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Quality of Cultured Shrimp from World Heritage Site of Indian Sundarbans in Context to Microbial Load

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Abstract

Fecal coliform and Total coliform count were done in cultured *Penaeus monodon* collected from two different islands of Indian Sundarbans namely Bali and Chotomollakhali during 2016. The count was higher in the shrimp sample, water and sediment collected from Chotomollakhali Island where the shrimps were not fed with feed containing additives (garlic extract). In Bali Island, the cultured shrimps were fed with feed containing additives (garlic extract) and seaweed based protein. This formulated natural feed not only boosted up the shrimp growth but also arrested the microbial load to a considerable level.

Introduction

The high population densities and activities often common in the coastal areas result in pollution and release of contaminated wastewater. Pathogenic microorganisms such as bacteria and viruses, abundant in human wastes [1] are often discharged into natural waters with little or no treatment [2]. Survival of microbes in waters depends on many parameters such as biological (interaction with other bacteria) and physical factors (temperature). Numerous studies have been carried out in coastal areas over long periods of time, demonstrating the various abiotic environmental conditions (fluxes, currents, presence of mud and silt etc.) due to which the distribution of microbes is affected. The under treated effluents from the coastal population and discharges from mismanaged aquaculture farms often pose an adverse impact on marine and estuarine species. Microorganisms discharged in coastal areas are accumulated in shellfish because of their filter feeding activity. The members like Salmonella sp., E.coli, Fecal coliform can multiply and survive in the estuarine environment for weeks [3]. Jimenze et al. [4] presented similar results on survival in tropical fresh water environments. The enterobacteriacea (Salmonella, Shigella, E. coli etc) are all occurring in the fish products as a result of contamination from the animal or human origin. This contamination has been normally associated with fecal contamination or pollution of natural waters or water environments, where these organisms survive for a long time (months) or through direct contamination of products during processing. Contamination of shellfish with Salmonella, E. coli, and Fecal coliform due to growth in polluted waters has been a problem in every parts of the world. In a recent review by Reily et al. [5], evidence is presented that farmed tropical shrimps frequently contain Salmonella. The case study of Bay of Bengal and its adjacent estuaries is no exception to this adverse process. In the entire Gangetic Plain, it is the river Hugli that is subject to heavy pollution load from the industrialized and highly urbanized cities of the Kolkata and Howrah. The discharges from the port-cum-industrial complex of Haldia have aggravated the magnitude of pollution [6]. The marine ecosystem nearest to the city of Kolkata is the Indian Sundarbans, which is the most biologically productive, taxonomically diverse and aesthetically celebrated ecotone in the Indian subcontinent [7]. Aquaculture in the form of shrimp culture by traditional method is presently practiced in this zone as the primary livelihood scheme. However the condition of the cultured shrimp ponds is not very healthy from the environmental point of view. The untreated and the under treated sewage of the city of Kolkata and Howrah is responsible for the microbial load in these cultured shrimp

ponds, which enters the farms through the inlet canals. Among microbial flora, the presence of pathogens such as Salmonella, Hepatitis A virus and Calcivirus has been determined [8]. These microorganisms are demonstrated to be responsible for some gastroenteritis cases due to shellfish consumption. Reports of the presence of Salmonella in the harvested shrimp sample were given by several workers [9]. Antibiotics like oxytetracycline are often used to get rid of the microbial contamination in the present study area [10]. These antibiotics not only cause the potential dangers like allergies, toxic effects, modifications in the bacterial flora of the human intestine, production of medicine resistance with disease causing bacteria in the human body [11], but also affect the environment like formation of the resistance bacteria trunks, the damage of organisms etc. With this background, the present programme was taken in some ponds of Indian Sundarbans, where the shrimp were fed with feed mixed with botanical extracts with the aim to boost up their growth and keep the ambient environment healthy. Microbial load in the cultured shrimp was also monitored from the viewpoint of quality control.

Materials and Methods

The present investigation was carried out during the month of May 2016 at two islands namely Chotomollakhali and Bali in the central sector of Indian Sundarbans. Water samples were collected using water sampler and the sediment samples were collected with the help of the Peterson grab. The water and sediment samples for microbial analysis were immediately transferred in to the sterile bottles and central portions of the sediment samples were aseptically taken and put into sterile polythene bags and transported to the laboratory under ice for bacteriological examinations. Prawn samples were collected from the ponds of both islands (coded as C1 for Chotomollakhali island and B1 for Bali island) for carrying out microbial load analysis in terms of Total coliform and Fecal coliform. A Celsius thermometer recorded the surface water temperature of the selected ponds C1 and B1. The surface water salinity was recorded in the field by means of a refractometer, which was cross-checked in the laboratory by argentometric method. The DO was measured by a pocket DO meter in the field and subsequently cross-checked by taking sample water from ponds into 300ml BOD bottles without agitation and fixed with manganous sulphate and alkaline potassium iodide immediately after collection and sent to the laboratory for iodometric titration. The pH of the surface water was measured by a portable pH meter (sensitivity±0.02) which was calibrated by standard buffers before every use and transparency was measured by a Secchi disc. Surface water for nutrient analysis was collected from cultured ponds C1 and B1 in clean TARSON bottles and transported to the laboratory in ice freezed condition. For bacterial analysis, the prawn samples of C1 and B1 ponds were accurately weighed and blended with 0.1% peptone buffer and 3% NaCl diluent for 1 minute and finally inoculated taking different dilutions. The incubation was done at 37 °C for 24hrs and the result was expressed from MPN index per gram basis. For bacteriological analysis of water and sediment samples the standard method as stated in APHA 20th Edition, 2001 was followed. The nutrient load with respect to nitrate, phosphate and silicate of the pond surface water were determined following the method as stated in APHA 20th Edition, 2001.

Results and Discussion

Table 1: A comparative table showing the physico-chemical parameters and microbial load of the two study areas (Chotomollakhali and Bali Islands) in the month of May, 2016.

Parameter		Chotomollakhali Island (C_1)		Bali Island (B_1)	
Temperature		35.1		35.3	
Salinity (%)		26.15		26.80	
pH		8.65		8.70	
Transparency (cm)		15.9		28.6	
D.O. (mg/l)		3.66		5.42	
Nitrate (µgat/l)		10.72		10.49	
Phosphate (µgat/l)		1.34		0.62	
Silicate (µgat/l)		74.70		53.07	
Microbial load	**Total coliform**	**Fecal Coliform**		**Total coliform**	**Fecal Coliform**
(a) Water (MPN / 100 ml)	22	3		4	>2
(b) Sediment (MPN/ gm)	15 X 10^2	10X 10^2		2X 10^2	2X 10^2
(c) *P. monodon* (MPN/gm)	4.5 X 10^2	2.1 X 10^2		1.9 X 10^2	0.6 X 10^2

Aquaculture in India plays an important role in nutrition, income employment and foreign exchange earnings. Maintenance of its food value thus is very much essential. For this purpose the microbial status of Penaeus monodon, a major exportable item has been studied under various circumstances by using natural feed. Microorganism's growth and survival are functions of the physico-chemical factors such as dilution factor, temperature, sunlight radiation, salinity, and predation

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etc. Bacterial metabolism can also be dramatically affected by hostile environmental conditions [12]. The microbial load in the present study was highest in the ambient media of the cultured shrimp pond C1 at Chotomollakhali. This has also been reflected in the prawn sample. The prawn sample collected from the pond of Bali Island is relatively less contaminated and pond health was also superior to Chotomollakhali with respected to selected variables. The high microbial load in the ambient media (water and sediment) and prawn sample of Chotomollakhali may be attributed to the proximity of the station to the highly urbanized city of Kolkata. The DWF and SWF canals act as the conveyor belt to release the untreated waste from the city into the Bidyadhari River from where the waste finally are drained to Matla estuary. Bali being located at a much greater distance from Kolkata experiences relatively uncontaminated water, which is reflected through lower microbial load in the shrimp sample collected from this island (Table 1).

Table 2: Results obtained from Department of Fisheries of West Bengal.

Station	Microbial Count	Predominant Strain Found
Kakdweep	40.5 X 10^5 /ml	*V. parahaemolyticus*
Frazergange	38.2 X 10^5 /ml	*V. parahaemolyticus*
Basanti	28.9 X 10^5 /ml	*V. parahaemolyticus*
Jammudweep	17.4 X 10^5 /ml	*Vibrio spp.*

Table 3: Comparative study of prawn growth in two islands.

Parameters	Pond Without Artificial Feed at Chotomollakhali Island (C_1)	Pond with Artificial Feed at Bali Island (B_1)
Weight	18gm	26gm
Size	12cm	15.8cm
Survival rate	45%	71%
Protein content	39.6%	44.2%
FCR	2.17	1.65

The results obtained for microbial load from these two islands are far less than that recorded by earlier workers (Table 2). This may be attributed to the use of natural additives (garlic extract) and seaweed based protein in the feed, which not only controls water health, but also boost up shrimp growth, and lowers the FCR value of the culturable species [13] (Table 3).

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