ICED STORAGE OF MALAYSIAN FISH

by

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Abstract

Quality changes during the storage in ice of popular Malaysian fish were monitored over a three-day period. Physical, microbiological and sensory evaluation of the various species kept under different ratios of ice was made. Recommendations on the methods of keeping fish in ice were made for the benefit of the trawling industry.

INTRODUCTION

The majority of the 400,000 tonnes of fish landed annually in Malaysia is marketed fresh. Trawling has contributed to the marked growth of the fishing industry over the last decade but it is sad to note that little technological innovation has been adopted to reduce the high losses in terms of quantity and quality. Of the total trash fish caught by trawlers operating off the cost of Selangor (west coast of Peninsular Malaysia), about 20 percent is commercial grade fish while that caught by trawlers off the coast of Trengganu (east coast of Peninsular Malaysia) amounts to about 40-60 percent (Kamari *et al.*, 1977).

Icing is the only method used to preserve fish during all stages of handling, storage and transportation. Crushed block ice is the common form of ice available to the industry, but it is only available in the newly established landing complexes managed by the Fishery Development Authority. In 1975 it was estimated that the annual ice requirement y the fishing industry exceeded the present supply by over 400,000 tonnes (Kamari, 1975).

The ice available to the industry generally is of poor quality. 'Green' ice is commonly supplied to the fishermen and there have been instances when ice was found to have been made from untreated river or well water. Improper handling of ice results in considerable loss through meltage. In Malaysia, ice is considered expensive at U.S.$ 22 per tonne. Some fishermen do not appreciate the need to ice their catch properly because visible signs of deterioration are not very significant while the fish are still on board the boat. The poor icing practice could be attributed to the high cost and also to the shortage of ice. Trawlers operating on the west coast usually take 2-3 blocks of ice (100 kg each) for a 3-day trip (Selvadurai and Lai, 1976).

There are few organized landing centres in the country and fish is landed at practically all fishing villages along the coast. The packing and transportation of fish from points of landing to large market centres is fairly well organized and those engaged in the business appear to appreciate the importance of using ice. However, the exorbitant cost of ice forbids its use in sufficient quantities. The ratio of ice to fish depends on the distance of the intended market. A 1:1 ratio is normally used for an 18-h journey and 1:1.5 for a 12-h journey (Kamari, 1977).

Microbial and endogenous enzymic activities are the main causes of quality deterioration in fish. Several reports on changes in levels and types of microflora affecting the quality of several species of temperate and tropical fish and crustaceans are available (Shewan, 1977; Cann, 1977; Cobb *et al.*, 1976). Several chemical criteria have been used to measure biochemical changes occurring during enzymatic breakdown in fish during cold storage, for example hypoxanthine (Herzberg *et al.*, 1977); total volatile nitrogen (TVN) and free amino nitrogen (Cobb *et al.*, 1976) and total viable bases (TVB) using the Conway micro-diffusion method. Cobb *et al.* (1976) were able to correlate the production of TVN and free amino nitrogen to bacterial levels and types in shrimps stored in ice.

The initial microbial load present on fish in their natural environment is governed by their habitat and feeding habits, the geography of the area, the season and the temperature and quality of the waters. During catching and handling, further contamination will occur as a result of contact with man. The quality and wholesomeness of the catch will, therefore, depend on the number and type of organisms present and how they are controlled during handling and transportation. Most temperate species carry more psychrophilic microflora than tropical fish. Thus the shelf-life, as affected by bacterial spoilage, of temperate fish stored in ice will be shorter than that of tropical species (Shewan, 1977).

The fish used in the present study is the relatively common *Pristipomoides typus* (sharp-toothed bass) known locally as ikan kerisi bali or ikan merah. Its pattern of spoilage resembles that of *Rastrelliger* species.

The purpose of the work is to determine the quality changes taking place when fish and ice are packed together in various ratios at the point of landing. The present studies report on the changes in physical characteristics, microbial counts and total volatile bases.

MATERIALS AND METHODS

Fish

The fish (ikan kerisi) were bought at the landing point, weighed and packed in boxes in triplicate (six to seven per box depending on size), with the following ice to fish ratios:

T_1 ice:fish (2:1)
T_2 ice:fish (1:1)
T_3 ice:fish (1:1.5)
T_4 ice:fish (1:2)

Temperature, Torrymeter readings and visual quality appraisal were made on the fish as they were landed. The samples were taken to a mobile laboratory for microbiological, chemical and other determinations.

Boxes

The boxes were made from timber discards. Each box measured 30 x 23 x 15 cm and was provided with a lid made of the same material.

Visual Quality Score

Visual quality score, based on a 0-3 point scale for each parameter, was made by one trained laboratory worker (see Appendix).

Chemical Analysis

Total volatile bases, measured by the Conway diffusion method were used as a measure of quality. A sample was taken from all the fish in each box at the stipulated time.

Total Viable Bacterial Counts

Samples of flesh (10 g) were taken at random and were blended for 2 min in 90 ml of sterile Ringer's Solution in a sterile Waring blender. Aerobic plate counts were carried out on Total Plate Count agar. Appropriate dilutions of the sample in 1 ml aliquots were pipetted into sterile petri dishes, cool molten agar was poured over them and the contents thoroughly mixed. Duplicate plates were incubated at 35°C for three days. The counts reported were the average of the three samples.

RESULTS AND DISCUSSION

Temperature

The average temperature of the fish when landed was 27°C indicating that the icing on board was insufficient. When ice had been used, the temperature of the fish dropped as shown in Fig. 1. The lowest temperature attained was 20°C, as a drop of 7°C for fish iced at 2:1 and 1:1 (ice to fish) ratio, indicating that the amount of ice used is insufficient if the aim is to keep the fish at the temperature of melting ice. After four hours of storage, only treatment T_1 (2:1) had some unmelted ice. In the other treatments, all the ice had melted and the temperature of the fish had started to rise. It took 15 h after icing for treatment T_2 (1:1), T_3 (1:1.5) and T_4 (1:2) and 19 h for treatment T_1 to rise to 24°C.

Quality Deterioration

At the point of landing the fish were considered to have lost about 40 percent of their freshness (visual score of 16 and Torrymeter reading of 11). Thus, the fish were already in an advanced state of deterioration.

Treatment T_4 showed a poorer storage life compared to the other treatments which showed no significant difference. This result could be attributed to the rapid loss of ice. In the other treatments, ice remained for up to 4-5 h after icing. Fish in treatment T_4 were unfit for human consumption (as determined by visual assessment) about 24 h after icing. As shown in Fig. 2 treatments T_1, T_2 and T_3 took about 30 h to reach the same level of deterioration, Torrymeter reading 6-7. The Torrymeter evaluation is able to detect small differences in quality at the early stages of storage (Fig. 3). However, as storage proceeded, the detectable differences by the Torrymeter were less sensitive compared with the visual method.

Microbiological changes

As Fig. 4 shows, there was no significant difference in bacterial counts between the treatments for the 48 h period. However, all treatments showed a continued increase in bacterial counts from landing up to 48 h. Treatment T_1, containing the highest amount of ice, showed a slower rate of increase within a 24 h period and treatments T_3 and T_4 showed a faster increase in counts within the same period.

The fish in treatment T_4 were unacceptable for human consumption after 24 h compared with 36 h for the other treatments. Two of the samples from treatment T_4, were infested with maggots after 48 h. Sampling errors and presence of spreader organisms from the samples also complicated the interpretation of the results.

Total Volatile Bases

The volatile bases released as fish spoil follow the pattern shown in Fig. 5. The samples from treatment T_1 released the least amount of volatile bases. Even 4 h after icing, the difference between the treatments can be seen. The amount of volatile bases released when the fish were visually unfit for human consumption remained constant irrespective of time. After 30-48 h, the amount of volatile bases released levelled out.

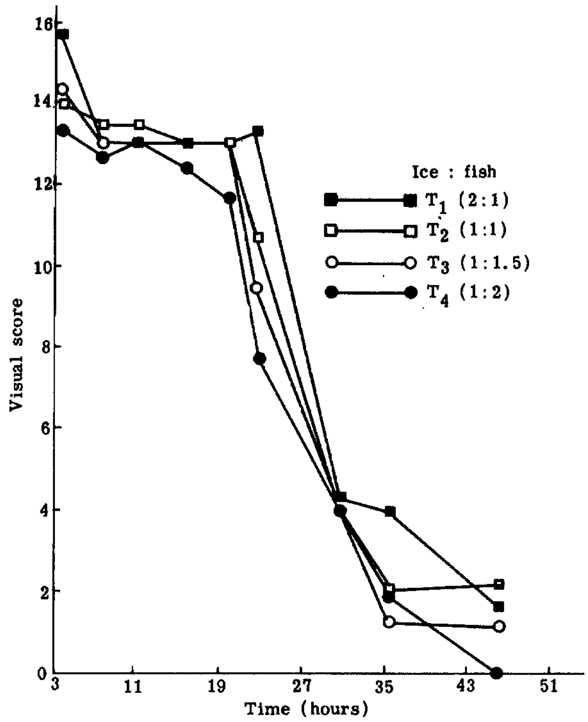

Figure 2 – Average visual score of fish stored in ice

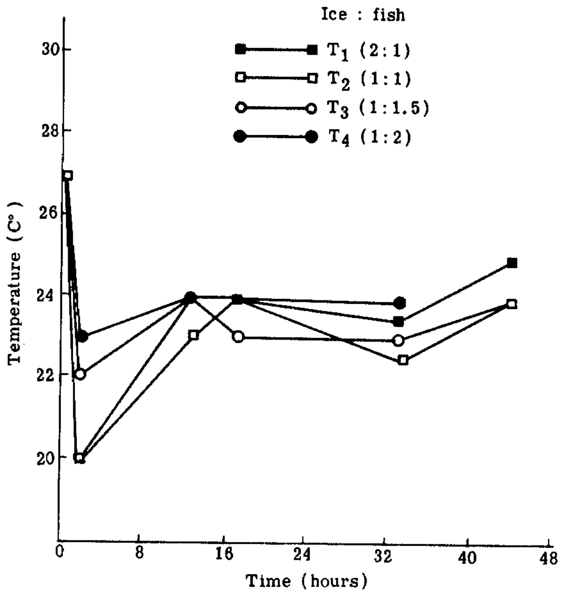

Figure 1 – Temperature of fish stored in ice

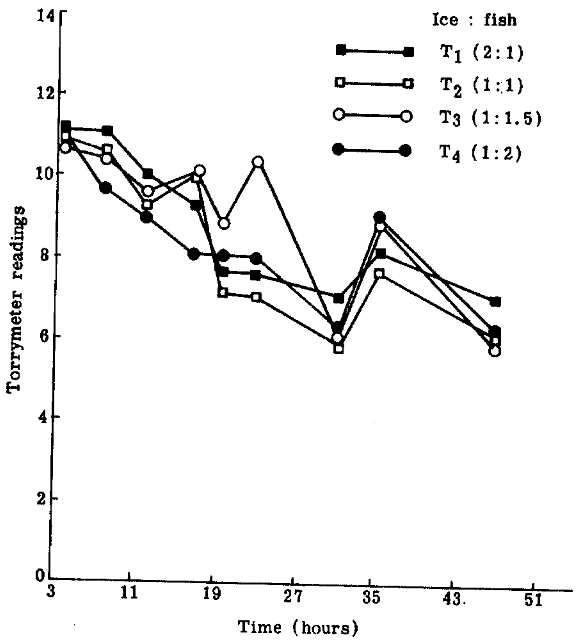

Figure 3 – Average Torrymeter readings of fish stored in ice

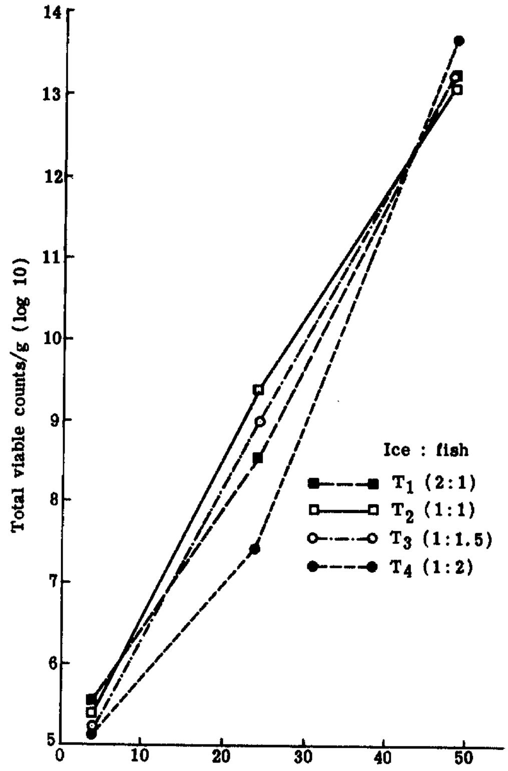

Figure 4 – Total viable counts of fish stored in ice

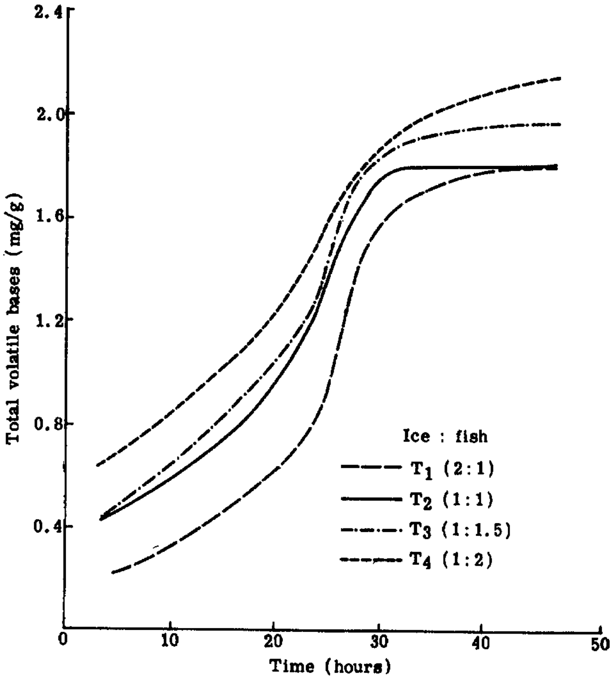

Figure 5 – Total volatile bases of fish stored in ice

RECOMMENDATIONS AND CONCLUSIONS

Ice storage practices on board fishing vessels are very inadequate and must be improved. This is clearly indicated by the temperature (27°C) and the quality of the fish when landed having lost 40 percent of their freshness. The present method of icing fish for transport is just adequate to prevent the fish from deteriorating to a state considered as unfit for human consumption. This practice is true only when there is a constant flow of fish, from catch to consumption. If storage at any point of the handling system is required, a ratio of 2:1 (ice:fish) in inadequate and re-icing is essential. The re-icing must be carried out within 12 h of the initial icing.

With the present system of transportation, ratios of 1:1 or 1:1.5 (ice:fish) are sufficient to prevent marked deterioration in quality. However, it must be stressed that re-icing must be done at the retail and wholesale level in order to prevent further deterioration. Re-icing at the ratio of 1:1.5 (ice:fish) would be sufficient to maintain quality during the time required to sell the fish.

On board the fishing vessel, it is important to ice the fish promptly and to keep the temperature of the fish as low as possible. Under present practices, the amount of ice used is only sufficient to bring down the temperature of the fish to about 26-27°C. More work is required to assess the rate of quality deterioration while onboard the fishing vessel.

In order to stabilize daily fish prices, there is a definite need to have facilities that will allow more than one day's storage at the port of landing and at the wholesale centres. The cost of ice needed to prevent deterioration would be high. The cost of storage using the present fish boxes and the amount of ice required may not be economical. There is a need to minimize meltage of the ice, and also to prevent deteriorative changes, by using properly designed fish boxes. Storing iced fish in cold rooms will further reduce meltage. However, the use of cold rooms for usch a purpose needs to be evaluated in economic terms.

Cheaper methods of maintaining fish on board fishing vessels must be found. Refrigerated sea water is one possibility. Another alternative is to increase the supply of ice at a much cheaper price. The Government should partly subsidize the cost of ice in order to promote good icing practices especially on the fishing vessels. More ice factories or flake ice machine centres should be established. It is impossible to make the fisherman use more ice under the present situation. Prices of fish, ex-fishing boat, and at the retail level should be dependent on quality as well as upon size and type. This is the only way to encourage good handling practices. There is therefore a need to develop quality standards or grades for the various types of fish in order to implement a price differential system.

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APPENDIX

Score Sheet

1) PLACE/DATE: . . . .

2) TIME: . . . .

3) TYPE OF DEALERS – *Wholesaler, Retailer* . . . .

4) NAME: . . . .

5) SOURCE OF FISH (Name of Place): . . . .

6) TYPE OF FISH: . . . .

7) *SCORE:*

	SCORE			
	3	2	1	0
(i) Eyes	Very bright, convex, black pupils	Still bright, convex, slightly grey pupil, opaque cornea	Dull and slightly sunken, grey pupil, milky cornea	Absolutely sunken cornea, pupil totally opaque
(ii) Body	Retain original colour	Slight discoloration	Discoloration of the body	Complete discoloration and faded
(iii) Odour	Seaweedy	Shellfish	Flat sour	Putrid, foul or nauseating
(iv) Texture	Firm and hard	Less firm	Some grittiness developed	Very soft
(v) Slime layer	Absent	Absent	Very thin layer present	Thick yellow bacterial slime present
(vi) Scale	Held firm	Held firm	Loose	Come off completely
(vii) Gills	Bright red	Pale red	Brown	Bluish brown
TOTAL:				