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A study on post-harvest fish handling practices at Versova landing centre, Mumbai

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Abstract
Post-harvest handling of a catch is a crucial component for the production of a high quality finished product. Realising the importance, a study was conducted to enquire about the post-harvest handling of fishes at Versova landing centre of Mumbai, India. The present study reveals details regarding the species landed, handling of the same on the landing centre as well as the microbial quality of fishes, ice and water used for storage. It also brings out specific needs at the Versova landing centre e.g. Infrastructure facilities for processing, availability of potable water for cleaning, training regarding alternative value addition methods, and linkage with high-value markets in order to ensure hygienic post-harvest fish handling practices as per the established quality standards. Adoption of hygienic handling practices, with the necessary infrastructural support, can be a boon for the socio-economic condition of fishers of Versova landing centre and public health at large.

Keywords: Post-harvest handling, quality standard, marine landing centre, hygiene

Introduction
Proper quality maintenance of fishes or any derived processed products is paramount for their higher acceptance among the consumers. Fish is a highly perishable commodity, if not meant for immediate consumption, requires proper post-harvest management and refrigeration or icing to improve and maintain its safety and quality [1]. The quality of products available in the market dramatically depends on their handling, storage, processing, and any other activities undertaken while bringing them from the point of harvest to the ultimate consumption [3, 19]. Many factors affect the quality of fish sold in a market such as the cleanliness of the market and storage place, quality and quantity of water used, the temperature at which fish used to maintain, the general handling practices adopted and cleanliness of the utensils used by the fish handlers [7, 13]. The desired hygienic practices include hand washing before food is touched, cleaning and sanitizing work surfaces and equipment, and sterilization to remove or destroy spoilage and pathogenic microbes [14, 15, 17]. These hygienic measures aim at preventing or reducing fish contamination and microbial growth. At fish landing centres, the landed fishes were auctioned and primarily intended for the sale at the local market. The leftover fishes, mostly the low value, are processed for marketing latter [16]. Sun-drying and salting are the standard age-old traditional method of post-harvest processing followed at the landing centre [12]. In the above context, this study aimed to get an idea about the type of post-harvest activities that occur after the unloading of massive catches at a major landing centre situated in a large fishing state like Maharashtra. In the process, hundreds of livelihoods are supported through activities cited above at the Versova landing Centre.

Materials and Methods
Study area
The survey study area covers the Versova fishing harbor located between 19° 0’ 15”N to 18° 0’45”N latitude and 72° 0’ 15”E to 73° 0’ 00”E longitude of Mumbai is located in the North Konkan region of Maharashtra state (Fig.1)

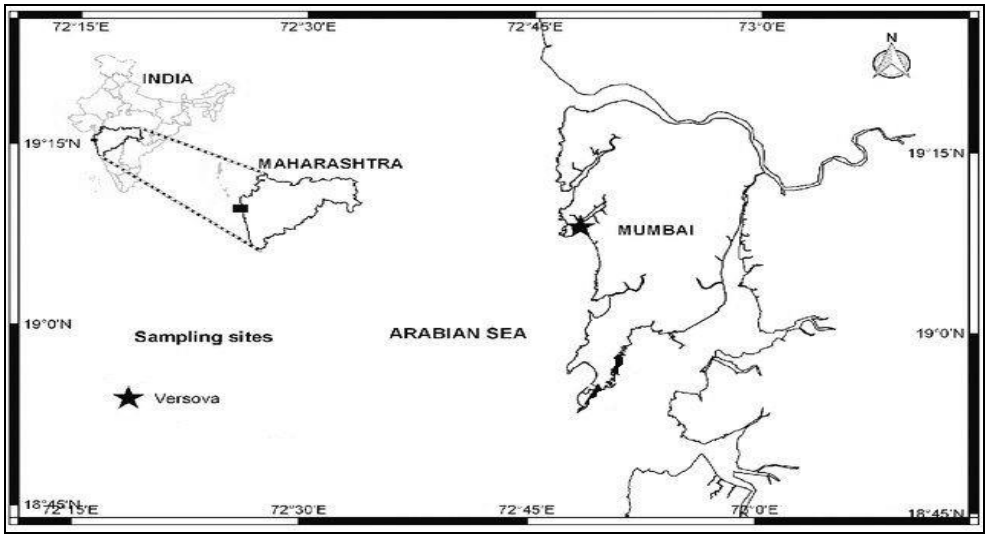

Fig 1: Map showing study sites of Versova landing centre

Sample collection and identification

Fish catches were identified up to the species level by using the FAO species identification sheet [8, 10]. Samples such as fresh fish, dry fish, ice, and harbour water were collected aseptically in sterile plastic bags or bottles and subjected to bacteriological analysis within two hours after collection. If there is any delay in the examination of the sample, it was stored at a temperature between 0 °C to 10 °C.

Microbiological and sensory analysis

An amount of 10g of muscle from different parts of the fresh and dried fish sample was collected aseptically and macerated with 90mlsterile saline. The microbial quality of the samples was determined after making serial dilution in the same diluents as per the methods of USFDA (2001) [9, 20] and APHA, (2001) [2]. All the samples of fresh fish, dried fish, ice and harbour water were assessed by determining the total plate count, *Escherichia coli* count, faecal Streptococci, *Staphylococcus aureus* and *Salmonella* spp. [21]. Potatodextrose agar was used in the dried fish sample for the isolation of yeasts and moulds by the pour plate method. The dried fish samples were also observed for visible fungal colonies [4]. Sensory evaluation of the selected dried fish products was carried out using the 9- point hedonic scale by a trained taste panel consisting of 10 members. The sensory quality of the samples was judged for appearance, colour, texture, odour and overall acceptability, following the methods described by Siddaiah *et al.* (2001) [18].

The total coliform counts were determined in ice and harbor water samples using the standard Most Probable Number (MPN) method [5] using the 5-tube technique. 5 double strength (DS) tubes and 10 single strength (SS) tubes of Lauryl Sulfate Tryptose Broth (LSTB) were made and to the first 5 DS tubes, 10 ml of 10^{-1} dilution (25ml water/ice- 225ml of saline) sample were added aseptically. To the next 5 SS tubes 1ml of 10^{-1} dilution sample was added and to the last 5 SS Tubes 0.1ml of 10^{1} dilution sample was transferred aseptically. These tubes were incubated at 37 ˚C for 24 hrs. After 24h, the tubes showed turbidity and gas production, positive results were interpreted in the appropriate table of MPN considering the inoculated dilutions, and then the MPN/100g was calculated.

Statistical analysis

The statistical analysis of the results was carried out by one-way analysis of variance (ANOVA) using the statistical package of social science program (SPSS-16), and differences (P<0.05) among the means were compared using the Duncan's Multiple Range Test (DMRT).

Results and Discussion

Fresh fish handling operation at Versova landing centre

Unloading of fishes: After the arrival of the craft at the jetty, the fish labors employed by the craft owners unload the catch with the help of carets made up of plastics and Bamboo.

Fig 2: Unloading of fish catch from craft

Dominant species landed: Among the catches landed at the Versova landing centre, the dominant species belonged to the Order Perciformes. Primary catch composition of multi-day trawlers comprised *Otolithus cuvieri, Arius maculatus, Lepturacanthus savala, Megalaspis cordylla, Thryssa dussummieri, Rastrelliger kanagurta, Cynoglossus*

macrostomus, Uroteuthis duvaucelii, Sepia pharaonis and Penaeid prawns. In the case of single-day trawlers, the major catch was constituted by *Otolithus cuvieri, Arius maculatus, Lepturacanthus savala, Thryssa dussummieri, Harpodon nehereus, Pampus argentius, Megalaspis cordylla, Lepturacanthus savala, Cynoglossus macrostomus, Uroteuthis duvaucelii* and Penaeid prawns etc.

Fig 3: Dominant Species sold at Versova landing centre after landing of catch

Microbiological quality of water and ice used: Harbour water and ice used in the Versova fish landing centre were analyzed for the microbiological safety point of view to know the overall quality as poor quality water and ice can be a potential source of secondary contamination. The general requirement of water to process 1 kg shrimp is usually 12 litres and 5 litres for fishes. The ice requirement is generally practice1: 1. Fishers use harbour seawater for washing the catch [22]. During the process of auction and transportation, block ice is crushed and used to maintain the freshness of the fishes. Plastics or PVC boxes are used while icing and temporary storage of catches. The total plate count (TPC) for water and ice should not exceed $1x10^5$ cfu/g and coliforms (MPN) should be less than one 100/ml as per the quality standard is a concern for the fresh fish processing. Harbour water and ice were analyzed for the microbiological quality by enumerating the total plate count (TPC) and coliforms (MPN) count.

Table 1: Microbiological quality of ice, harbour water and fresh fish sample of Versova fish landing centre

Sample	TPC (Log cfu/g.)	Coliform (MPN/g.)	*E. coli*	Faecal Streptococci (MPN/g.)	*Staphylococcus aureus*	*Salmonella* spp
Ice	3	Absent	Absent	Absent	Absent	Absent
Harbour water	6	95.00	Positive	40.0	Absent	Absent
Fresh fish	4	25.00	Positive	10.0	Present	Absent

Fig 4: Type of ice and containers used for preliminary catch storing

Auctioning, Retailing, and Peeling: Women are dominantly (entirely) involved in the process of auctioning, retailing, and peeling. All these activities are conducted on the landing centre itself.

Fig 5: Peeling and dressing of fishes during retailing

Transportation: With its strategic location in the Mumbai city, transportation means such as a truck, auto-rickshaw, pick-up van were readily available at the landing centre.

Fig 6: Transportation of the catch to other retail markets

Dry fish production at Versova landing centre

In dry fish production and value addition, there is a dearth of required infrastructure facilities to obtain the wholesome end product, such as potable water for washing the catch, ice boxes for holding the fishes and shelves for drying operation are not available at Versova landing centre. Harbour seawater is used for washing fish that are later used for dry fish production and other value-added product preparation. Non-availability of drying racks/shelves and potable water leads to a reduction in the efficiency of the dry fish production and creates a negative impact on the quality of the end product. Thus the net effect of all the limitations prevailing in the Versova landing centre, adversely affect the end product quality, marketability, and shelf-life of dry fish.

Sun drying

This method is mostly employed for fishes such as Bombay duck and Anchovies. The proportion of salt and fish varies from 1: 4 to 1: 6 by weight depending upon the size of the fish. The period under cure ranges from 12 to 24 hours. Drying is done by spreading the fishes on the beach sand or other open grounds where the fishes get dried by the solar heat. During drying, the fishes are turned occasionally, usually in two to three hours, to ensure quick and uniform drying. Dried fishes are gathered and heaped inside a godown or kept heaped in the drying ground itself with a covering of palmyrah leaves mats.

Fig 7: Sun drying of Bombay duck

Dry salting: Curing by this method is practiced for almost all varieties of fishes, with the most common being, Acetes and Mantis shrimps. Direct salting is done in a pit or tub using brine further, followed by drying. Salt: The shellfish ratio is maintained at 1: 4 by weight. After complete drying, the salted fishes are either placed in tubs or simply heaped on the floor to remain for two to three days with more salt being sprinkled over each layer of shellfish while packaging.

Fig 8: Dry salting of Squilla sp. and Acetes sp.

Microbiological and sensory quality of dried fish products

International Commission on microbial safety of food (ICMSF) has specified that fresh fish and dried fish have standard Plate Count (SPC) should be less than $5x10^5$ cfu/g. and $1x10^5$ cfu/g. respectively. Fungal growth is a highly detrimental threat for dried fish, which adversely affects its quality [6]. This further leads to substantial amounts of dried fish being discarded, causing economic loss. The dried fish samples of the present study were free from visible fungal colonies. However, plating on potato dextrose agar revealed the presence of fungi to the extent of 1.0-1.2 log cfu/g in Bombay duck, squilla and acetes sp. (Table 2).

The ultimate measure of quality is consumer acceptance, and hence sensory quality of the dried fish product plays a

significant role in determining the overall quality of the product [11]. The products were found to have an overall acceptability score in the range of 5.10-7.0 (Table 3), and the present study revealed that Bombay duck acceptability was high by the panelists compared to squilla and acetes sp. The difference in the sensory quality and overall acceptability of the dried fish product might be attributed to the different degree of biochemical as well as microbiological changes during the drying process and subsequent storage period.

Table 2: Microbiological quality of dried fish sample of Versova landing centre

Sample	TPC (log cfu/g)	Yeast and mould (log cfu/g)	*Staphylococcus aureus* (log cfu/g)
Bombay duck	4.25±0.05	1.10±0.10	1.30±0.03
Squilla sp	4.8±0.10	1.25±0.05	1.45±0.05
Acetes sp	4.62±0.08	1.15±0.05	1.25±0.05

E. coli and Faecal Streptococciwere undetectable (<10/g sample) and *salmonella spp* was absent in all the dried fish sample. All values are represented as mean ± standard deviation

Table 3: Sensory quality of three dried fish products of Versova landing centre

Parameter (N=3)	Bombay duck	Squilla sp	Acetes sp
Appearance	7.10 ± 0.48	5.25 ± 0.67	6.85 ± 0.67
Colour	6.90 ± 0.21	5.20 ± 0.84	6.60 ± 0.84
Texture	6.80 ± 0.21	5.15 ± 0.88	6.60 ± 0.88
Odour	6.70 ± 0.2	5.25 ± 0.63	6.30 ± 0.67
Overall acceptability	7.0± 0.28	5.10 ± 0.26	6.80 ± 0.26

All values are mean ± standard deviation; (P<0.05).

Packaging materials for dried fish products: Cured products fetch a good market and are an excellent source of income for the fishermen communities. Salted fish and other dried fish products are packed in a plastic pouch for selling at the local market. These are appropriately labeled with the product name and sold in the landing centre locality. Some are sold in fish festivals held every year among the Koli communities or are transport at some nearby local markets. Dried *Acetes* shrimp species, due to its exclusive small size, is one of the most popular commodities for curing, which are sold by packing in polythene consumer packets or even in small gunny bags. Middlemen's are sometimes involved by many fishermen for their better product marketing to distant places.

Conclusion

The study throws light on the need to adopt hygienic post-harvest handling practices as per the established quality standards in the fishing industry. Major constraints identified were lack of availability of quality ice, abysmal infrastructure facilities, lack of potable water, lack of a good landing jetty and racks for dry fish production as well as poor access to improved technologies such as drying and other value-added preservation technique. The study recommends a requisite investment, awareness and training regarding alternative value addition methods, linkage with high-value markets for ensuring the excellent quality of the fisheries products. Adoption of hygienic handling practices, with the necessary infrastructural support, can be a boon for the socio-economic condition of fishers of the Versova landing centre and public health at large.

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