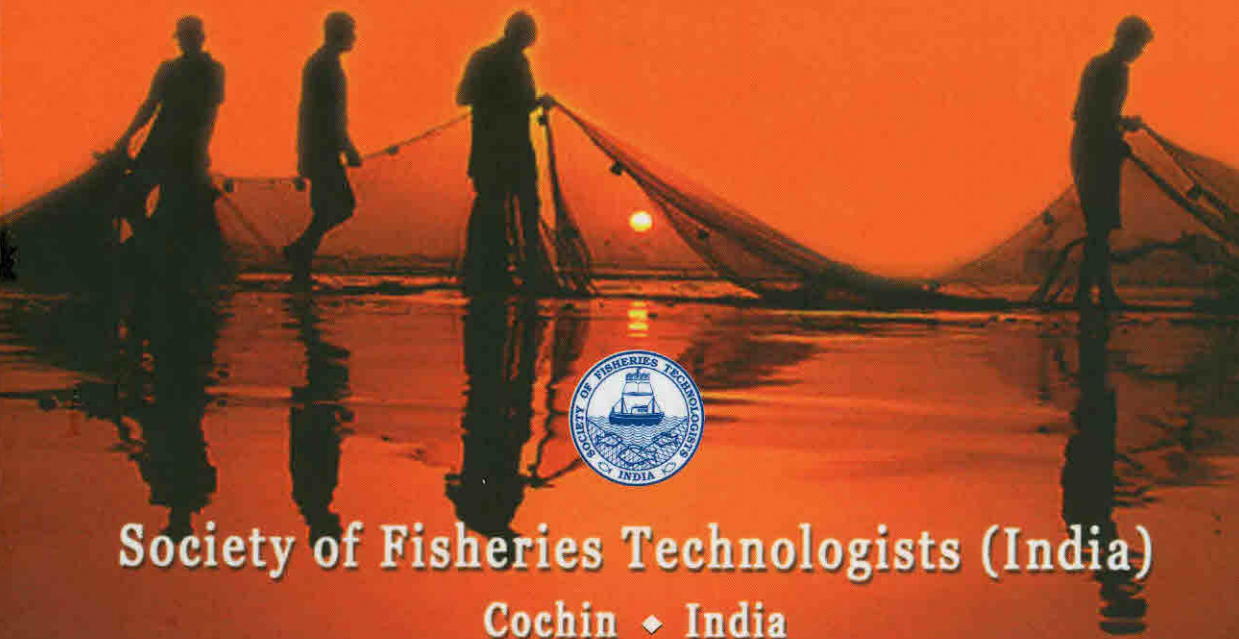
Coastal Fishery Resources of India

Conservation and Sustainable Utilisation



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Simple Interventions to Preserve Quality of Iced Fish and Minimize Post-harvest Losses

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Introduction

Fish is highly perishable material and it undergoes bacterial, enzymatic and biochemical decomposition after death. The quality of fish or prawn reaching the consumer or the processing factories will greatly depend on how the fish is handled after the catch; how it is preserved and transported before it reaches the user. Since 50-70% of the total landing of fish is consumed as fresh, it is absolutely important that efficient and hygienic practices are employed, so as to ensure that fish reaches the consumer in very fresh condition. In ambient conditions, the fish becomes unfit for human consumption in about 8 to 12 h after they are taken out of water. Hence, it is imperative to cool them down with crushed ice as early as possible after they are caught, in order to retain their freshness for the maximum length of time.

Spoilage rate is dependent mainly on the temperature condition under which the fish is stored. Temperature abuse is the single largest factor in loss of quality in fish and sea food products. The spoilage rate of fish at 5.5° and 11°C is twice and four times as fast as that at 0°C. Generally, icing is done at 1:1 level and ice is replenished at intervals to keep the temperature down. Advantages of the use of ice for cooling the fish are its non-toxic nature and rapid cooling effect. When the ice melts, the melt water washes away the slime and bacteria from the exterior of fish. Ice has high relative humidity and hence retards desiccation of the fish.

Jeeva *et al.* (2006; 2007) and Srinath *et al.* (2008) studied the harvest and post harvest losses in inland and marine fisheries sectors in Andhra Pradesh and Kerala, respectively. They assessed the percentage of losses

at various handling, marketing channels up to consumer level. Ward *et al.* (1998) reported that post-harvest fish losses, suffered by small-scale traders in India were excessive during monsoon. Some of the main reasons of spoilage and losses were attributed to faulty handling practices, spoilage due to insufficient icing, improper packing and inefficient containers. They recommended intensification of training and awareness on hygiene and sanitation in fish handling and improved handling practices and efficient containers at all levels. (Jeeva *et al.*, 2007; Srinath *et al.*, 2008).

Icing is usually done in insulated ice-boxes which are effective but are not handy for use by fishermen on small traditional craft, fish vendors and consumers. Fish caught by the traditional fishermen using smaller boats are usually kept directly on the deck or in non-insulated bags. Iceboxes are not preferred as they are very inconvenient to be kept on these small boats. In the domestic fish markets, fish are generally displayed on wooden or plastic planks exposed to the open air thereby attracting flies and dust contamination. The ice placed on the planks melts faster as it is in contact with the ambient air temperature.

In the present work, simple interventions in the form of plastic sheets, insulated bags of different sizes and shapes and fish display cabinet were designed with an objective to avoid contamination and spoilage, thereby preserving the freshness and quality of the fish during different stages of handling until it reaches consumer.

Materials and Methods

Materials for insulated bags are polyvinyl chloride (PVC) sheets, cotton coated rexin and polyethylene foam. Materials used for fish display cabinet are PVC sheets, cotton coated rexin, polyethylene foam (thermofoam), PVC connecting tubes and joints. Freshwater fish (*Labeo rohita*) and marine fishes (*Trichiurus lepturus* and *Sphyraena* sp.) were used in the experiments. Crushed block ice was used for cooling the fish.

Aerobic plate count (APC) of fish was determined using tryptone glucose beef extract agar (Speck, 1978) and H_2S producing bacteria count was obtained using peptone iron agar (Gram *et al.*, 1987). Total volatile base nitrogen (TVBN) was determined by the micro diffusion method (Conway, 1950) using trichloro-acetic acid extract. Peroxide value (PV) was determined iodometrically (AOAC, 1990) after extracting the fat from the fish meat using chloroform and analysed immediately. Temperature was measured using digital probe thermometer and alcohol thermometer.

Results and Discussion

Insulated bags were designed with an objective to preserve the quality of the fish caught by the fishermen. The bag was made of three layers, *viz.*, an outer waterproof covering, a middle insulation foam layer and an inner plastic lining. Outer water proof covering is made up of cotton coated rexin that minimizes the seepage of melt ice water, does not allow outside water to enter into the bag and also allows for easy washing. The middle layer is made up of thick expanded polyethylene foam (thermo foam) which helps in slowing the melting of ice thereby maintaining the lower temperature required for preserving the quality of iced fish. The inner polythene layer prevents the contact of fish with the thermo foam thereby maintaining the quality of fish and makes the bag easy to wash.

The insulated fish bags are convenient and find use in the transportation of iced fish. Insulated fish bags of various shapes and sizes were made to suit the needs for different types of users (fishermen, fish retailers, fish consumers). Big size insulated tuna bags with dimensions of length 175 cm, breadth 22 cm and height 44 cm were designed for use by traditional fishermen for preserving the quality of tuna caught by traditional fishing boats. In order to fetch better price it is necessary that the freshness of tuna fish has to be maintained from time of catch on-board the craft. In case of smaller crafts, the use of insulated bags is convenient and the freshness of tuna can be preserved immediately in the insulated bags without getting exposed to the hot sun.

Medium sized insulated fish bags (60 cm bottom length, 30 cm upper length, 22 cm breadth and 45 cm height) and small sized insulated fish bags (48 cm bottom length, 30 cm upper length, 18 cm breadth and 35 cm height) were designed and fabricated, which can be used by fish retailers/vendors in preserving the quality of iced-fish, both during transport and storage. The small insulated bags are particularly suitable for fish vendors/fisher women who purchase the fish by auction at the fish landing centres and keep them in open baskets or aluminium vessels, cover them with a plastic sheet and move about in the streets selling fish from home to home. In towns and cities the fisherwomen vendors carry the wet fish in the traditional containers into the apartments, some tenants object their entry due to fish off odour and surrounded by flies. By using these insulated bags along with ice, the fish is chilled immediately, maintained in fresh condition for the whole day time (minimum 6 hours duration) and with no flies, no off-odour and dust contamination. The consumers can feel very happy seeing the 'hygienically iced fish' in the insulated bags

and they can feel/afford to pay better price as they are getting fish in fresh and clean condition at their door step. The medium and small insulated bags will also be of much use for the fishermen who go for fishing in reservoirs and rivers on small boats, where they cannot take ice boxes. Usually these fishermen keep their catch on the boat directly exposing the fish to hot sun and sometimes to flies and contamination thus affecting the quality of fish quickly. With the use of these insulated bags which is very convenient to carry as well as to keep on the boat, the quality of the freshly caught fish can be maintained and the fishermen can get better price for better quality fresh fish.

A consumer fish bag with dimensions 30 cm length and 60cm height was designed for use by the fish consumers. Using the consumer bags, people can bring iced-fish/prawns in insulated bags so that the freshness and good quality of fish can be maintained until reaching home. The consumers can also freeze gel packs in refrigerator in their homes and take them in insulated bags to the fish market to maintain freshness of the fish and shellfish purchased by them.

Ice melting studies of the insulated fish bags

Laboratory studies using insulated bags filled completely with ice showed that ice remained intact for a period of 6 h in the insulated bag after which there was slow melting of ice. About 60% of the ice remained intact after 12 h and 20% of the ice still remained in the bag even after 24 h.

Quality of fish stored in insulated fish bags

Field studies were conducted onboard research vessel CIFTECH-1 (15.5m L_{OA}, 122 hp steel trawler) in the Bay of Bengal. Immediately after harvest, the temperature of different fish and shellfish species was recorded and the fish were placed in insulated bag containing sufficient ice (1:1 by weight). The temperature of freshly caught fish and shellfish ranged between 26° and 27°C. At the end of 6 h, the temperature of ribbonfish (*Trichiurus lepturus*) stored in the insulated bag ranged between 2° and 4°C, whereas the temperature of ribbonfish kept at ambient temperature ranged between 25° and 27°C. The average time taken for the traditional boat operators to reach the shore after catching fish is about 6 h and the results of this study suggest that the traditional fishers can bring the fish in chilled condition by keeping the fish in the insulated fish bag containing sufficient quantity of ice.

Similar studies were carried out for freshwater fish rohu (*Labeo rohita*) weighing about 1 kg each, purchased from Rajahmundry fish market. The fish were placed in insulated fish bags with fish : ice ratio of 1:1, by weight. Control fish were kept at ambient temperature (28-30°C). The fish were transported from the Rajahmundry fish market to CIFT, laboratory at Visakhapatnam by road. The distance covered was 230 km and the time taken for travel was 4 h. The fish were analysed immediately upon arrival. The temperature of the fish placed in insulated fish bag was 2°C and that of control fish was 31°C. TPC ($7x10^4$ cfu.g^{-1}), H_2S producing bacteria count (220 cfu.g^{-1}), peroxide value (10.95 meq O_2.kg fat^{-1}) and TVBN values (12.62 mg%) were lower in the iced fish brought in insulated bag suggesting that the insulated fish bags are useful in keeping the fish fresh and maintaining the chilled temperature. TPC ($4.12x10^5$ cfu.g^{-1}), H_2S producing bacteria count (1390 cfu.g^{-1}), peroxide value (15 meq O_2.kg fat^{-1}) and TVBN values (18.15 mg%). Fish used in this experiment were fish brought from market and, hence, the quality is not as that of the farm-fresh fish. The quality of the fish needs to be preserved from the time of catch. The results indicate that use of insulated fish bag helps in preserving fish quality.

A comparison of the quality of fish placed in insulated fish bag and in commonly used bamboo basket was carried out using marine fish, barracuda (*Sphyraena* sp.) each weighing about 350 g. About 4 kg of fish were placed in bamboo basket and a similar quaintly in insulated fish bag and kept at room temperature (27 to 31°C; RH 86- 88%) for 6 h. The temperature of fish was monitored at hourly intervals. Samples of fish were drawn at 3 h and 6h of storage both from the basket and insulated fish bag and analysed for bacteriological and chemical parameters. Changes in temperature of marine fish, barracuda (Sphyraena sp.) stored in insulated fish bag and traditional bamboo baskets are given in Table 1. The temperature of fish stored in insulated fish bag was always lower than that of bamboo basket. The quantity of ice was weighed at the end of 6h period. There was practically no ice left in the bamboo basket (less than 10 g) whereas 1250 g of ice (31.3%) was still present in the insulated fish bag after 6h of storage at room temperature (27 to 31°C).

An insulated fish display cabinet was designed and fabricated for the display of fish during sale by the fisher women in fish market. The insulated fish-display cabinet has 2 racks on which plastic trays can be placed for keeping fish and ice. The front portion of the display cabinet was made of transparent material to see through. The sides are covered with three

Table 1: Changes in the temperature of barracuda stored in ice (1:1 by weight) in bamboo basket and insulated fish bag

Time	Insulated fish bag		Bamboo basket	
	Fish in upper layer	Fish in inner layer	Fish in upper layer	Fish in inner layer
0 h	26°C	26°C	26°C	26°C
1 h	8°C	8°C	9°C	9°C
2 h	2°C	2°C	8°C	4°C
3 h	0°C	0°C	8°C	4°C
4 h	0°C	0°C	8°C	4°C
5 h	0°C	0°C	7°C	5°C
6 h	2°C	0°C	6°C	6°C

layered insulation (outer cotton coated rexin, middle thermofoam and inner plastic sheet). The air temperature inside the cabinet (20°C) was lower than the room temperature (27-31°C). The fish contamination with flies and dust was minimised.

Conclusion

It is well known that improper handling of fish accounts for huge post-harvest losses. Simple interventions were suggested to prevent post-harvest losses during storage and transport. Use of these insulated bags during transport of fish from harvest point to the landing centre and from the landing centre to fish markets and the use of fish display cabinet at fish markets can help to prevent or minimize the post-harvest losses of harvested fish and shellfish. By using insulated fish bags along with ice, the fish is chilled immediately, maintained the fresh condition for a minimum of 6 h duration. Thus, the major problem of temperature abuse, incidence of flies, off-odours and dust contamination are addressed in these simple interventions.

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