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A Survey on Wholesale Fish Market of Surat City with Reference to Microbial Contamination of Fishes and Shrimps

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Abstract: A survey was conducted on wholesale fish market of Surat city to appraise the present structure, infrastructure facilities and hygienic conditions of market. Markets were found unorganized and unfettered. Even basic facilities such as platform, proper flooring, drainage system, cold storage and preservation were not found in fish market. Microbiological analyses were also performed to determine the quality of fishes sold at the only wholesale fish market of Surat city. Fish samples were collected from fish markets for enumeration of the total viable count (TVC) and identification of bacteria. Fresh water fishes collected from fish market were almost free from bacteria while the pathogenic bacteria were present in marine species with higher count which crossed permissible limit in marine fish samples (5×10^5 CFU/g). The pathogenic bacteria *Escherichia coli* can survive and multiply in the fish, transferred to humans from fish which is used as food and cause food poisoning, diarrhea, meningitis and septicemia. The fishes were contaminated with *Escherichia coli* indicating poor hygiene and sanitary condition of the wholesale fish market.

Keywords: Microbiological analyses, Total viable count, *Escherichia coli*, Wholesale fish market, Sanitary condition

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Introduction

Fish market is a place where the fishes and fish products of commercial importance are available to sale. Regulation of fish production and consumption through sale is known as fish marketing (Shammi and Bhatnagar, 2002). Biswas (2006) reported that demand and consumption patterns of fish are determined by geography, feeding habits of the locality, traditional and

nutritional standards. Demand of fish may be either domestic or for export purpose. The potential demand of fish in the markets changes according to the taste and needs of consumers. Market infrastructure includes wholesale market, retail market and fish retail outlets. In wholesale markets, large quantity of fishes are collected from the surrounding places and sold to other

wholesalers and retailers whereas in retail markets, fishes are sold to consumers or to agents (Gadhia and Shah, 2013). The third type of marketing is the retail outlets where the fish shops are operated by Government bodies or private individuals (Kumar *et al.*, 2008).

In India, most of studies on fish markets and marketing have been conducted with reference to the unorganized retail markets. This information is restricted to gender, age and credit (Tietze, 2004), frozen fish retailing (Agbeja, 2004), marketing facilities, hygiene and sanitation (Bestari, 2004). Hygienic condition of fish is an essential criteria for consumer's health because unhygienic conditions are the causes of many diseases (Mol and Saglam, 2004). Sallam (2007) observed that fish is one of the most highly perishable food products. When fishes are alive, their natural defence mechanism keeps these microorganisms from invading the flesh. After death, the microorganisms or enzymes they secrete are free to invade or diffuse into the flesh, where they react with the complex mixture of natural substances present, resulting in a well-defined sequence of changes in odoriferous and flavors compounds (Rani *et al.*, 2016). Saliu (2008) reported that fish spoilage is influenced to a large extent by high ambient temperature, considerable distances of landing ports to points of utilization and poor infrastructure for post harvesting and distribution. Spoilage is caused by nonpathogenic and pathogenic organisms. Non-pathogenic microorganisms cause spoilage to fish but pathogenic microorganisms such as *Escherichia coli*, *Klebsiella pneumoniae*, *Vibrio cholerae*, *Pseudomonas aeruginosa* and *Salmonella typhi* cause food poisoning and severe diseases (Omojowo and Sogbesan, 2003).

In this study a survey was conducted on wholesale fish market of Surat city to appraise the present structure, infrastructure facilities and hygienic conditions of market. Microbiological analyses were also performed to determine the quality of fishes sold at the only wholesale fish market of Surat city. Fish samples were collected

from fish markets for enumeration of the total viable count (TVC) and identification of bacteria.

Materials and Methods

Wholesale Fish Market Details:

Visits were made to wholesale fish market located at Nanpura area of Surat city. Wholesalers engaged in fish marketing from Surat city were chosen applying convenience sampling technique from the study area (Kothari, 2004). Information on wholesale market regarding fish collection, distribution, fixation of price and hygienic condition of fish market were collected from wholesalers through structured interview schedule to know the present status of fish market.

Microbiological Analyses:

Fish samples were collected from wholesale fish markets of Surat city to check the edible quality of the fishes.

Sample collection:

Fish samples collected in zip-lock plastic bags were brought immediately to the laboratory. 1 g of skin surface of fish was scraped with a sterile knife and transferred in 10 ml of distilled water under aseptic conditions.

Total Viable Count (Quantitative Analysis):

Fish samples were analyzed for hygienic condition using quantitative method as described by Surendran *et al.* (2008) and APHA (1995). 9 ml of sterile distilled water was poured aseptically into five tubes each and 1 ml of the original fish sample was added to the first test tube giving a 1:10 dilution. Again 1 ml was taken from the first tube and added to the second tube and mixed well. Procedure continued until the fifth test tube. Each sample was diluted from 10^{-1} to 10^{-5} . Nutrient agar plates were inoculated with 0.2 ml of the diluted solution (10^{-2} to 10^{-4}) using spread plate technique. All plates were incubated at a temperature of 37°C for 24 h before colony enumeration and isolation. The mean colony count on the nutrient agar plates of each given dilution

was used to estimate the total viable count for the samples in colony forming units per gram (CFU/g).

Identification of Microorganisms (Qualitative Analysis):

Fish samples were analysed for hygienic condition using qualitative method of Patel and Patel (2000), Cheesbrough (2002) and Cappuccino and Sherman (2005). Differential media (Nutrient agar and MacConkey's agar), selective media (Eosin methylene blue) and different biochemical media were used for identification. The organisms were identified by cultural, morphological and biochemical characteristics.

Cultural Characterization of Microorganism:

Cultural characteristics of the colony of selected isolates were examined from nutrient agar plate after 24 h of incubation. Different characteristics of colonies such as size, shape, edge, elevation, surface, texture, consistency, colour, transparency, pigmentation etc. were recorded.

Morphological Characterization of Microorganisms:

The colony of isolate was selected and suspension was prepared in 1 ml of distilled water. The smear was prepared, allowed to dry and fixed with heat. Smear was stained with crystal violet stain for one minute. After one minute, smear was covered with Gram's iodine for 30 sec and washed with running water. Thereafter, smear was covered with 95% ethanol for 10 to 15 sec followed by washing in running water and was stained with Safranin for 5 min and again washed with running water. Slides were examined under oil immersion and morphological characteristics of microorganisms were recorded.

Biochemical Characterization of Microorganisms:

Different microorganisms require different biochemical component for their growth. Selected isolates were biochemically characterized by different tests such as Sugar fermentation test, Indole production, Methyl red, Voges Proskauer, Citrate utilization, Gelatin liquification, Nitrate reduction, Urea hydrolysis, Hydrogen sulfide, production, Coagulase tests and Triple sugar iron

agar.

Results

Wholesale Fish Market Details:

The only wholesale fish market located at Nanpura area of Surat city (Fig. 1) was studied. The market was constructed in 1950 by Surat Municipal Corporation (SMC). Total 68 traders were enrolled and allotted fixed place by SMC for fish trading from 6:00 a.m. to 10:00 a.m. The market was dominated by women wholesalers.

Trucks loaded with fishes were brought to fish market early in the morning without cooling facility. Fishes sold in the wholesale market were brought from villages of Choryasi taluka (Bhimpore, Dumas, Hazira, Magdalla, Kavas and Ichchhapore), outside Surat city (Porbandar, Veraval, Jamnagar, Junagadh, Jakhao and Golai) and other states of Maharashtra, Andhra Pradesh and Kerala by road and railways. Approximately 40 ton fishes were marketed daily by wholesalers of fish market. Dead fishes were packed in thermocol boxes with ice while live fishes were brought to the market in drums. Fishes were sorted according to the species and size and sold in the market.

Fish distribution was at local and district level. Traders of wholesale fish market sold their fishes to retailers of various local fish markets (Nanpura, Golwad, Navsaribajar, Saiyadpura, Dilligate, Rander, Bhimpore, Dumas, Suvali and Hazira), fish markets of Valsad and Navsari, retail outlets, vendors, also to hotels and restaurants of Surat city.

Variety of freshwater fishes such as *Catla* sp. (catla), *Labeo* sp. (rohu), *Cirrhinus* sp. (mrigal), *Pangasius* sp. (pangas), *Oxygaster* sp. (chaliya), *Mystus* sp. (singala) and *Macrobrachium* sp. (sondhiya) were found to be sold in the market. Among marine water fishes viz., *Dasyatis* sp. (patara), *Atropus* sp. (bangda), *Stromateus* sp. (paplet), *Harpodon* sp. (bumla), *Parastromateus* sp. (halwa), *Polynemus* sp. (rawas, cheriyu, dara), *Muraenesox* sp. (vam), *Protonibea* sp. (ghol), *Scylla*



Fig. 1: Nanpura Wholesale Fish Market.



Fig. 2: Fishes piled up on the floor.

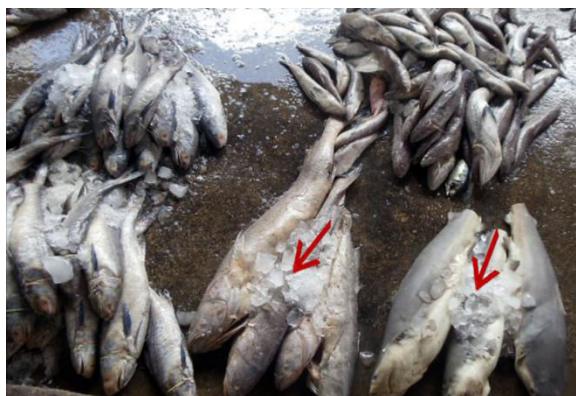


Fig. 3: Preservation of fishes with meagre amount of ice.



Fig. 4: Unsold fishes in thermocol boxes with ice for the next day sale.

Table 1: Microbiological Quantitative and Qualitative Analyses

S. No.	Name of the species	Total Viable Count (TVC) (CFU/g)	Permissible limit of micro-organisms in fish*	Name of the Microorganisms
1.	<i>Catla catla</i> (fresh)	No growth	5×10^5 *	Absent
2.	<i>Labeo rohita</i> (fresh)	No growth		Absent
3.	<i>Atropus</i> sp. (marine)	69.5×10^5		<i>Escherichia coli</i>
4.	<i>Stromateus cinereus</i> (marine)	51.2×10^5		<i>Escherichia coli</i>
5.	<i>Penaeus monodon</i> (marine)	49.3×10^5		<i>Escherichia coli</i>

*Source: Central Institute of Fisheries Technology, Cochin (2008)



Fig. 5: Isolation of *Escherichia coli* on Nutrient agar.



Fig. 6: Isolation of *Escherichia coli* on MacConkey's agar.



Fig. 7: Isolation of *Escherichia coli* on EMB agar.

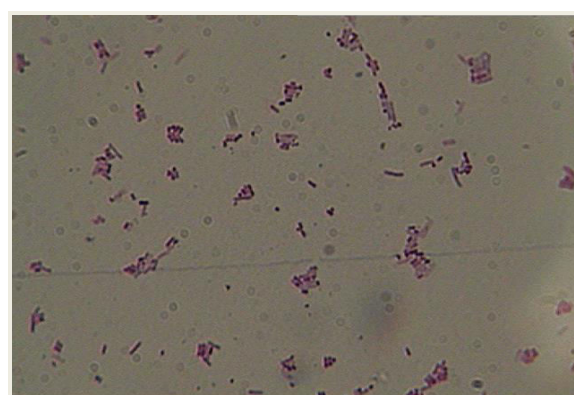


Fig. 8: Gram stain of *Escherichia coli*.

sp. (karachla) and *Penaeus* sp. (zinga) were commonly sold in wholesale fish market.

The wholesale market was centrally located in Surat city. There was no proper building for marketing, the selling of fish was on the road without facility of electricity, water, drainage, storage room and proper flooring. Small platform was constructed in the market but wholesalers did not use for fish selling. There was no lavatory and washing facilities. Hygienic conditions were very poor. Fishes were piled up on the floor (Fig. 2). Most of the fish merchants did not use ice or any chilling facilities while very few of them used meagre amount of crushed ice during selling the fishes (Fig. 3). As a result, fishes tend to deteriorate in the quality and traders sold at lower price. Some traders were found to pack the unsold fishes in thermocol boxes with ice for the next day sale (Fig.4).

The National Fisheries Development Board (NFDB), Hyderabad had allotted a grant of Rs. 1.39 crore to Surat Municipal Corporation in the year 2011 for the construction of a modern fish market at Nanpura area of Surat city. There was a need to broaden the roads near the market to renovate the fish market which would have affected the houses of local people. Residents of the area and wholesalers protested, SMC planned to shift the market from Nanpura to other place of Surat. Till date no modern fish market is constructed in the city.

Microbiological analyses:

Fifteen fish samples of five species from wholesale market were analyzed thrice to check the quality of fishes.

Total Viable Count (TVC):

The results of total bacterial count in fish samples

expressed in colony forming unit per gram (CFU/g) are shown in Table 1. Colonies were observed in plate ranged from 10^{-2} - 10^{-4} dilution factor.

Fish samples from wholesale market showed higher bacterial count (69.5×10^5 CFU/g) in *Atropus* sp. followed by *Stromateus cinereus* (51.2×10^5 CFU/g). Bacterial counts (49.3×10^5 CFU/g) from shrimp of same study area was noted. All fish samples crossed the permissible limit (5×10^5 CFU/g) showing very high bacterial count.

Apart from this, fresh water fish samples of *Catla catla* and *Labeo rohita* from same wholesale market were found completely free from the bacterial growth.

Gram Staining and Biochemical Test:

The results of qualitative analysis are shown in Table 1. Out of total fifteen fish samples, *Escherichia coli* was found in nine fish samples collected from wholesale fish market.

Large circular, slightly raised, translucent white colonies of *Escherichia coli* with entire edge was seen on Nutrient agar (Fig. 5) while lactose fermenting pink spreading colonies was on MacConkey's agar (Fig. 6) and greenish metallic sheen was seen on Eosine methylene blue (EMB) agar (Fig. 7). *Escherichia coli* exhibited positive reactions to motility and negative to gram stain (Fig. 8). *Escherichia coli* was found to be Indole and methyl red positive while Voges Proskauer and Citrate utilization test were negative. Organisms fermented glucose, sucrose, lactose, maltose, xylose and mannitol. Results of various agar plates, gram staining and biochemical tests confirmed the presence of *Escherichia coli* in the fish samples.

Discussion

The improvement of an efficient fish marketing system from the present status depends upon the overall level of national development. A vigorous attempt to improve the system should begin from a very careful and detailed evaluation of the

problem. For example, market power used by traders will not be operative if actually any problem exists in transport, storage or handling (Alam *et al.*, 2010).

Mol and Saglam (2004) reported that floor of markets in Bobigny (France) and Bielefeld (Germany) covered with tiles. Automatic doors were used in the markets. Restrooms were located away from the seafood Departments with the hand washing facilities and lavatory. Workers had to wear plastic boots, coats, caps and gloves in the fish market. Chemical solutions were available for the disinfection of boots, coats, caps and gloves. Routine health checkups of workers were carried out by the administration in all markets. On the other hand, Olalusi *et al.* (2010) found the erratic supply of electricity, inadequate cold storage facilities and stalls in the markets of Nigeria. On the other side the fish sellers of Okavango delta, Botswana were constrained by several factors including lack of preservation facilities and transport (Jagger and Pender, 2001; Adeokun *et al.*, 2006). Islam *et al.* (2021) noted that similar conditions of the markets studied which were not satisfactory judging with the point sanitation, shade, water supply, drainage system, ice supply and preservation facilities. Findings of present study also showed that even basic facilities like electricity, water, drainage and proper flooring were not found in the fish market of Surat city. Hygienic conditions were found to be very poor in study area.

Olalusi *et al.* (2010) reported that the Liverpool fish market in Lagos state of Nigeria was mostly dominated by women and only few men were found to be involved in the market. Similar observations were made in the current study. Study area was dominated by women indicated active participation in fishing sector. Price fixation was generally determined by the fish sellers including in present study on fish marketing in Surat city. The work of Graddy (2006) strengthens the concept.

Microbiological analysis is a tool to check the

quality of fish and pathogens harmful to humans. Type and total number of bacteria on fish skin indicate the quality of fishes. Marine fish samples (*Atropus* sp. and *Stromateus* sp.) from wholesale fish market had high TVC with *Escherichia coli* exceeded the permissible limit (Surendran *et al.*, 2008). The bacterial load was significant with *Escherichia coli* in *Penaeus monodon* detected from same fish market also exceeding the permissible limit. It was due to unhygienic condition and inadequate use of ice. The results of this site claimed for proper preservation facilities for bacterial load. Also fishes were contaminated with pathogenic bacteria which indicates poor hygiene and sanitary condition of fish market.

On the other hand, samples of freshwater fishes *Catla catla* and *Labeo rohita* analyzed from same wholesale market of study area were found completely free from bacterial growth indicating less susceptible to microbial counts and pathogens. These findings were first time noted in this particular study area.

Temperature plays an important role in growth of bacteria. In support to current study, Dutta *et al.* (2010) reported that number of *Escherichia coli* had increased remarkably at the temperature between 31°C to 34°C in all fish samples collected from ponds of Nadia district of West Bengal which is due to the increase in temperature which affected the population of *Escherichia coli*. This temperature is extremely suitable for *Escherichia coli* growth and proliferation. This organism is capable of producing hazardous amounts of toxin histamine in a very short period of time when the fishes are kept at elevated temperature which cause fish poisoning, diarrhoea, meningitis and septicaemia (Kim *et al.*, 2001; Cemek *et al.*, 2006; Ananthanarayan and Paniker, 2009) and a health hazard to human (Ampofo and Clerk, 2010).

Conclusion

The findings of this study revealed that wholesale fish market has unsatisfactory structure and poor hygienic conditions still it is regard as an

important wholesale fish market in Surat city due to wide distribution of fishes. Although some fresh fish samples collected from wholesale fish market were completely free from bacteria as they were less susceptible to microbial counts and pathogens. On the other side, findings of the present study showed that all marine fish samples were contaminated with pathogenic bacteria such as *Escherichia coli* due to lack of preservation and improper sanitary condition of fish market of Surat city. Above described pathogenic bacteria cause fish deterioration and food poisoning which make fishes unsafe for human consumption. Thus, serious efforts should be made as soon as possible to create awareness among fish sellers regarding infrastructure development and use of proper preservation facilities to maintain the quality of fishes which is mandatory for consumer's good health.

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