Microbial quality of ice used for preservation of seafood in Veraval, Gujarat

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Ice preserves freshness of fish and fishery products, which otherwise deteriorates rapidly during distribution, storage and marketing. Ice acts as a preservative agent by reducing the temperature of fish and thereby retarding the growth of microorganisms. However, ice can act as both source of contamination and a medium for bacterial cross contamination. Microbial contamina-tion of ice is associated with many factors including the use of contaminated water used for its production, storage conditions, unsanitary ice handling, production and transportation procedures and type of use and production equipment (Teixeira et al., 2019). If quality of source water used for manufacturing ice is not good, there is a chance of carryover contamination of pathogenic microorganisms which cannot be destroyed completely during freezing of water. In fact, many microor-ganisms can survive in ice but their numbers decrease gradually with time. When ice is thawed, the remain-ing microorganisms may get injured, but they tend to recover their viability when the ice melts into the fish. This means that if pathogenic microorganisms are present in the source water used to make ice, they remain viable in the ice and are capable of causing contamination to fish (FEHD, 2005). Ice-making machines may also contribute to contamination of ice by seeding from the mains supply, defective plumbing that allows backflow from drains and inconsistent cleaning of the machines and containers (Burnett et al. 1994). The improper handling of ice by dragging on floor or storing on contaminated floors before being transported to fishing boats, or poor hygienic practices during transportation and inadequate knowledge of workers in handling and washing of contact surfaces can also increase the chance of microbial contamination in ice.

Ice can act as an important vehicle for trans mission of pathogenic bacteria and viruses to fish leading to food borne illness such as gastroenteritis in humans (Gerokomou et al., 2011). Indicator micro-organisms are used to assess the hygienic status of ice and possible presence of pathogens. The coliforms, *E.coli* and the total count of heterotrophic micro-organisms indicate the sanitary quality of ice (Smoot and Pierson, 1997). According to the World Health Organization (WHO 1997), the ice which is to be consumed or which is in direct contact with food should be of same quality and safety as that of drinking water. The Indian standard (IS 10500) recommends that the ice should be devoid of total coliforms, fecal coliforms and *E. coli* and should meet the requirements of drinking water standards. There-fore, the present study was undertaken to evaluate the microbial quality and contamination sources of ice used for fish preservation in Veraval.

Seventy five samples including water from ice plant used for production of ice, ice from ice plant, ice before crushing (after unloading from transportation vehicle), ice after crushing and ice from fish hold (after fishing) were collected (Fig.1). Microbial parameters such as Heterotrophic plate count (HPC), Total coliforms (TC), Faecal coliforms (FC) and E.coli were determined as per APHA, 2017 and results are shown in Table 1. The microbial count of water used for ice production, ice from ice plant, ice before crushing, ice after crushing and ice from fish hold were found in the range of 2 - 6.65 log cfu/ml. Significant increase in the microbial count was observed from ice plant to fish hold which indicate inadequate hygienic and sanitary measures during handling and transportation of ice from ice plant to fishing vessel. The heterotrophic count of water (@37°C) used for ice production were above the values (20 cfu/g) stipulated by EU directive 98/83/EC, (Table.1). Total coliforms (TC) and faecal coliforms (FC) showed a steep increase in the distribution chain of ice. Average TC of water, ice from ice plant, ice before crushing and ice ranged from 83.15- 752 MPN/100ml and average FC value were 1.39 -71.65 MPN/100ml for the different points. The remarkable increase in TC and FC may be due to the unhygienic and improper handling practices during transportation and also there is a general practice of

keeping ice on the floors in the landing centre before crushing. Average TC and FC of ice collected from fish hold were 3834.3±744 and 1198.14±400 MPN/100ml respectively, indicating improper cleaning of fish hold and lack of sanitary practices and cleaning schedule at the end of each fishing trips.

E.coli was detected in all the stages from water from ice plant to fish hold with an average count of 1.86±0.62 to 25.57±6.6 MPN/100ml respectively. The presence of *E.coli* in water and ice in the ice plant indicated the poor quality water used for making ice and the lack of hygienic practices. Environmental contamination and contamination from transportation vehicles, utensils, ice crushing machines etc. also might have played a significant role in the high levels of coliforms and *E.coli*. The presence of faecal coliforms and *E.coli* in ice is an indication of fecal contamination (Falcao et al., 1993). The high load of *E.coli* in ice from fish hold is of concern since the ice from the fish hold was used for icing and re-icing of fish after landing and distributed to far off places. The crew of the fishing vessels and personnel involved in the production of ice are not trained on maintenance of personnel hygiene and hygienic handling of ice.

Overall the study revealed that out of seventy five samples collected from different stages of ice distribution chain, 94.66, 89.33 and 60% of samples had TC, FC and *E.coli* above acceptable limit as per IS 10500:2012 (Fig.2).

In conclusion, the study highlighted important sanitary issues in the distribution chain of ice used for fish preservation in Veraval. The ice used for refrigeration of fish can be a source of bacterial (pathogen) con-tamination. Only potable water shall be used for preparation of ice. Extreme care has to be taken in handling of ice during transportation and practices such as dragging of ice on contaminated floors should be avoided. Training on hygienic handling of ice shall be ensured for all the personnel involved in every stage of handling ice. There is need for strict monitoring by competent authorities for the improvement of quality of ice used for seafood preservation in Veraval, Gujarat.

Fig: 1 *Sampling points: water from iceplant, ice from ice plant, ice before crushing (after transportation), ice after crushing, ice from fish hold.*

Table.1 *Microbial quality of ice collected from various stages of distribution*

Test	Water Sample	Ice from Ice plant	Ice before crushing	Ice after crushing	Fish hold
Heterotrophic plate count (log cfu/ml)	3.31±0.18 † (2.95–4.95) ‡	2.95±0.15 † (2.0-3.96) ‡	4.57±0.15 † (3.58-5.37) ‡	4.76±0.18 † (3.68-5.91) ‡	5.95±0.13 † (5.9-6.65) ‡
Total coliforms (MPN/100ml)	83.15±51.6 † (0-790) ‡	11.41±4.8 † (0-49) ‡	675.82±271.7 † (16-3300) ‡	752±336 † (16-4900) ‡	3834.3±744 † (70-11000) ‡
Faecal coliforms (MPN/100ml)	6.19±2.5 † (0-33) ‡	1.39±0.38 † (0-4.5) ‡	63.32±27.3 † (0-350) ‡	71.65±28 † (0-350) ‡	1198.14±400 † (9.2-4900) ‡
E.coli (MPN/100ml)	1.86±0.62 † (0-23) ‡	0.35±0.03 † (0-4.5) ‡	5.08±1.6 † (0-70) ‡	5.87±2.2 † (0-79) ‡	25.57±6.6 † (0-170) ‡

† Average values
‡Range

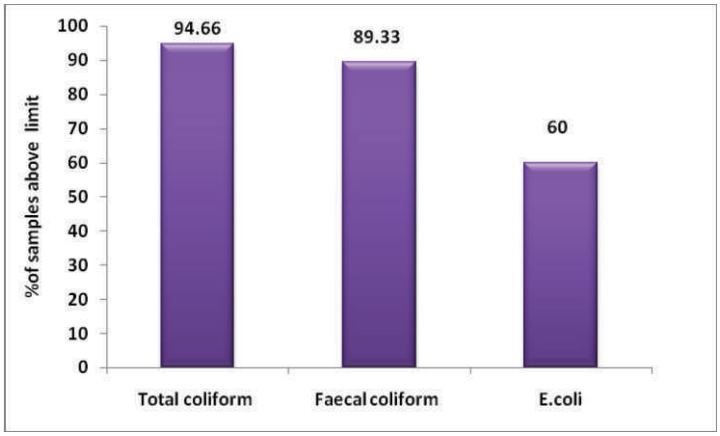

Fig:2 *Percentage of various microorganisms exceeded the limit in collected samples*

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