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Popular Article

Aeromonas An intermediary in the One Health World

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Introduction

Food borne diseases are one of the major causes of morbidity and mortality all around the world. Foodborne disease can be defined as "any disease usually either infectious or toxic in nature, caused by agents that enter the body through ingestion of food" (Adams and Moss, 2003). Food borne diseases due to consumption of various animal products, *viz.* fish, milk, meat and eggs have remained a major topic of veterinary public health research. Various factors such as pathogen evolution, changes in agricultural and food manufacturing practices, changes in the host immune status and environmental changes etc., are contributing to the emergence and re-emergence of food borne pathogens and illnesses. The globalization of food trade has increased the risk of spreading foodborne hazards around the world.

Food safety and fisheries

Foods of animal origin is considered superior mainly because of its high-quality protein with higher biological value. Fish is said to have 15-20% proteins and rich in vitamins, minerals and omega-3 fatty acid. It has a low cholesterol content. Fish is an excellent nutritious medium for the microbes to grow, due to high moisture, minerals, accessory growth factors and a favourable pH. Food safety implies absence or acceptable and safe levels of pathogens, adulterants, naturally occurring toxins or other substances in food, that make it injurious to human health. Aeromonas is one of the emerging foodborne pathogens. Increasing reports of Aeromonas infections in human as well as animals have drawn attention of researchers in the field of microbiology and molecular biology.

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Taxonomy of Aeromonas

The genus Aeromonas belongs to the class of Gammaproteobacteria, order Aeromonadales, and family Aeromonadaceae. The word Aeromonas was derived from two Greek words 'aer' (gas) and 'monas' (units), meaning gas-producing units. The genus Aeromonas comprises 36 species of which at least 19 are considered emerging pathogens to humans, causing a broad spectrum of infections. The most relevant clinical species are *A. caviae, A. veronii, A. hydrophila* and *A. dhakensis* (Fernández-Bravo *et al.*, 2020).

Growth characteristics of Aeromonas

The Aeromonads are Gram-negative, rod-shaped, non-spore forming, non-acid-fast facultative anaerobes which are widely distributed in the soil, foodstuffs, and aquatic environment. The members of the genus are able to grow or survive at temperatures ranging from <5 °C to 45 °C, in vacuum packaged food, under 100% CO_2 atmosphere, and in nutrient poor conditions. Metabolically Aeromonads are chemoorganotrophic, produce catalase and are oxidase positive. They resist pH ranges from 4.5 to 9 but the optimum pH range is 5.5 to 9 and optimum sodium chloride concentration range is 0 to 4%. The Aeromonads and Enterobacteriaceae share many biochemical characteristics but are easily differentiated by oxidase test for which the Aeromonads are positive. Aeromonas are resistant to vibrostatic compound O/129 (150 µg) and variable presence of ornithine decarboxylase activities differentiates the genus from Plesiomonas and Vibrio. Other important distinguishing qualities include their inability to grow in the presence of 6.5% sodium chloride, inability to ferment inositol and negative string test (Joseph and Carnahan, 2000).

Aeromonas in aquatic environment

The *Aeromonas* spp. are autochthonous to the aquatic ecosystems, including ground water, surface waters, marine waters, non-chlorinated drinking water, chlorinated drinking water and bottled mineral water. Screening of drinking water for the presence of *A. hydrophilla* is mandatory in United States as per the Safe Drinking Water Act of United States Environmental Protection Agency (Environmental Protection Agency, 2006). The organism has been listed on the first and second Contaminant Candidate List (CCL-1 and CCL-2) of potential waterborne pathogen. These emerging enteric pathogens flourish in the water distribution system by forming biofilms in the water channels (Igbinosa *et al.*, 2012).

Aeromonas in animals

Aeromonads have been reported both in cold-blooded and warm-blooded animals causing variety of illnesses. Aeromonas was first isolated from septicemias in frogs and sick fish. The

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important fish pathogens like *A. salmonicida* and *A. hydrophila* particularly affect salmonids, causing ulcers, hemorrhages, furunculosis, and septicemias. Other conditions include ulcerative stomatitis in snakes and lizards, "red leg" disease in frogs, septicemia in dogs, septic arthritis in calves and seminal vesiculitis in bulls (Beaz-Hidalgo *et al.*, 2009).

Aeromonas in humans

Aeromonas spp. cause cellulitis, abscess, wound infection, necrotizing fasciitis, myonecrosis, pneumonia, empyema, septicemia, septic arthritis, osteomyelitis, endocarditis, meningitis, gastroenteritis, appendicitis, peritonitis, acute suppurative cholangitis, and corneal ulcer in humans (Figueras *et al.*, 2005). They were also reported among humans suffering from urinary tract infections, gastroenteritis and neonatal meningitis (Mandal *et al.*, 2010).

Aeromonas in foods

Most *Aeromonas* spp. particularly those associated with human infections are found in a wide variety of fresh produce, meat and dairy products (Igbinosa *et al.*, 2012). These foods play an important role in the dissemination of the potentially pathogenic Aeromonas to humans. Though the foodborne outbreaks caused by Aeromonas are few, epidemiological evidence suggests that the bacterium can cause self-limiting diarrhoea in susceptible population especially in children. Most of the aeromonads can grow in refrigeration temperature. Aeromonads are not resistant to food processing procedures and are easily destroyed by heat treatment.

Virulence factors

The versatility of *Aeromonas* spp. in inflicting diseases in man and animals is attributable to an array of virulence factors possessed by the members of the genus. *Aeromonas* spp. has been reported to secrete exotoxins (hemolysins, cytotoxins and enterotoxins), hemagglutinins, adhesions and several hydrolytic enzymes. Many of the studies also reported the distribution of virulence genes among the isolates (Janda and Abbott, 2010).

Aeromonas as an indicator of antimicrobial resistance in aquatic environment

A wide variety of antimicrobials are used for treating human infections, animals and fish farms resulting into the release of such antimicrobials into the aquatic environment either through sewage or directly from farms. This provides a selective pressure for the development or acquisition of antimicrobial resistance genes. Therefore, Aeromonas can be used as an indicator organism to monitor antimicrobial resistance in the aquatic environment. One interesting characteristics of *Aeromonas* spp. is their inherent resistance to broad spectrum antimicrobials *viz.*, ampicillin. Perhaps this is the reason for inclusion of this antimicrobial in selective isolation medium like Ampicillin Dextrin Agar. Indeed, not all Aeromonads are resistant to ampicillin (Rall

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et al., 1998). Genes conferring resistance to tetracyclines and β-lactam groups of antibiotics have been identified in Aeromonads (Janda and Abbott, 2010).

Conclusion

Aeromonas is predominantly distributed in the aquatic system and environment, leading to a variety of infections in humans and animals. Various foods acts as a potential transmission source of Aeromonas infections. Proper surveillance of water, food and sanitation facilities using public health diagnostic and detection procedures is essential to protect infections caused by Aeromonas. One Health approach has the potential in solving these problems holistically and systematically. Fish farmers, consumers, researchers, government agencies and consumer advocacy groups play an important role in influencing food safety policies and aquaculture practices.

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