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Bacterial Hazards Especially Pathogenic to Human in Consumable Marine Fishes of Noakhali Sadar, Bangladesh

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ABSTRACT

The present study was conducted for microbiological assessment of ten available marine fish species of three different feeding habits collected from three different markets of Noakhali district from July, 2012 to April, 2013. For this, Total Bacterial Counts (TBC), Total Coliform (TC), Fecal Coliform (FC) and the occurrence of *Salmonella* and *Vibrio* spp., were determined by using serial dilution and spread plate technique. Among three feeding habits, the highest TBC ($2.67\pm1.69\times10^{8}$ CFU g^{-1}), *Vibrio* ($2.37\pm1.83\times10^{3}$ CFU g^{-1}) and *Salmonella* spp., ($2.19\pm1.26\times10^{3}$ CFU g^{-1}) were found in carnivorous and the highest TC ($4.74\pm0.16\times10^{6}$ CFU g^{-1}) and FC ($2.03\pm0.72\times10^{5}$ CFU g^{-1}) in omnivorous fishes. Among 10 marine species, Spotted Croacker, Greenback mullet, Asian Seabass contain the highest TBC ($5.09\pm3.73\times10^{8}$ CFU g^{-1}) and TC ($4.18\pm4.01\times10^{6}$ CFU g^{-1}); FC ($2.54\pm1.95\times10^{5}$ CFU g^{-1}) and *Vibrio* spp., ($1.39\pm2.09\times10^{4}$ CFU g^{-1}); *Salmonella* spp., ($3.5\pm2.36\times10^{3}$ CFU g^{-1}), respectively. TBC ($2.99\pm2.76\times10^{8}$ CFU g^{-1}), TC ($1.79\pm0.25\times10^{6}$ CFU g^{-1}), FC ($2.23\pm1.45\times10^{5}$ CFU g^{-1}), *Vibrio* ($9.16\pm1.36\times10^{3}$ CFU g^{-1}) and *Salmonella* spp., ($2.55\pm2.01\times10^{3}$ CFU g^{-1}) were the highest in gill and the lowest in skin. Among fishes of three different markets, the highest TBC ($2.16\pm0.96\times10^{8}$ CFU g^{-1}), FC ($1.73\pm1.08\times10^{5}$ CFU g^{-1}) and *Salmonella* spp., ($2.72\pm0.86\times10^{3}$ CFU g^{-1}) were found in the fishes of Dutter hat and the highest TC ($1.13\pm0.45\times10^{6}$ CFU g^{-1}) and *Vibrio* spp., ($4.38\pm1.02\times10^{3}$ CFU g^{-1}) in the fishes of Sonapur market. Bacterial densities of these fishes were higher than the acceptable limits. Findings of the present study suggest that marine fishes may act as reservoirs of harmful pathogenic species which creates many dangerous diseases such as cholera, typhoid etc. and the consumers should be careful about the qualities of fishes.

Key words: Marine fish, feeding habits, pathogenic species, bacterial load, organs of fish

INTRODUCTION

Fish is one of the best sources of proteins, vitamins, minerals and essential nutrients required for supplementing both infant and adult diets (Abdullahi *et al*., 2001). Fish are extremely susceptible to microbial contamination because of their soft tissues and aquatic environment. Contamination results mainly from rupturing of fish intestine during poor processing or unhealthy washing. Millions of bacteria, many of them potential spoilers, are present in the surface slime, on the gills and in the intestines of live fish, although the flesh itself is normally sterile. Bacterial growth and invasion on the fish are prevented by the body's natural defense system during life but after death the defense system breaks down and the bacteria multiply and invade the flesh (Abolagba and Uwagbai, 2011). Microbial action has been known to play a large part in the spoilage of fish (Eyo, 2001).

Fishes become contaminated in various ways. However, the type of microorganism associated with a particular fish depends on the waterbodies it was found (Thatcher and Clark, 1973; Clucas and Ward, 1996). Fishes which live in the polluted waterbodies can easily intake these bacteria while feeding along with contaminated aquatic foods. Phytoplankton such as *Anabaena variabilis* and zooplankton like copepode which are the reservoir of *Vibrio* and *Salmonella* as long term and short term, respectively and fish could easily feed on them and act as a reservoir or vector for the *Vibrio* and *Salmonella.* Thus, it is important to determine the relationship of occurrence of *Vibrio* and *Salmonella* with the feeding habits.

Pathogenic bacteria associated with fish and fishery products can be categorized into three general groups: (1) Bacteria (indigenous bacteria) that belong to the natural microflora of fish (*Clostridium botulinum*, pathogenic *Vibrio* spp., *Aeromonas hydrophila*), (2) Enteric bacteria (nonindigenous bacteria) that are present due to fecal contamination (*Salmonella* spp., *Shigella* spp., pathogenic *Escherichia coli*, *Staphylococcus aureus*) and (3) Bacterial contamination during processing, storage or preparation for consumption (*Bacillus cereus*, *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium perfringens*, *Salmonella* spp.) (Lyhs, 2009).

Fish is also contaminated during post-harvest activities such as poor standards of hygiene and sanitation, inadequate processing, unhygienic condition of market etc. Most of persons associated with the culture and marketing of marine fishes in Bangladesh are not well educated and having no proper knowledge about hygiene and sanitation which lead to contamination of fishes by microbes. A large amount of marine fishes are found in fish markets of Noakhali Sadar because Noakhali is a coastal district in the southeast region of Bangladesh which is bounded by Bay of Bengal to the south.

The present study was therefore aimed to estimate the microbial load in different organs of fishes of different feeding habits and to find out the occurrence of bacterial pathogens such as *Vibrio*, *Salmonella* spp., in the available consumable marine fishes of three markets of Noakhali district that would thus provide knowledge on the survival and multiplication of harmful bacteria via different marine fishes.

MATERIALS AND METHODS

Experimental fish: Ten different marine fishes of three feeding habits (carnivores, omnivores and detrivores) were examined with three replicates each (Table 1).

Table 1: List of fish species of different feeding groups

Feeding habits	Scientific name	English name	Local name	References
Carnivorous	*Harpadon nehereus*	Bombay duck	Loitta	Hamilton (1822)
Carnivorous	*Sillaginopsis panijus*	Flathead sillago	Tular dandi	Hamilton (1822)
Carnivorous	*Lates calcarifer*	Barramundi, Asian Seabass	Asian Seabass, Bhetki	Bloch (1790)
Carnivorous	*Polynemus paradiseus*	Paradise threadfin	Rishi, Taposi	Linnaeus (1758)
Carnivorous	*Protonibea diacanthus*	Spotted Croacker	Spotted Croacker	Lacepede (1802)
Carnivorous	*Leptomelanosoma indicum*	Indian threadfin	Lakhua	Shaw (1804)
Omnivorous	*Tenualosa ilisha*	Hilsa shad shad	Hilsa shad	Shafi and Quddus (2001)
Omnivorous	*Liza subviridis*	Greenback mullet	Greenback mullet	Cuvier and Valenciennes (1836)
Detrivorous	*Odontamblyopus rubicundus*	Rubicundus Eelgoby	Rubicundus Eelgoby	Hamilton (1822)
Detrivorous	*Trypauchen vagina*	Burrowing goby	Burrowing goby	Bloch *et al.* (1801)

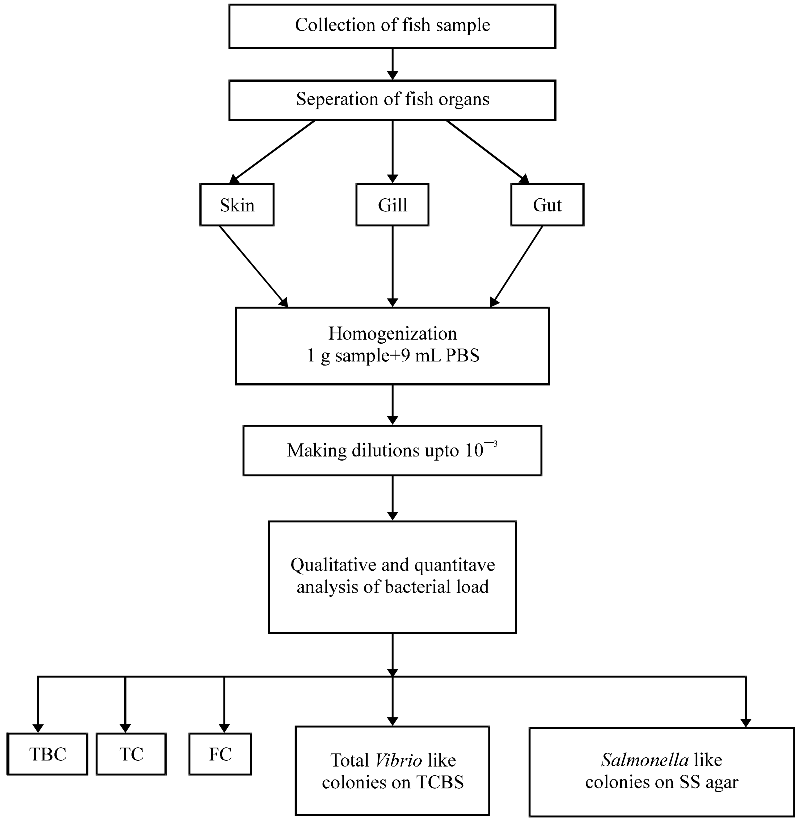

Fig. 1: Processing of fish sample and identification of *Vibrio* and *Salmonella* spp.

Study area and collection of samples: The study area of this research was Noakhali Sadar in Noakhali district of Bangladesh. The fish samples were collected from different sellers of three different markets (Maijdi Municipal market, Dutter Hat and Sonapur Bazar) of Noakhali Sadar during the early morning hours of the day (between 8:00 and 9:00 am local time) from July, 2012 to April, 2013. The fish samples were transported to the laboratory by collecting in sterilized plastic bag put into icebox and processed within 2 h of collection aseptically. All the used glass wares such as conical flasks, beakers, measuring cylinder, test tubes were washed, dried and sterilized in autoclave (40B series, LDZX) at a temperature of 121°C for 15 min at 15 lb/inch^2 pressure.

Processing of samples: At first the samples were washed with sterile Phosphate Buffer Saline (PBS) to remove sand, detritus as well as microorganisms attached to the surface of fish. Then the skin, gill and gut samples from each samples were collected aseptically and homogenized separately with PBS solution using Vortex machine (Digisystem Laboratory Instruments INC., Model VM-1000). Each of the five tubes were filled with nine milliliters of PBS solution aseptically and 1 g of homogenized tissue of each sample was mixed with 9 mL PBS solution of first tube to prepare 10^{-1} dilution. The 1 mL was taken from the first tube and mixed to the second test tube to prepare 10^{-2} dilutions. The 10^{-3} to 10^{-5} dilutions were prepared by this subsequent serial dilution technique (Fig. 1).

Inoculation of plates for enumeration of bacterial load: The 100 µL from diluted solution of each sample were transferred to culture media containing petri-dish and inoculated using spread plate method for bacteriological analysis (Fig. 1). For enumeration of total bacteria in sample fishes, nutrient agar media was used and after inoculating incubated at 37°C for 18-24 h in the incubator. For the enumeration of total and fecal coliform, Membrane Fecal Coliform (mFC) agar media was used and after inoculating petri-dishes were incubated at 37°C for 18-24 h in the case of total coliform and in the case of fecal coliform at 44-44.5°C for overnight. *Vibrio* spp., colonies were counted on TCBS plate and after 18-24 h of incubation, slightly flattened, yellow with opaque centers colonies were considered as *Vibrio* spp., *Salmonella* spp., were counted on SS plate after 18-24 h of incubation and colorless, transparent, with a black center colonies were considered as *Salmonella.*

Bacterial density data were transformed into natural log before statistical analysis. The means of bacterial load were compared using ANOVA. Statistical software SPSS version 10.0 was used to analyze the data with the level of significance at $p<0.05$.

RESULTS AND DISCUSSION

Fishery products which are of great importance for human nutrition worldwide and provide clear health benefits (Kromhout *et al.*, 1985) can act as a source of food borne pathogens. If the bacterial loads of fishes are greater than acceptable limit of bacterial pathogens in fishes, those fishes are unacceptable and pose a potential risk to public health.

This study has clearly demonstrated that marine fishes may act as reservoirs of *Vibrio* and *Salmonella* spp., Among 71 species of *Vibrio*, pathogenic *Vibrio* include *V. cholerae* (the causative agent of cholera), *V. parahaemolyticus* and *V. vulnificus.* In the present study, only genus *Vibrio* and *Salmonella* spp., was identified on TCBS and SS agar in marine fishes.

Comparison of bacterial load (CFU g^{-1}) in different feeding groups: The densities of TBC, TC, FC and *Salmonella* spp., were more or less similar in fishes with different feeding habits but total *Vibrio* spp., were significantly ($p<0.05$) different. Among three feeding habits, the highest densities of TBC ($2.67\pm1.69\times10^8$ CFU g^{-1}), *Vibrio* ($2.37\pm1.83\times10^3$ CFU g^{-1}) and *Salmonella* spp., ($2.19\pm1.26\times10^3$ CFU g^{-1}) were observed in carnivorous fishes that may be due to the consumption of those fishes which harbour *Vibrio* pathogen or culturing in the contaminated water or delay processing or unhygienic handling. TC ($4.74\pm0.16\times10^6$ CFU g^{-1}) and FC ($2.03\pm0.72\times10^5$ CFU g^{-1}) were highest in omnivorous fishes which may be grown in that water which is contaminated by warm-blooded animal feces (Table 2). The presence of higher range of coliform group suggests sewage contamination of the samples during culturing, processing or marketing. Rahman *et al.* (2010) found that among four feeding habits detrivorous freshwater fishes contain the highest TBC, TC and FC. *V. parahaemolyticus* has been isolated from 56.3% detrivores while was relatively lower in carnivores, planktivores and omnivores (Natarajan *et al.*, 1979).

Table 2: Bacterial density (CFU g^{-1}) measured in different fishes of three different feeding habits

Feeding habits	TBC	TC	FC	*Vibrio* spp., colonies on TCBS	*Salmonella* spp., colonies on SS
Carnivorous	$2.67\pm1.69\times10^8$	$1.48\pm1.44\times10^6$	$1.21\pm0.79\times10^5$	$2.37\pm1.83\times10^{3a}$	$2.19\pm1.26\times10^3$
Omnivorous	$1.42\pm0.06\times10^8$	$4.74\pm0.16\times10^5$	$2.03\pm0.72\times10^5$	$1.23\pm0.22\times10^{4ab}$	$5.38\pm0.7\times10^2$
Detrivorous	$2.26\pm1.4\times10^7$	$3.85\pm0.74\times10^5$	$1.03\pm0.40\times10^5$	$8.38\pm2.59\times10^{2b}$	$1.27\pm0.38\times10^3$

TBC: Total bacterial count, TC: Total coliform count, FC: Fecal coliform count. Mean±SD within column with different letters are significantly different (ANOVA, HSD; $p<0.05$)

Table 3: Bacterial density (CFU g^{-1}) measured in different fishes sampled from different markets

Fishes	TBC	TC	FC	*Vibrio* spp., colonies on TCBS	*Salmonella* spp., colonies on SS
Paradise threadfin	$1.59\pm1.26\times10^{8ab}$	$5.79\pm4.61\times10^{5ab}$	$1.22\pm1.17\times10^{5}$	$5.67\pm4.82\times10^{3ab}$	$1.59\pm1.27\times10^{3}$
Flathead sillago	$1.92\pm1.34\times10^{8ab}$	$7.12\pm4.54\times10^{5ab}$	$7.23\pm7.10\times10^{4}$	$9.2\pm5.2\times10^{2ab}$	$2.58\pm2.05\times10^{3}$
Indian threadfin	$2.61\pm2.3\times10^{8ab}$	$1.48\pm1.17\times10^{6ab}$	$1.43\pm1.41\times10^{5}$	$3.21\pm2.58\times10^{3ab}$	$3.14\pm1.09\times10^{3}$
Asian Seabass	$4.23\pm3.05\times10^{8ab}$	$1.71\pm1.36\times10^{6ab}$	$2.53\pm2.47\times10^{5}$	$1.56\pm1.18\times10^{3ab}$	$3.5\pm2.36\times10^{3}$
Spotted Croacker	$5.09\pm3.73\times10^{8a}$	$4.18\pm4.01\times10^{6a}$	$1.23\pm1.17\times10^{5}$	$1.98\pm1.46\times10^{3ab}$	$2.33\pm1.86\times10^{3}$
Bombay duck	$5.98\pm4.35\times10^{7ab}$	$2.18\pm1.49\times10^{5b}$	$1.48\pm1.47\times10^{4}$	$8.88\pm8.56\times10^{3ab}$	00.00 ± 0.00
Hilsa shad	$1.38\pm1.23\times10^{8ab}$	$4.85\pm4.1\times10^{5ab}$	$1.53\pm1.3\times10^{5}$	$1.08\pm1.73\times10^{4ab}$	$4.88\pm3.37\times10^{2}$
Greenback mullet	$1.47\pm1.45\times10^{8ab}$	$4.62\pm3.56\times10^{5ab}$	$2.54\pm1.95\times10^{5}$	$1.39\pm2.09\times10^{4a}$	$5.88\pm3.91\times10^{2}$
Burrowing goby	$1.27\pm1.15\times10^{7b}$	$4.38\pm4.3\times10^{5ab}$	$7.59\pm6.44\times10^{4}$	$6.55\pm5.54\times10^{2b}$	$1.54\pm1.05\times10^{3}$
Rubicundus eelgoby	$3.25\pm2.98\times10^{7ab}$	$3.33\pm3.06\times10^{5ab}$	$1.32\pm1.04\times10^{5}$	$1.02\pm0.84\times10^{3a}$	$1\pm1.00\times10^{3}$

TBC: Total bacterial count, TC: Total coliform count, FC: Fecal coliform count. Mean±SD within column with different letters are significantly different (ANOVA, HSD; $p<0.05$)

Table 4: Bacterial density (CFU g^{-1}) measured in different organs of fishes collected from different markets

Organs of fish	TBC	TC	FC	*Vibrio* spp., colonies on TCBS	*Salmonella* spp., colonies on SS
Skin	$4.68\pm3.93\times10^{7b}$	$2.06\pm0.28\times10^{5}$	$1.99\pm1.71\times10^{4b}$	$1.83\pm1.22\times10^{2b}$	$5.46\pm0.65\times10^{2}$
Gill	$2.99\pm2.76\times10^{8a}$	$1.79\pm0.25\times10^{6}$	$2.23\pm1.45\times10^{5a}$	$9.16\pm1.36\times10^{3a}$	$2.55\pm2.01\times10^{3}$
Gut	$2.35\pm2.01\times10^{8ab}$	$1.18\pm0.93\times10^{5}$	$1.61\pm1.11\times10^{5ab}$	$2.83\pm2.13\times10^{3ab}$	$1.94\pm1.22\times10^{3}$

TBC: Total bacterial count, TC: Total coliform count, FC: Fecal coliform count. Mean±SD within column with different letters are significantly different (ANOVA, HSD; $p<0.05$)

Comparison of bacterial load (CFU g^{-1}) in different marine species: The densities of FC and *Salmonella* spp., were more or less similar while TBC, TC and *Vibrio* were significantly ($p<0.05$) different in different marine fish species. Among 10 marine species, TBC ($5.09\pm3.73\times10^{8}$ CFU g^{-1}) and TC ($4.18\pm4.01\times10^{6}$ CFU g^{-1}) were highest in Spotted Croacker and FC ($2.54\pm1.95\times10^{5}$ CFU g^{-1}) and *Vibrio* spp., ($1.39\pm2.09\times10^{4}$ CFU g^{-1}) were highest in Greenback mullet that may be due to culture in most polluted water or due to unhygienic handling and preservation or preserved with contaminated ices. *Salmonella* spp., ($3.5\pm2.36\times10^{3}$ CFU g^{-1}) was highest in Asian Seabass while nil in Bombay duck (Table 3).

Comparison of bacterial load (CFU g^{-1}) in different organs: The densities of TBC, FC and *Vibrio* spp., were significantly ($p<0.05$) different and TC and *Salmonella* spp., were more or less similar in different organs of fishes. Gill had significantly highest densities of TBC ($2.99\pm2.76\times10^{8}$ CFU g^{-1}), TC ($1.79\pm0.25\times10^{6}$ CFU g^{-1}), FC ($2.23\pm1.45\times10^{5}$ CFU g^{-1}), *Vibrio* ($9.16\pm1.36\times10^{3}$ CFU g^{-1}) and *Salmonella* spp., ($2.55\pm2.01\times10^{3}$ CFU g^{-1}) due to direct contact between contaminated water and gill (Table 4). In the present study, the total bacterial load in skin, gill and gut were $4.68\pm3.93\times10^{7}$ CFU g^{-1}, $2.99\pm2.76\times10^{8}$ CFU g^{-1} and $2.35\pm2.01\times10^{8}$ CFU g^{-1}, respectively which was more or less similar with Jannat *et al.* (2007) who found that the total bacterial count in skin and scale, gill, muscles and gut were 9.4×10^{9}, 8.5×10^{7}, 6.0×10^{7} and 9.0×10^{7} CFU g^{-1}, respectively in raw Hilsa shad (*Tenualosa ilisha*). And gut had higher densities of TBC ($2.35\pm2.01\times10^{8}$ CFU g^{-1}), FC ($1.61\pm1.11\times10^{5}$ CFU g^{-1}), *Vibrio* ($2.83\pm2.13\times10^{3}$ CFU g^{-1}) and *Salmonella* spp., ($1.94\pm1.22\times10^{3}$ CFU g^{-1}) than skin except TC (Table 4).

Comparison of bacterial load (CFU g^{-1}) in three different fish markets: The highest densities of TBC ($2.16\pm0.96\times10^{8}$ CFU g^{-1}), FC ($1.73\pm1.08\times10^{5}$ CFU g^{-1}) and *Salmonella* spp., ($2.72\pm0.86\times10^{3}$ CFU g^{-1}) were found in the fishes of Dutter hat and lowest densities were

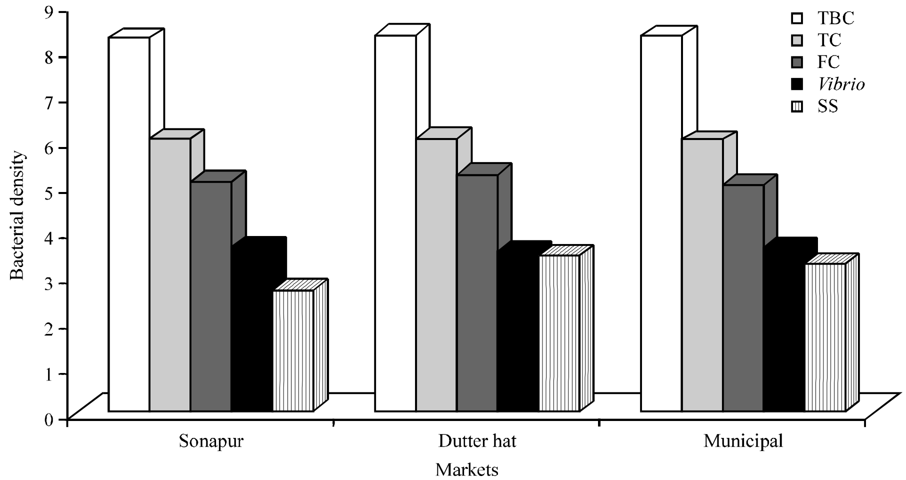

Fig. 2: Bacterial densities in marine fish species of three different markets

found in Municipal market. The densities of TC ($1.13\pm0.45\times10^6$ CFU g^{-1}) and *Vibrio* spp., ($4.38\pm1.02\times10^3$ CFU g^{-1}) were highest in the fishes of Sonapur market and lowest in the Municipal market (Fig. 2). It was concluded that the rate of contamination of fishes is lowest in Municipal market. The environment of Municipal market may be most hygienic than Sonapur market and Dutter hat.

However, in the present study the fish samples of different feeding habits were highly contaminated with total aerobic bacteria as well as total coliform, fecal coliform, *Vibrio* and *Salmonella* spp., This might be due to the contamination of water from where the fishes were cultured or might be due to secondary contamination during the time of handling as well as storage of fishes in ice made with contaminated water. Margolis (1935) reported that the bacterial flora of marine fish depends solely upon the fish's recent intake of food and the degree of contamination in the food and water.

According to FAO (1979), good quality fish should have counts of total bacteria of less than 10^5 per gram and fecal coliforms and total coliforms should not exceed 10 and 100 g^{-1}, respectively. TBC, total coliform, fecal coliform count of the fishes of different feeding habitats examined in this study exceeded the acceptable limit recommended by Food and Agricultural Organization. This indicates human health risk due to consumption of marine fishes. Therefore, precautions should be taken to prevent contamination during harvesting as well as post-harvest handling of fishes.

Incidence of *Vibrio* and *Salmonella* spp.: The occurrence of *Vibrio* was found in all three organs of 10 marine fishes except the skin of Hilsa shad. The *Salmonella* spp., was found in all three organs except Bombay duck. However, no *Salmonella* spp., was found in any organs of Bombay duck. Among 10 marine species, the occurrence of *Vibrio* and *Salmonella* spp., in different organs of fishes was highest in Greenback mullet (Table 5 and 6). The highest incidence of *Vibrio* and *Salmonella* spp., in gill could have been resulted in due to direct contact between contaminated water and gill while respire. Natarajan *et al*. (1979) have showed that in planktivores, isolation of *V. parahaemolyticus*, another member of vibrionaceae, from the gills was quite high when comparing with other organs.

Table 5: Percentage occurrence of *Vibrio* spp., in different organs of fishes

	Organs			
Fishes	Skin	Gill	Gut	Total
Paradise threadfin	33.33	100.00	66.67	66.67±33.34
Flathead sillago	66.67	66.67	66.67	66.67±00.00
Indian threadfin	33.33	100.00	66.67	66.67±33.34
Asian Seabass	66.67	100.00	66.67	77.78±19.24
Spotted Croacker	66.67	100.00	66.67	77.78±19.24
Bombay duck	33.33	66.67	66.67	55.56±19.25
Hilsa shad	0.00	100.00	100.00	66.67±57.74
Greenback mullet	66.67	100.00	100.00	88.89±19.24
Burrowing goby	33.33	66.67	66.67	55.56±19.25
Rubicundus Eelgoby	33.33	66.67	66.67	55.56±19.25

Table 6: Percentage occurrence of *Salmonella* spp., in different organs of fishes

	Organs			
Fishes	Skin	Gill	Gut	Total
Paradise threadfin	33.33	66.67	66.67	55.56±19.25
Flathead sillago	33.33	66.67	66.67	55.56±19.25
Indian threadfin	66.67	66.67	66.67	66.67±00.00
Asian Seabass	33.33	66.67	33.33	44.44±19.25
Spotted Croacker	66.67	66.67	66.67	66.67±00.00
Bombay duck	0.00	0.00	0.00	0.00±00.00
Hilsa shad	33.33	66.67	66.67	55.56±19.25
Greenback mullet	66.67	100.00	66.67	77.78±19.24
Burrowing goby	33.33	66.67	66.67	55.56±19.25
Rubicundus Eelgoby	66.67	66.67	33.33	55.56±19.25

CONCLUSION

Food borne pathogens are a growing concern for human illness and death (Losito *et al.*, 2012). According to the guideline of ICMSF, acceptable limit of total bacterial counts for giant prawns and white fish are 10^6 and 5×10^5 CFU g^{-1}, respectively. Total coliform, fecal coliform and *Vibrio cholerae* counts are 10^2, 10 and 0 CFU g^{-1}, respectively, for both the types of fish. Therefore, the bacterial loads (total bacteria, total coliform, fecal coliform and *Vibrio*) found in this study for different fishes were beyond the standard value suggested by ICMSF (1982) which indicate their unacceptability as food from public health point of view. The presence of high loads of coliform and fecal coliform in the fish samples collected from fish markets may be due to the heavy load of sewage disposal into the waterbody which could act as a suitable culture medium for these pathogens to survive and grow. This untreated and the improper way of sewage disposal system is one of the main sources for microbial water contamination which results in the accumulation of these bacterial pathogenic species in the commercial edible fishes. Moreover, these fishes act as reservoirs of human pathogens which are a serious threat to the fish consuming community. Unhygienic fish handling practices of these infected fishes such as chances of cross contamination via kitchen utensils or by handling and inadequate cooking may further contribute to the spread of these pathogens. Hence, we are in urgent need to implement programmes such as HACCP as a part of Good Manufacturing

Practices (GMP) and Sanitation Standard Operating Procedures (SSOP) to monitor the quality of the fishes (Mandal *et al*., 2011). So, care should be taken for potentially pathogenic bacteria in marine fishes collected from different markets of Noakhali sadar with regards to the public health.

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