Growing significance of *Vibrio parahaemolyticus* as an emerging foodborne bacterial pathogen.

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Introduction

Foodborne diseases, caused by diverse etiology, are important from public health, and economic point of view. Currently, more than 200 diseases may be transmitted to humans through the ingestion of food contaminated either with microorganisms or with chemicals [1]. These diseases can occur in sporadic as well as in epidemic form resulting in significant morbidity and mortality in people worldwide [1]. There are many emerging bacterial foodborne pathogens, such as *Aeromonas hydrophila, Arcobacter butzleri, Bacillus cereus, Campylobacter jejuni, Clostridium botulinum, Cronobacter skazakii, Eshcheria coli O157: H7, Listeria monocytogenes, Plesiomonas shigelloides, Yersinia enterocolitica, Vibrio parahaemolyticus, and V. vulnificus,* which are reported from developed as well as developing nations of the world [1,2]. These pathogens can cause life threatening infections, especially in children, elderly, pregnant women, and immune compromised persons; and are responsible for a great number of diseases with significant impact on human health and economy [2]. Among these, *V. parahaemolyticus* is an emerging foodborne bacterium that is the leading cause of gastroenteritis in many countries of the world including India [2]. The etiologic agent is a Gram negative, halophile, motile, oxidase positive, straight or curved rod-shaped, facultative anaerobic bacterium that occurs naturally in the marine, estuarine, and coastal environments throughout the world [3]. The organism is recovered from coastal water, seas and, plankton, crabs, fish, shellfish, finfish, and molluscs in Africa, Asia, Australia, Europe, New Zealand, North America, and South America [1,4].

The survival of *V. parahaemolyticus* in seafood's is subjected to chilling, freezing, heating, drying and smoking. Low-temperature freezing (at -18°C or -24°C) or High-temperature treatment above 55°C and low-temperature freezing at -18°C for 10 min is described to inactivate or kill *V. parahaemolyticus* in oysters [5]. The pathogen is reported to be sensitive to heating, freezing, refrigeration, and common disinfectants [6].

It is believed that the impact of climate change may perhaps attribute to the rising incidences of *V. parahaemolyticus* infection [7]. Most sporadic infections and outbreaks in USA were linked to consumption of contaminated, raw Mollusca shellfish. Majority of cases have occurred during the warm months. There seems to be no association with age, sex, race, and occupation in the epidemic of *V. parahaemolyticus* infection [1]. A plethora of seafood's including fish, shellfish, oysters, mackeral, crabs, mussel, lobster, calms, and shrimp are linked to several outbreaks of *V. parahaemolyticus* infection [1,8]. It is pertinent to mention that ingestion of raw and undercooked seafood, including finfish, constitutes the chief vehicle of transmission of *V. parahaemolyticus* infection to human beings [1,9].

V. parahaemolyticus was first time identified as a foodborne pathogen in Japan in the 1950s during a massive outbreak, which involved 272 persons and killed [10]. Since then, the infection is recorded in many countries, such as Australia, Bangladesh, Canada, China, France, Germany, Hong Kong, India, Indonesia, England, Italy, Laos, Malaysia, Philippines, Spain, Taiwan, Tanzania, Thailand, Vietnam, and USA [1,7,11-13]. The first isolation of *V. parahaemolyticus* from a case of gastroenteritis in India was reported by Chatterjee and co-workers in 1970. In the United States, the first outbreak of *V. parahaemolyticus* was reported in Maryland in 1971, where in 425 cases of gastroenteritis occurred following the consumption of improperly cooked crabs [14]. The bacterium is responsible to cause an estimated 4,500 illnesses in the U.S. annually, and around 90% of them were from the consumption of seafood. Between 1986 and 1995, some 197 outbreaks of foodborne disease were caused by *V. parahaemolyticus* in Taiwan [13]. This marine pathogen is recognized as an important cause of food-borne gastroenteritis, particularly in the Far East due to more consumption of seafood. *V. parahaemolyticus* causes three major syndromes of clinical illness namely, gastroenteritis, wound infections, and septicaemia [1]. *V. parahaemolyticus* is reported as common cause of diarrhoeal disease throughout the world. In this context, Su and Liu mentioned that *V. parahaemolyticus* should be considered as important pathogen of sea food safety concern It is important to cite that thermo stable direct haemolysin (TDH) and TDH-related haemolysin (TRH) are two major virulence factors of *V. parahaemolyticus*, which are closely related to its pathogenicity [6]. Although various serotypes of *V. parahaemolyticus* are found to be associated with human infections, however, serotype O3:K6 is implicated in several outbreaks [15].

The infection primarily occurs through consumption of contaminated raw fish, shellfish and other sea foods. Rarely, infection can also be acquired when a person with open wound is exposed to warm sea water. The sources of contamination are sea fish, sea water, salted vegetables, kitchen knife and chopping board [1]. The incubation period of *V. parahaemolyticus* is 3-24 hours, usually about 10-15 hours. The clinical manifestation in patients include diarrhoea, abdominal cramps, nausea, vomiting headache, fever, chills, dehydration, weakness, hypotension, and cyanosis [9]. In addition, the pathogen also causes wound infection, ear infection, traveller's diarrhoea, and septicaemia in humans [1,16].

Summary

V. parahaemolyticus from stool, rectal swab and food is attempted in several nutrient media such as arabinose gluconate agar, glucose salt teepol agar, marine agar, thiosulphate citrate bile salt (TCBS) agar, and Vibrio agar [9]. Among this, TCBS is a selective medium on which colonies of *V. parahaemolyticus* can be easily identified due to blue green colour. Kanagawa test is helpful in the identification of pathogenic isolates recovered from patients or food. The haemolysis of human or rabbit red blood cells on Wagatsuma Agar *V. parahaemolyticus*thiosulphate citrate bile salt (TCBS) agar should be widely used for the isolation and presumption identification of *V. parahaemolyticus* by poor resource countries who do not have facilities of molecular tools in the laboratory.

As *V. parahaemolyticus* infection is self-limited, no chemotherapy is required. However, in severe cases, ciprofloxacin, neomycin, tetracycline may be tried. In addition, supportive therapy with oral or intravenous electrolyte fluid is also given to save the life of patient [9]. Presently, no vaccine is available, and therefore, the infection can be controlled by thorough cooking of fish, shellfish and other seafood's before consumption, use of safe and potable water in kitchen, proper handling of seafood's, satisfactory refrigeration of foods, and avoiding cross contamination of processed food with raw food. In addition, health education of fish eating community about the hazards of eating raw or undercooked or insufficiently cooked fish and other seafood's and kitchen hygiene [9]. It is advised that persons with liver disease should avoid eating raw or undercooked Mollusca shellfish, since they are at particularly high risk for *V. parahaemolyticus* [12,20].

It is emphasized that incidence and frequency of pathogenic *V. parahaemolyticus*in water, finfish and shellfish should be deterimined. There is a need to improve global public health surveillance of *V. parahaemolyticus*to identify new epidemic strains. Further work on the pathogenesis, risk factors, and molecular epidemiology should be conducted.

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