

## **Emerging Role of *Aeromonas hydrophila* as a Foodborne Pathogen of Public Health Concern**

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### **Abstract**

*Aeromonas hydrophila* is an emerging and re-emerging bacterial foodborne pathogen that can cause life threatening infections. It is ubiquitous in various aquatic environments, and has been considered as a pathogen of fish, amphibians, reptiles and mammals. The organism has been readily isolated from a wide variety of foods, such as fish, eggs, vegetables, sea foods, meat, meat products, milk and milk products. Young children, elderly people and immunocompromised patients are at higher risk of infection. *Aeromonas hydrophila* infection has been reported from many countries of the world including India. The source of infection is exogenous, and humans can acquire the infection by ingestion of contaminated fish, sea foods, raw milk, raw meat, raw vegetables, and water contaminated with *A. hydrophila*. Infection can also occur through open wound contamination. The duration of illness may range from 3 days to 6 months. *Aeromonas hydrophila* is found to be associated with variety of extra-intestinal infections like meningitis, peritonitis, osteomyelitis, cholangitis, pneumonia, septicemia, cellulitis, myonecrosis, eczema, conjunctivitis, and endophthalmitis. When *A. hydrophila* crosses the blood-ocular barrier to reach the eye via blood stream, it causes a sight-threatening condition known as endogenous endophthalmitis. Most of the infections caused by *Aeromonas* spp. are gastrointestinal infections and can be easily prevented by maintaining adequate sanitary conditions, such as proper hand hygiene, efficient sewage disposal, and hygienic food preparation. Furthermore, thorough cooking of the food product also minimizes the transmission of infection.

**Keywords:** *Aeromonas hydrophila*; Emerging Pathogen; Food Borne Disease; Sanitation; Public Health

### **Introduction**

*Aeromonas hydrophila*, a Gram-negative, motile, rod shaped, facultative anaerobic bacterium, has emerged as an important foodborne pathogen worldwide [1-3]. It is widely prevalent in diverse aquatic environments, and has the potential to infect amphibians, fish, reptiles, and mammals [1,4]. The pathogen is isolated from a wide variety of foods, such as fish, vegetables, milk, milk products, meat, meat products, eggs and sea foods [1,4-7]. Due to its capacity to grow even at low temperatures that range from -0.1 to 37°C, it has major role in the spoilage of packaged foods [8]. *Aeromonas hydrophila* is a ubiquitous microorganism that is found in a variety of aquatic environments worldwide, including well water, lakes, rivers, swamps, ground water, bottled water, chlorinated water and sewage [1,4]. It causes illness mainly in fish and amphibians because this organism lives in aquatic environments. Kirov and co-investigators [9] recorded that over 50% of the raw milk samples were contaminated with *A. hydrophila*. A large epidemic of *A. hydrophila* was described in college students

from China by Zhang and co-workers [10]. The affected subjects showed clinical spectrum, which included acute diarrhea, abdominal pain, vomiting, headache, and fever. The epidemiological investigation indicated that the vegetables used to prepare salad were washed in polluted water from a tank located near to sewage pit.

*Aeromonas* is recognized as potential foodborne pathogen for more than 20 years. The organism is very frequently found in many food products, including raw vegetables. *Aeromonas* species primarily *A. hydrophila* HG1, *A. veronii* biovar *sobria* HG8/10, and *A. caviae* HG4 can cause self-limiting diarrhoea, particularly in children [11]. Janda and Abbott [12] described that *Aeromonas hydrophila* is a complex of three species including *A. hydrophila sensu stricto*, *A. bestiarum* and *A. salmonicida*. Very recently, Pal [3] has mentioned that *A. hydrophila* is an emerging bacterial agent of food safety concern.

*Aeromonas hydrophila* has been associated with foodborne diseases and is frequently found in drinking water and raw meat. A greater risk of infection is reported in young children, elderly people and immunocompromised patients [13]. *Aeromonas hydrophila* is responsible for food and water borne disease causing plethora of human disease varying from a self-limiting gastroenteritis to potentially fatal septicemia [2]. These bacteria cause hemorrhagic septicemia, fin rot, soft tissue rot and furunculosis in fish. It was recently reported that epizootic ulcerative syndrome (EUS) caused by *Aeromonas sobria* resulted in great damage to fish farms in parts of southeast Asia, such as Bangladesh and India [14].

*Aeromonas hydrophila* is the most important species that causes gastrointestinal as well as extra-intestinal infections in humans. They can produce virulence factors including a relatively heat stable cholera-like enterotoxin and heat labile cytotoxic enterotoxin and is recognized as a potential cause of food associated outbreaks of gastroenteritis and as etiological agent of acute diarrheal in particular among children [15]. The present communication delineates the growing role of *Aeromonas hydrophila* as an emerging foodborne bacterial pathogen of public health concern.

### Transmission

Humans can acquire the infection by ingestion of contaminated fish, sea foods, raw vegetables, raw milk, raw meat, and water. Drinking of contaminated water, raw milk and consumption of contaminated foods are important risk factors, which predispose the individuals to *A. hydrophila* infections. Swimming in contaminated water can also pose a risk to infection [3]. *Aeromonas hydrophila* infection can also occur through open wound contamination [3].

### Clinical signs in humans

The incubation period of *Aeromonas hydrophila* is 1 to 2 days. The bacterium is found to be associated with gastrointestinal symptoms, such as nausea, vomiting, diarrhea and also with a variety of extra-intestinal infections like meningitis, peritonitis, cholangitis, pneumonia, skin and soft tissue infections, haemolytic uremic syndrome, septicemia, myonecrosis, eczema, and ocular infections [1,16-18]. The pathogen can cross the blood-ocular barrier to reach the eye via blood stream, and can result in endogenous endophthalmitis [19,20]. In this context, Pal [1] described *A. hydrophila* infection in a person who developed diarrhea following the ingestion of contaminated uncooked fish. Similarly, Kamalpreet and others [7] reported that *A. hydrophila* may act as causative agent of diarrhea resulting from improper handling and consumption of contaminated food.

### Diagnosis

As clinical signs are not very specific to warrant the diagnosis, laboratory help by using microbiological, immunological, and molecular technique is required to establish an unequivocal diagnosis of *A. hydrophila* infection [1]. A number of media, such as nutrient agar, blood agar, MacConkey agar, thiosulphate citrate agar, starch ampicillin agar, ampicillin dextrin agar and Pyan's agar are employed for the

isolation of organism. The organism produces beta haemolytic colonies on blood agar. It is important to mention that *A. hydrophila* should be differentiated from *Plesiomonas shigelloides*, *Vibrio cholera*, *V. parahaemolyticus* and *V. vulnificus* [3].

### Treatment

A number of antibacterial antibiotics, such as ciprofloxacin, chloramphenicol, enrofloxacin, levofloxacin and meropenem can be used in the treatment of *A. hydrophila* infection [1]. Supportive treatment includes oral fluid electrolyte to check the dehydration. Some isolates of *A. hydrophila* show *in-vitro* resistance to common antibiotics, such as ampicillin, colistin, penicillin, and tetracycline. In this context, Kaskhedikar and Chhabra [21] reported multiple drug resistance in *A. hydrophila* isolates, which originated from fish. It is recommended that early therapy is imperative in immunocompromised patients to prevent the serious complications.

### Prevention and control

Most of the infections caused by *Aeromonas* spp. are gastrointestinal infections. These can be easily prevented by maintaining adequate sanitary conditions, such as correct hand washing, hygienic preparation of food, and efficient disposal of sewage [1,3]. The transmission of infection can be minimized by pasteurization of milk and cooking of the food. Adequate disposal of the diseased animal and proper water treatment can prevent the spread of the microbes. Continuous monitoring of the quality of water is vital to reduce the health risk due to *Aeromonas* species [2]. Proper attention to wound and antiseptic dressing before handling of fish can check the entry of bacteria through skin lesions [1]. Health education of public to avoid the consumption of raw fish, raw milk, sea foods and other foods is highly imperative [1]. The importance of sanitation in food establishments is well documented by Pal and Mahendra [22].

### Conclusion

*Aeromonas hydrophila* occurs ubiquitously in different aquatic environments and can be isolated from a wide variety of foods including fish, milk, and meat. It is an important emerging bacterial pathogen, which is associated with foodborne diseases in many countries of the world. The pathogen can cause life threatening infection, particularly in young children, elderly people and immunocompromised patients. The infection can occur in sporadic and epidemic form. It is emphasized to maintain high standards of sanitation in food establishments to prevent the spread of *Aeromonas* infection. The application of good hygienic practices and hazard analysis critical control point is highly pertinent from food safety point of view. Additional studies on the virulence, risk factors, and molecular epidemiology should be undertaken.

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### Conflict of Interest

None.

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