school in 1992, an outbreak of recurring stomach

pains linked to *A. butzleri* occurred. As revealed by polymerase chain reaction-mediated DNA fingerprinting, all 14 outbreak-related organisms appeared to be generated from a single clone [5,6]. This communication is an attempt to present an overview on Arcobacters as an emerging potential pathogen of humans and animals.

Arcobacters

Due to their similarities to the organisms of the genus *Campylobacter*, the genus *Arcobacter* was originally known as "aerotolerant campylobacters" [3]. *A. butzleri* was named after Jean-Paul Butzler, a Belgian clinician and microbiologist [7]. The organism has been found in a wide range of environments and hosts, making the genus uncommon within the Proteobacteria's epsilon subdivision [8].

Organisms belonging to the genus *Arcobacter* are primarily differentiated from campylobacters by their ability to grow in air and between 15 ^{0}C to 30^{0}C temperature. *Arcobacte*r is a Gram-negative, helical, non-spore forming rod that belongs to the *Campylobacteraceae*, which was called 'arc shaped bacterium' in Latin and also, helical, non-spore forming rods. Arcobacters are generally 0.2-0.9 mm wide and 1-3 mm long [8].

Arcobacter butzleri strain can grow within a temperature range from 15^{0}C to 37^{0}C, but optimal growth is observed at 30^{0}C [9]. Microaerobic conditions are required for primary isolation, and no measurable growth is normally found at 40^{0}C. It can endure freezing for up to 6 months at -20^{0}Cand up to 24 months at -70^{0}C, however at temperatures beyond 55^{0}C, the organism becomes inactive quickly. *Arcobacter* strains can grow in a pH range of 5.5 to 9.5, howeve, growth is best between 6.8 and 8.0. Among the various species of Arcobacters, *A. butzleri*, *A. cryaerophilus*, *A. skirrowii*, and *A. cibarius* are emerging food-borne pathogens of public health concern. The most prevalent *Arcobacter* species is *A. butzleri*, which has been linked to enteritis, severe diarrhea, and septicaemia in human beings [9].

Arcobacter infections have been reported in chickens, domestic animals (pigs, cattle, sheep, horses, and dogs), reptiles (lizards, snakes, and chelonians), meat (poultry, lamb, pork, beef, goat, and rabbit), vegetables, and humans in many countries of the world such as Belgium, Brazil, Denmark, Italy, the Netherlands, Australia, Malaysia, Japan, Spain, and the Czech Republic Korea, Egypt, and India [10].

Transmission

Although this has not been verified, consumption of *Arcobacter* infected food or water is thought to be the route of transmission to humans and animals [10]. *Arcobacter* spp. has been isolated from patients and/or contaminated water in certain drinking water outbreaks [11]. In addition, because of their pathogenic function in people and animals, *Arcobacter* species have been classified as potential zoonotic agents, and *A. butzleri* was ranked as a microbe of major importance using an evidence-based semi-quantitative method for prioritizing food-borne zoonoses [12]. There is yet to be proof of direct transmission between these two groups [10].

Pathogenesis of arcobacters

The pathogenic potential of *A. butzelri* is still understudied, with few investigations devoted to elucidating the pathogenic pathways associated with this genus. To begin unraveling the mechanism that may promote *Arcobacter* infection, researchers examined both *in vitro* and *in vivo* models. Several *Arcobacter* species may adhere to and penetrate eukaryotic cells, as well as create toxins that harm host cells, according to *in vitro* human and animal cell culture experiments. Scarce *in vivo* studies were performed to clarify the pathophysiology and pathogenic potential of *Arcobacter* species [11].

Diseases caused by arcobacters in animals

Various *Arcobacter* species have been identified from a variety of animals and their excretions, including saliva, feces, and vaginal secretions [13]. In India, prevalence rates of 21% in pigs, 15% in poultry droppings, and 3% in human diarrheal samples have been reported; isolation rates of 8% in poultry droppings, 10% in bovine fecal samples, 13% in pigs, and 2% in human diarrheal samples have been reported; and 29 have reported an isolation rate of 2% from human diarrheal samples [12]. *Arcobacters* have been found in live fowl skin, droppings, and meat, indicating that they are a potential reservoir for the bacteria [13,14].

In nature, *Arcobacter* causes many infections, but only a few develop into clinical conditions. In animals, *Arcobacter* causes abortions, diarrhea, and mastitis [15]. In pigs, cattle, and horses, *Arcobacter butzleri* produces enteritis and/or diarrhea, whereas *A. skirrowii* causes diarrhea and/or hemorrhagic colitis in sheep and cattle [16]. Cases of *A. skirrowi* induced abortions in ewes

have been reported in South Africa. This paper also emphasized the importance of learning more about this pathogen's propensity to cause abortion in other animals. Reports from animals are restricted to terrestrial animals. Because *A. butzleri* pathogenesis is dependent on the host species and breed, the laboratory animal models for investigating the pathogenesis of *A. butzleri*are currently unavailable. *A. butzleri*, on the other hand, did not produce disease in conventional chicken but did cause disease in turkey [4].

Infections caused by arcobacters in humans

In 1988, *Arcobacter cryaerophilus* became the first *Arcobacter* species to be identified in humans. Human feces and blood samples have been shown to contain *Arcobacter*, which can cause symptoms ranging from diarrhea to septicemia [8]. Gastrointestinal manifestations are prevalent in humans and might include watery diarrhea in the case of *A. butzleri* infection, as well as other symptoms, while bloody diarrhea is usually noticed in *Campylobacter jejuni* [8]. Along with *E. coli, Shigella, Salmonella, and Campylobacter, Arcobacter* species has been identified as a bacterial agent of traveler's diarrhea [17].

Arcobacters have also been found in blood samples from patients with cirrhosis of the liver and appendicitis [15]. *Arcobacter* enteritis is characterized by severe diarrhea that lasts 3-15 days and can be persistent or recurring for more than two weeks or even two months [12]. Abdominal discomfort and nausea are common symptoms, and some patients have fever, chills, vomiting, and weakness [12]. The etiological agent of traveler's diarrhea acquired by US and European tourists visiting Guatemala, Mexico, and India was discovered to be *Arcobacter butzleri* [18].

With watery diarrhea, *Arcobacter butzleri* has comparable characteristics to *C. jejuni*. During an outbreak among nursery and primary school children in Italy, *Arcobacter butzleri* was the only probable enteric pathogen recovered; in this case, ten infected children suffered from recurrent stomach cramps without diarrhea [5]. After *Campylobacter jejuni*, *C. coli* and *C. upsaliensis*, *Arcobacter butzleri* is the fourth most frequent *Campylobacter* like bacteria isolated from the stool of human patients in France and Belgium [6]. *Arcobacter butzleri* was isolated from blood of a 69-year-old woman [15]. Researchers reported isolation of *A. cryaerophilus* from a blood sample of a boy who developed acute respiratory distress and succumbed. In an instance of neonatal bacteremia, vertical/transplacental transfer was thought to be the mode of transmission [19].

Infections caused by arcobacters in animals

Abortions, mastitis, and diarrhea are the most significant *Arcobacter* consequences in animals [10]. Although *Arcobacter* has been linked to bovine abortion on multiple occasions, the germs have also been found in healthy bovine preputial sheath washings and vaginal swabs from cows with no reproductive issues [20]. It has also been connected to porcine miscarriage, sows with reproductive difficulties, and boars' and fattening pigs' preputial fluid [20]. In pigs, cattle, and horses, *Arcobacter butzleri* has been linked to enteritis and diarrhea, whereas *A. skirrowii* has been associated with diarrhea and hemorrhagic colitis in sheep and cattle [10].

Treatment and control

Several antimicrobials have been proposed for the treatment of *Arcobacter* infections; however, based on case studies, the choice of antibiotic class for a treatment was mostly cephalosporins or combinations with this class of antibiotics [15]; however, the treatment of intestinal infections was less consensual, and the use of quinolones [20], tetracycline, macrolide or even a b-lactam antibiotic combined with a b-lactamase inhibitor have been postulated [1]. The findings of limited resistance to fluoroquinolones prompted the authors to believe that they could be utilized to treat severe *Arcobacter* [21].

Furthermore, *A. butzlerii,* like many other pathogens, is resistant to a variety of medicines, necessitating the development of new treatments to manage and prevent infections caused by this bacterium. Although progress is being made in this field, additional research into the impact of various antimicrobials on intentionally and naturally contaminated matrices/surfaces is required. Only by gaining more information, it will be possible to assess and manage the danger provided by *A. butzleri*, allowing for the prediction, prevention, and control of foodborne public health risks caused by this emerging bacterium [22].

Conclusion and Recommendations

Despite the fact that several studies on *Arcobacter* infections are continually becoming available from various nations, there is still no clear documentation on the virulence genes/factors that are directly involved in the causation of infection and pathogenesis of

this disease. In the near future, focused study should be aimed at unraveling the unknown elements of pathology and pathogenesis of these organisms, paving the way for the development of effective management measures. Veterinarians and medical professionals should be aware of *Arcobacter* transmission route so that they can educate the public about hygienic measures in the kitchen and abattoirs, reducing the possibilities of these organisms spreading. Antimicrobial resistance is also on the rise in *Arcobacters* against commonly used antimicrobials, which is concerning from a public health standpoint. Herbal active principles, essential oils, bacteriophages, probiotics, avian egg antibodies, and RNAi technologies are all recommended as ways to help prevent the development of antibiotic resistance and the spread of *Arcobacters*. Since isolation is considered as the gold standard for confirmation of *A. butzelri* infections, sincere attempts should be directed towards the development of cheap, specific, selective media that can be widely used even by the poor resource nations.

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Author's Contribution

All the authors contributed equally. They read the final version, and approved it for the publication.

Conflict of Interest

The authors declare that they do not have conflict of interest.

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