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MANAGEMENT STRATEGIES FOR MINIMISING THE INCIDENCE OF PATHOGENIC BACTERIA IN SEAFOODS AT KOLKATA FISH MARKET

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Abstract:
Food poisoning is a common phenomenon oftenly seen in the media. This is caused by a variety of pathogenic bacteria, viruses, or parasites that contaminate food rather than chemical or natural toxins. Bacterial pathogens associated with seafood can be categorized into three general groups: bacteria that are normal components of the marine or estuarine environment, enteric bacteria present due to faecal contamination, and bacteria introduced during processing. Good hygiene practices before, during, and after food preparation can reduce the chances of contracting an illness.The present study is aimed to examine the prevalence of spoilage and pathogenic micro-organisms such as *E coli, V cholera, V parahaemolyticus* and *Salmonella* in fin and shell fishes collected from retail markets in Kolkata.Study revealed that, fresh water fish are hygienically sound, less contaminated, and safe, having less health hazard after consumption. Marine fish suffer from cross contamination because of their natural habitat and unhygienic handling practices. To avoid this, rather to minimise the contamination level, good sanitation and hygiene is required to be maintained, use of fresh uncontaminated chilled water and icing is to be practiced by fish handlers.

Key Words: Food poisoning, Pathogenic , Micro-organisms, Marine fish, Contamination

I.INTRODUCTION

Population explosion and inadequate infrastructure to properly treat and dispose the sewage, lack sanitary condition, poverty, over exploitation of natural waters has resulted in the discharge of considerable quantities of untreated waste into the natural waters. Direct discharge of domestic waste, leaching from poorly maintained septic tanks and improper management of farm waste are suspected as the major source of waterborne disease (Huttly, 1990). Sewage effluent contains a wide range of pathogenic micro-organisms that may pose a health hazard to human population when they are discharged into the recreational waters (Borrego et al., 1997) and the health hazard could be severe in heavily populated country such as India. On a global basis, around 2 million deaths per year are attributed to water-borne diseases especially due to diarrhoea in children (Gordon et al., 2004). Typhoid and paratyphoid fever resulting in an annual incidence of about 17 million cases worldwide (Kindhauser, 2003), and India has the highest incidence of typhoid, around three million cases each year (Hatha et al, 2008). Coastal waters often provide very important recreational and economic resources and therefore the trophic status and quality of coastal waters, the safety of shellfish and fish farming waters are concern for many countries including India. The microbial status of fish after catching is closely related to environmental conditions and the microbiological quality of the water. Important environmental factors include water temperature, salt content, distance between catch and chilling localization, and postharvest handling or processing conditions. Fish and fish products are eaten raw in many cultures, and these raw foods can be a route for direct transmission of pathogens.Foodborne illness usually arises from improper handling, preparation, or food storage. . Foodborne disease can also be caused by a large variety of toxins that affect the environment, by chemicals, called Food contaminants, pesticides or medicines in food and naturally toxic substances like poisonous mushrooms or reef fish.In spite of the common term food poisoning, most cases are caused by a variety of pathogenic bacteria, viruses, or parasites that contaminate food rather than chemical or natural toxins. Bacterial pathogens associated with seafood can be categorized into three general groups: bacteria that are normal components of the marine or estuarine environment (e.g., *Vibrio* spp., *Listeria monocytogenes*, *Clostridium botulinum*, and *Aeromonashydrophila*), enteric bacteria present due to faecal contamination, and bacteria introduced during processing. Good hygiene practices before, during, and after food preparation can reduce the chances of contracting an illness.Bacteria are a common cause of foodborne illness.Symptoms for bacterial infections are delayed because the bacteria need time to multiply. They are usually not seen until 12–72 hours or more after eating contaminated food.

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Most common bacterial foodborne pathogens are:

- Salmonella spp.
- Escherichia coli O157:H7
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- Listeria monocytogenes
- Shigella spp.
- Staphylococcus aureus
- Streptococcus
- Vibrio cholerae, including O1 and non-O1
- Vibrio parahaemolyticus
- Vibrio vulnificus
- Yersinia enterocolitica
- Clostridium spp.

Seafood borne pathogenic bacteria may conveniently be divided into two groups as shown in following table.

Table 1. Seafoodborne pathogenic bacteria

		Mode of action		Heat stability of toxin	Minimum infective dose
		Infection	Pre-formed toxin		
Indigenous bacteria (Group 1)	*Clostridium botulinum*		+	low	-
	Vibrio sp.	+			high
	V. cholerae				-
	V. parahaemolyticus				(> 10^6/g)
	othervibrios: *V. vulnificus, V. hollisae, V. furnsii, V. mimicus, V. fluvialis.*				-
	Aeromonashydrophila	+			Not known
	Plesiomonasshigelloides	+			Not known
	Listeria monocytogenes	+			Not known/ variable
Nonindigenous bacteria (Group 2)	*Salmonella* sp.	+			from < 10^2 to >10^6
	Shigella	+			10^{1}- 10^2
	E. coli	+			10^{1}- $10^{3\,2)}$
	Staphylococcus aureus		+	high	-

Clostridium spp.

C. botulinum is widely distributed in soil, aquatic sediments and fish. Human botulism is a serious but relatively rare disease. The disease is an intoxication caused by a toxin pre-formed in the food. Symptoms may include nausea and vomiting followed by a number of neurological signs and symptoms: visual impairment (blurred or double vision), loss of normal mouth and throat functions, weakness or total paralysis, respiratory failure, which is usually the cause of death.It should be noted that fresh and frozen fish has never been shown to cause human botulism. This is probably due to the fact that fresh fish normally spoil before becoming toxic. The ultimate safeguard is very low heat stability of botulinum toxin, which means that normal household cooking will destroy any preformed toxin. Thus the risk is clearly associated with foods that do not require cooking immediately before consumption.

Vibrio sp.

Most vibrios are of marine origin and they require Na+ for growth. *V. cholerae* occurs in two serotypes, the 01 and the non-01, and the 01 serotype occurs in two biovars: the classic and the El tor. The classical biovar, serovar 01 is

today restricted to parts of Asia (Bangladesh), and most cholera is caused by the E1 tor biovar. The pathogenic species are mostly mesophilic, i.e. generally occurring (ubiquitous) in tropical waters and in highest numbers in temperate waters during late summer or early fall. The diseases associated with *Vibrio* sp. are characterized by gastro-enteritis symptoms varying from mild diarrhoea to the classical cholera, with profuse watery diarrhoea. One exception is infections with *V. vulnificus*, which are primarily characterized by septicaemias.The mechanisms of pathogenicity for the vibrios are not entirely clear. Most vibrios produce powerful enterotoxins and as little as 5µg cholera toxin (CT) administered orally caused diarrhoea in human volunteers. A number of other toxins are produced by *V. cholerae*, including a haemolysin, a toxin similar to tetrodotoxin and one similar to shiga-toxin. Pathogenic strains of *V. parahaemolyticus* are known to produce a thermostable direct haemolysin (Vp-TDH), which are responsible for the Kanagawa-reaction, but it is now documented that also Kanagawa-negative *V. parahaemolyticus* are able to produce disease.Historically cholera is an illness of the poor and undernourished, but this is to some extend due to low standards of hygiene. This allows relatively low initial numbers to increase dramatically under improper conditions of harvesting, processing, distribution and storage.In the case of cholera, water and faecal contamination of water is of major importance in spread of the disease, but food is becoming increasingly important. However, raw, uncooked, or cross-contaminated cooked shellfish has been established as the major vehicle for *V. cholerae* 01 and non-01. Outbreaks of *V. parahaemolyticus* have most often been associated with cross-contamination or time/temperature abuse of cooked seafood. For all other vibrios, consumption of raw shellfish, especially oysters, is the major cause of infection.

Table 2: Survival of *V. cholerae*.

Food	**Survival times (days)**
Fish stored at 3–8°C	14–25
Ice stored at -20°C	8
Shrimp, frozen	180

*Salmonella*sp

Salmonella are members of the family Enterobacteriaceae and occur in more than 2000 serovars. These mesophilic organisms are distributed geographically all over the world, but principally occurring in the gut of man and animals and in environments polluted with human or animal excreta.The principal symptoms of salmonellosis (non-typhoid infections) are non-bloody diarrhoea, abdominal pain, fever, nausea, vomiting which generally appear 12–36 hours after ingestion. However, symptoms may vary considerably from grave typhoid like illness to asymptomatic infection. The disease may also proceed to more serious complications. The infective dose in healthy people varies according to serovars, foods involved and susceptibility of the individuals.Contamination of shellfish with *Salmonella* due to growth in polluted waters has been a problem in many parts of the world and even farmed tropical shrimps frequently contain *Salmonella*. *Salmonella* in aquaculture shrimp products originate from the environment rather than as a result of poor standards of hygiene, sanitation, and poultry manure as feed. Most literature reports indicate that seafood is a much less common vehicle for *Salmonella* than other foods, and most prawns and shrimps are cooked prior to consumption and these products therefore pose minimal health risks to the consumer except by cross contamination in kitchens.

Escherichia coli

E. coli is the most common aerobic organism in the intestinal tract of man and warm blooded animals. Generally the *E. coli* strains that colonize the gastrointestinal tract are harmless commensals, or they play an important role in maintaining intestinal physiology. However, within the specie there are at least 4 types of pathogenic strains:

1. enteropathogenic*E. coli* (EPEC)
2. enterotoxigenic*E. coli* (ETEC)
3. enteroinvasive*E. coli* (EIEC), shiga-dysentery-like *E. coli*
4. enterohaemorrhagic*E. coli* / (EHEC) / verocytoxin producing *E. coli* (VTEC) or *E. coli* 0157:H7

Clearly *E. coli* may be isolated in environments polluted by faecal material or sewage, and the organism can multiply and survive for a long time in this environment.Pathogenic *E. coli* strains are producing diseases of the gut which may vary in severity from extremely mild to severe and possibly life-threatening depending on a number of factors such as type of

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pathogenic strains, susceptibility of victim and degree of exposure.There is no indication that seafood is an important source of *E. coli* infection. Most infections appear to be related to contamination of water or handling of food under unhygienic conditions.

Staphylococcus aureus

The staphylococci are ubiquitous organisms and can be found in water, air, dust, milk, sewage, floors, and surfaces, all articles that come into contact with man and survive very well in the environment. The human carrier rate may be up to 60% of healthy individuals with an average of 25–30% of the population being positive for enterotoxin-producing strains. The disease caused by *S. aureus* is intoxication. Common symptoms, which may appear within 2–4 hours of consumption of contaminated foods, are nausea, vomiting and sometimes diarrhoea. Symptoms usually persist for no more than 24 hours, but in severe cases, dehydration can lead to shock and collapse.Seafood may be contaminated with *Staphylococcus* via infected food handlers or from the environment. More often the contamination is from an individual with an infection on hands or with a cold or sore throat. The incidence of organism has been found comparatively higher in cooked and prepared fishery products due to additional human handling after cooking and the inherent behaviour of *Staphylococcus aureus* to grow comparatively in substrates contain minimum number of microorganisms.*S. aureus* is mesophilic with a minimum growth temperature of 10°C, but higher temperatures are required for toxin production (> 15°C).*S. aureus* is halotolerant and able to grow at water activities as low as 0.86. Minimum pH for growth is 4.5. It should also be emphasized that staphylococci are poor competitors and do not grow well in the presence of other microorganisms. Thus the presence of staphylococci in raw, naturally contaminated food is of little significance. In contrast rapid growth and toxin production can take place in precooked seafood (shrimp) if recontaminated with *S. aureus* and time/ temperature conditions allow for growth. *S. aureus* produces a number of enterotoxins, when growing in the food. These toxins are generally very resistant to proteolytic enzymes and heat. There have been no outbreaks reported from foods that have undergone normal canning procedures, but the heat applied in pasteurization and normal household cooking is not sufficient to destroy the toxin.

II. MATERIALS AND METHODS

In the southern fringes of Kolkata a fish market namely Garia Station Market was chosen as the study. Geographically the market is located about 9m above the mean sea level (MSL) about 15 kms from Kolkata city centre ($22^0$34’11”N $88^0$22’11”E). A sewage canal runs alongside the market and is located amidst a densely populated area. The only source of water is a tube well dug in the vicinity of the canal and it is this water which is used for all activities in the market. The ice used is sourced from ice plants located away from the area under study. Studies were carried out from December 2010 to March 2011. Monthly collections of fish samples were done for five different fish species, rohu, hilsa, pomfret, horse mackerel and black tiger shrimp. The samples were transported to the laboratory in iced condition and subjected to bacteriological examination within 2 hours of collection through standard methodology..

III. RESULTS AND DISCUSSION

TABLE:3 Showing the incidence of pathogene occurance

Sl. No.	Sample analysed	No. of sample analysed	TPC	No. of samples showing incidence. of				
				E. coli	*S. aureus*	*V cholera*	*V parahaemolyticus*	*Salmonella*
1	Rohu	20	10^6	5	6	ND	ND	ND
2	Hilsa	20	10^4	2	3	ND	1	ND
3	Pomfret	20	10^5	3	2	ND	2	1
4	Horse mackerel	20	10^6	4	1	2	4	5
5	Black tiger shrimp	20	10^6	3	2	3	4	2

Out of 20 samples of Rohu analysed during the period of study, six samples showed occurrence of *Staphylococcus aureus* (i.e. 30% of the samples) and five samples showed presence of *E. coli* (i.e. 25% of samples).In case of Hilsa, apart from *S. Aureus* &

E.coli,(15% & 10% respectively), *Vibrio parahaemolyticus* is also reported in one of the examined samples, i.e.5% of occurrence. In both of the samples of Rohu and Hilsa*Salmonella* was not detected in 375g of the samples.In case of pomfret and horse mackerel, similar trend was observed as like previous, such as, *E. coli* 15% & 20% respectively, *S. aureus* 10% & 5% respectively, *V. parahaemolyticus* 10% & 20% respectively and *Salmonella* 5% &25% respectively. It is observed that, among two species of fish under discussion, occurrence of *V. cholera* was 10% in horse mackerel whereas in pomfretit was not detected.Among Black Tiger Shrimp samplesincidence of occurrence of *E. coli*,*S. aureus*, *V. cholera*, *V. parahaemolyticus*and *Salmonella sp.* wasreported to be about 15%, 10%, 15%, 20% and 10% respectively.Among the different species of fish the incidence of occurrence of different pathogenic organisms was found not to vary significantly ($p>0.05$) among the fish species although *V. cholera*was not detected in Rohu, Hilsa and pomfret, *Salmonella*was not reported in rohu and Hilsa and *V. parahaemolyticus*was not reported in Rohu. Naturally consumption of these species from retail fish markets are safe provided good cooking practices to kill the organisms are undertaken.

The possible causes of contamination in other samples may be:

- Poor handling practices and shock during rough handling
- Harvesting of fish from contaminated waters.
- Time lag between fish catch, icing and proper preservation
- Use of contaminated ice
- Poor quality water is used in the market by fish handlers, wholesalers and retailers.
- Poor hygiene of the market place,
- Lack of maintenance of cold chain

IV. CONCLUSION

From the obtained result and after detail discussion, we can conclude that, fresh water fish are hygienically sound, less contaminated, and safe, having less health hazard after consumption. Marine fish suffer from cross contamination because of their natural habitat and unhygienic handling practices. To avoid this, rather to minimise the contamination level, good sanitation and hygiene is required to be maintained, use of fresh uncontaminated chilled water and icing is to be practiced by fish handlers.

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Biography

Dr. Somen Sahu is an Associate Professor and Head in the Department of Fishery Economics and Statistics, Faculty of Fishery Sciences, West Bengal University of Animal and Fishery Sciences,W.B. He had an experience of more than 12 years in this field. He had a background of M.Sc. in Statistics, M.B.A. and Ph.D. He organised more than 5000 fish farmers at Purba Medinipur district for transfering of technology through networking model targetted to their socio-economic upliftment.