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REVIEW

Antimicrobial resistance of *Aeromonas hydrophila* isolated from different food sources: A mini-review

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Summary *Aeromonas hydrophila* is a Gram-negative, oxidase-positive, facultative, anaerobic, opportunistic aquatic pathogen. *A. hydrophila* produces virulence factors, such as hemolysins, aerolysins, adhesins, enterotoxins, phospholipase and lipase. In addition to isolation from aquatic sources, *A. hydrophila* has been isolated from meat and meat products, milk and dairy products, and vegetables. However, various studies showed that this opportunistic pathogen is resistant to commercial antibiotics. This is attributed to factors such as the indiscriminate use of antibiotics in aquaculture, plasmids or horizontal gene transfer. In this report, we highlight the occurrence, prevalence and antimicrobial resistance of *A. hydrophila* isolated from different food samples. The presence of antimicrobial-resistant *A. hydrophila* in food poses threats to public and aquatic animal health.

Contents

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Introduction

The genus *Aeromonas* consists of oxidase-positive, facultative, anaerobic Gram-negative bacteria that normally inhabit the aquatic environment. Depending on the physiological properties and hosts, they are divided into two large groups. The first group includes motile aeromonads, with *Aeromonas hydrophila* as a typical representative that causes infections mainly in humans. The other group consists of non-motile species, represented by *Aeromonas salmonicida*, causing disease in fish [1]. Aeromonads have been isolated from a variety of foods, such as fish, mussels, shrimps, meat, meat products, milk and vegetables, with total counts ranging from 10^2 cfu/g to 10^5 cfu/g. Motile aeromonads produce virulence factors at varying growth temperatures [2]. The presence of Aeromonads has been reported in dairy products (4%), vegetables (26—41%), and meat and poultry (3—70%), and the majority of positive samples are isolated from seafood (31—72%) [3]. The identification of foodborne *Aeromonas* spp. shows a predominance of *A. hydrophila* [4—10].

Parker and Shaw [11] observed that aeromonads possess virulence factors such as hemolysins, aerolysins, proteases, adhesins, enterotoxins, phospholipase and lipase. Infections caused by aeromonads can lead to gastroenteritis, septicemia, meningitis, respiratory and hemolytic uremic syndrome. According to some authors [12—15], *A. hydrophila* affects humans and causes gastroenteritis. Saavedra et al. [16] stated that *A. hydrophila* causes hemorrhagic septicemia in stressed fish or those suffering from other illnesses, thereby posing health risks to consumers.

The use of antibiotics is one of the most important factors influencing the emergence of resistance in bacterial pathogens. Multi-resistant *A. hydrophila* were isolated from different parts of the world and are reported to be resistant to penicillin and ampicillin, but sensitive to aminoglycosides, tetracycline, chloramphenicol, trimethoprim-sulfamethoxazole, quinolones, and second- and third-generation cephalosporins [1,17]. However, the increase in *A. hydrophila* resistance to antibiotics is a public health concern; therefore, there should be a continuous and concerted effort to monitor the existence of this opportunistic pathogen globally [18].

Despite the vast information on the isolation and characterization of *A. hydrophila* from seafood, little information exists on the antibiotic resistance of *A. hydrophila* from meat, meat products and dairy products. The objective of this report is to review the prevalence of antibiotic-resistant *A. hydrophila* in different food sources.

Antimicrobial resistance of *A. hydrophila* in different foods

Seafood

Over the last five decades, there has been an increased production of fish at the global scale. The marketing of fish as a food increased by an average annual rate of 3.2%, which exceeds the annual growth of the global population (1.6%). The global per capita consumption of fish increased from 9.9 kg in 1960 to 19.2 kg in 2012. This impressive growth is simultaneously due to population growth, increasing income and urbanization, as well as the extensive development of fish farming and more efficient distribution channels [19].

Intensive fish farming is accompanied by a number of bacterial diseases, resulting in the increased use of antimicrobial drugs. The prevention and treatment of fish diseases through extensive application of antimicrobial agents contributes to the development of antibiotic-resistant bacterial strains [20]. Among these diseases, *A. hydrophila*-induced septicemia is a serious disease, which is treated with different antibiotics [21]. The frequent use of antibacterial drugs in aquaculture could lead to increased antimicrobial resistance and unacceptable levels of drug residues in aquaculture products and the environment [22].