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The Storage of Red Snapper (Lutjanus Spp.) in Ice, Chilled Sea Water and Chilled Fresh Water

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ABSTRACT

Introduction

Refrigerated Sea Water (RSW) and Chilled Sea Water (CSW) Systems are used in many countries in handling large catches of pelagic fish, most effectively. These systems are used mainly on purse seiners which catch very large quantities of pelagic fish. Chilling of such quantities of fish using ice and boxes is practically very difficult and time consuming. The CSW Systems consist of an insulated tank in which a known quantity of ice is placed (1 ton of ice: 1 ton of fish). At the fishing grounds the tank is partially filled with sea water and the fish is placed in the tank and the whole system agitated by compressed air to facilitate even cooling (Petersen *et al*, 1977). With CSW or RSW Systems speed of transfer and rate of chilling the catch is greater than that achieved by conventional icing and the effort required to load and unload the catch, which can be done by suction pump, is less (Eddie & Hopper, 1974). An added advantage is that the fish can be cooled to just above its freezing point (–1°C), a temperature lower than that attained by using ice, thus reducing even further the spoilage caused by biochemical and physical processes (Petersen *et al* 1977). Further more, in RSW and CSW Systems the fish is less susceptible to crushing and it has also been noted that the weight loss is less and that the flesh retains its firmness for a longer period.

The Ceylon Fisheries Corporation (CFC) in Colombo has used refrigerated fresh water tanks, to preserve fish landed in Colombo for a further period of 3 to 4 days. These are fish which have been captured about 14 to 17 days prior to landing and usually form a mixed demersal catch. RSW & CSW storage has been used on occasions when it has not been possible to process the fish immediately (Poulter, 1979). The work presented here was carried out to determine the effect on quality of holding fish in chilled Fresh water and also to compare the quality loss of fish stored in CSW, CFW and in ice. To simulate conditions at CFC, fish after landing was used for the experiment. Refrigerated tanks were not available at the Institute of Fish Technology where this work was carried out, and hence two insulated barrels were used to hold the CSW and CFW.

Materials and Methods

Two insulated barrels, 48 cm. diameter and 45 cm. height were used for the chilled Sea Water and Chilled Fresh Water Systems. The Capacity of each barrel was 1.84 M^3.

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Fish Samples

Storage trials were carried out with Red Snapper (Lutjanus sp.) bought from the fish landing site in Negombo. It has to be assumed that the fish was kept at ambient temperature for about 6–8 hours, before it was bought and iced immediately on purchase. The fish was brought to IFT and divided into 3 groups; Group A (15 kg) was iced, Group B (16.5kg) was placed in an insulated barrel which contained 16 kg of ice and sea water and the contents were stirred intermittently till the fish cooled. Group C (15.5 kg) was placed in the other insulated barrel with 15 kg of ice and fresh water and also stirred as Group B. To maintain the temperature in the insulated barrels, ice and water (sea and fresh) had to be renewed daily, and also fresh ice was put on the fish in ice (Group A).

At set intervals, samples of fish were taken from the 3 containers for assessment of Organoleptic acceptance (raw and cooked), Total Volatile Nitrogen, Trimethyl Amine, salt and moisture content and the Total Bacterial count (TBC).

At each sampling interval (once in 3 days) the sample of fish was first examined visually and sub samples taken for TBC: the rest of the fish were filleted, skinned and a portion was taken for taste-panel assessments and the rest minced to prepare extracts for the chemical analysis.

Visual Examination

The shape and colour of the eyes, colour and odour of the gills, skin and texture of the raw whole fish was examined.

Determination of Total Bacterial Count

Fish flesh (10 g) was weighed aseptically into a Sterile blender jar (MSE homogeniser), sterile peptone water (90 ml) was added and the contents homogenised for 30 seconds. Ten fold serial dilutions were made and 1 ml placed on petri dishes: Nutrient agar (10 ml) was poured, contents mixed and the plates were incubated at 30°C for 3 days and 5°C for 14 days. Duplicate sampling was carried out.

Taste panel assessment

The fillets were washed and sealed in polythene bags and cooked in boiling water for 10 minutes and judged by each panel member for odour, flavour, texture and overall quality, A 0–10 Hedonic scale was used where the limit of acceptability is 4.

Total Volatile base/Trimethyl amine content

The Conway-Byrnes methods (Beatty and Gibbons, 1937) was used to determine total volatile bases. Sampling was done in duplicate with 125 gm fish and 375 ml water being used to make the required samples of 100 gm.

Salt content

The salt content was determined in duplicate by the method (19.030) of the Association of Official analytical Chemists on 2 g samples of the mince (Horwitz, 1980).

Moisture content

2 of fish was weighed into a dry weighed crucible, and placed in the drying oven (110 °C) for 24 hours, cooled and re-weighed.

Results & Discussion

The results are presented in Tables 1–5 and in Fig. 1. Overall the results indicate title difference in the three storage media during the first week of storage. This may be due to the storage media being renewed each day, thereby removing surface decomposition and bacterial metabolic products. In practice however, this is difficult to do and a slightly higher rate of spoilage could be expected in both CSW and CFW systems, because the fish would then be soaked in a medium suited for growth of psychrophilic bacteria. In iced fish, the melted water removes a portion of the surface bacterial metabolic products.

The taste-panel scores (Table 1) indicate that the fish kept in Chilled Sea Water aCSW was unacceptable first (after 18 days), and the fish in ice and CFW was unacceptable at the end of 20 days. After the 9th day in storage the fish lost its freshness and the quality deteriorated. Previous experiments too have shown that Red Snapper kept at an acceptable even for 3 weeks in ice (Putiwaranart & Merican, 1978).

The visual examination showed that the fish stored in ice maintained a good condition for the first 6 days. On the 9th day the eyes of the fish were grey and convex, and the kills were bleached of colour and smelt stale or sour, and the flesh slightly soft. The fish kept in CSW and CFW lost appearance from about the 3rd day in storage, as the eyes bulged out and the skin and the gills were bleached of colour. Though they were not good to look at the fish was found to be quite acceptable by the taste panel.

TABLE 1

AVERAGE TASTEPANNEL SCORE OF FISH STORED IN ICE, CSW AND CFW

Days in storage	*STORAGE MEDIUM*		
	Ice	*CSW*	*CFW*
1	8.0	8.1	8.5
3	7.5	6.0	7.2
6	6.8	7.4	6.6
9	7.3	7.0	5.9
12	5.5	6.2	5.6
15	5.6	5.4	5.7
19	4.7	3.8	5.3
22	2.5	2.0	2.3

The rejection of the fish stored in CSW was mainly due to the high salt intake of the fish, for panel members found it too salty, and therefore unaceptable (Table 2). The panel members first detected the salt on the 9th day (salt-1.02%) and found it to be too salty on the 15th day (salt-1.38%). This has been observed previously by others who found the salt intake to be greater in eviscerated fish. A salt content of 1% was found to be the most palatable amount (Roach *et al* 1967). Fish with a low fat content (in Red Snapper its less than 2.0%), tend to absorb salt excessively and thereby limit the storage time in CSW.

TABLE 2

PERCENTAGE SALT CONTENT OF THE FISH STORED IN ICE, CSW AND CFW

Day in Storage	*STORAGE MEDIUM*		
	Ice	*CSW*	*CFW*
1	0.29	0.34	0.34
3	0.27	0.56	0.28
6	0.20	0.76	0.18
9	0.25	1.02	0.12
12	0.16	0.02	0.08
15	0.14	1.38	0.06
19	0.13	1.36	0.09
22	0.06	1.72	0.02

The moisture contents (Table 3) of the fish were determined to find whether they gained or lost water. The results are scattered and except for a slight increase in the fish kept in CFW, there does not seem to be a marked change in the moisture content. Overall, the fish in all three media have gained a little moisture. Results obtained by Smith *et al* (1980) do not show a marked change in the water content.

TABLE 3

PERCENTAGE MOISTURE CONTENT OF THE FISH STORED IN ICE, CSW AND CFW

Day in storage	*STORAGE MEDIUM*		
	Ice	*CSW*	*GFW*
1	78.4	78.2	78.8
3	79.8	79.4	79.3
6	79.9	72.7	81.1
9	76.9	79.6	82.5
12	79.1	81.4	84.1
15	80.4	81.5	83.9
19	81.3	82.3	83.0
22	81.8	82.1	83.7

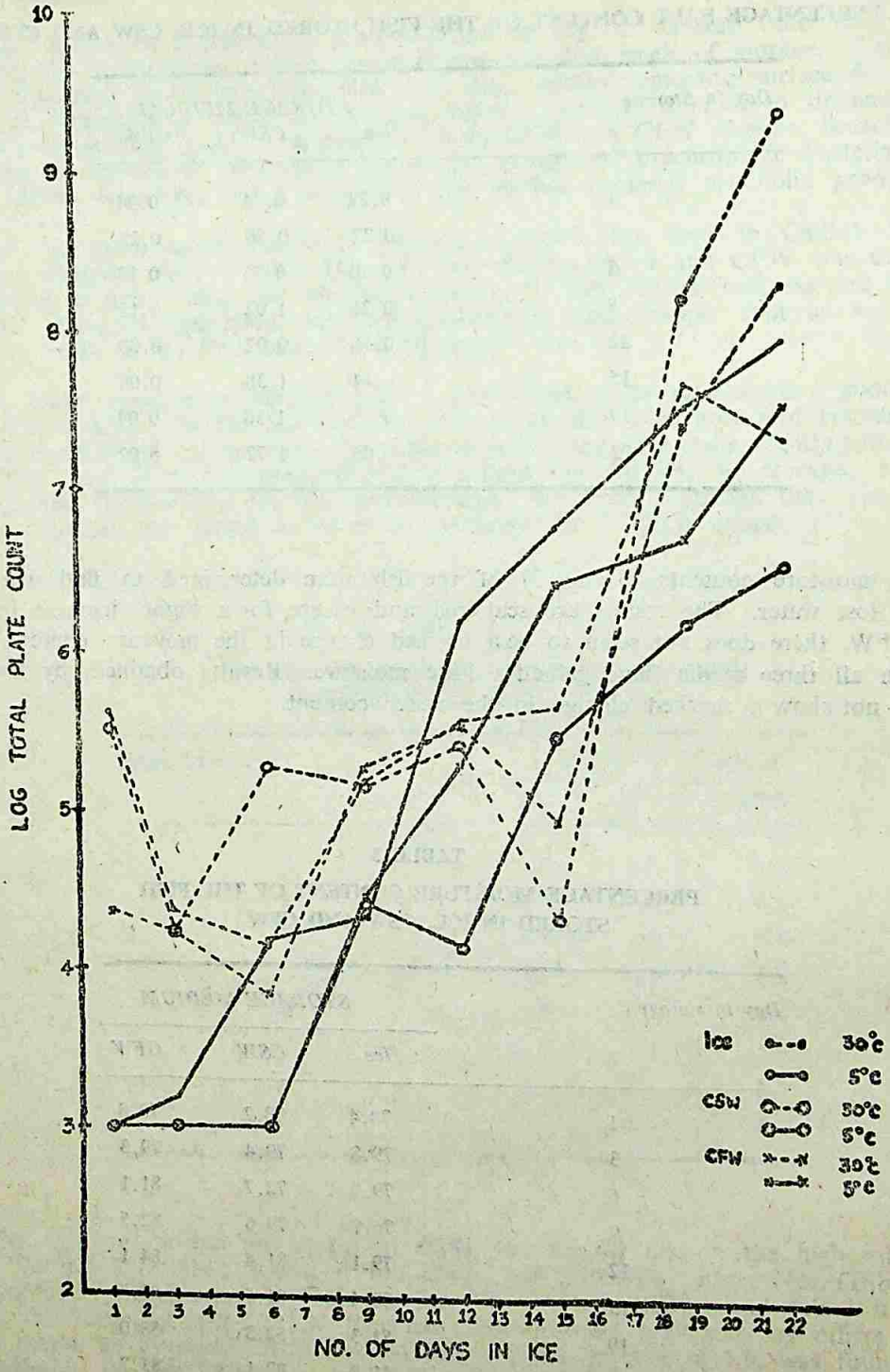

Fig. 1 – Bacteriological counts of fish stored in ice, CSW and CFW

The Total Volatile Nitrogen (TVN) and Trimethylamine (TMA) results for all three media (Tables 4 and 5) are scattered but they show a sharp increase after the 15th day of storage. There is some correlation between the taste panel scores and the TMA results. TMA values remain low till about the 12th day in storage, and from the 15th day (near the end of acceptability) the values rise sharply. Previous experiments with Red Snapper has shown a similar correlation between Taste panel scores and TMA values (Putiwaranart & Merican 1978). Some workers have observed that at a TMA value of 8–10 mg/100g, off flavours are detected and the fish found unacceptable, (Boyd of 1971). In this experiment the fish kept in ice is found to be unacceptable when the TMA level is about 5.0mg/100g. But the fish kept in CSW is acceptable at a higher TMA level. The TMA level of the fish kept in CFW is very low at unacceptability. Therefore it is not possible to indicate a TMA value at which spoilage is evident. But the TVN value is between 20–30 mg/100g at spoilage in all three storage media. As is the case in many species of fish, in this too the TVN and TMA indicate the spoilage rather than the freshness of the fish.

The bacteriological counts incubated at 30°C are considerably scattered at the begining but increases sharply after 15 days storage (Fig. 1). But the psychrophilic count (incubated at 5°C) showed a gradual increase till the 9th day and thereafter a sharp increase for the fish stored in ice. The counts on the fish in CFW remained very low for the first week, and increased rapidly after 6 day. It is difficult to draw any correlation between bacteriological counts and taste panel scores, but a bacterial count incubated at 5°C gives a better indication of the bacterial flora that spoils the fish.

TABLE 4

TOTAL VOLATILE NITROGEN CONTENT OF FISH STORED IN ICE, CSW AND CFW (mg TVN/100g FISH)

Days in storage	*STORAGE MEDIUM*		
	Ice	*CSW*	*CFW*
1	20.25	18.78	17.64
3	15.51	12.71	13.20
6	19.53	13.24	14.14
9	26.39	24.94	15.66
12	19.74	19.74	13.75
15	18.74	31.87	12 02
19	31.45	28.04	14.18
22	30.57	35.39	20.20

TABLE 5

TRIMETHYL AMINE CONTENT OF FISH STORED IN ICE, CSW AND CFW (mg TMA/100g FISH)

Days in storage	*STORAGE MEDIUM*		
	ice	*CSW*	*CFW*
1	0.65	0.65	0.65
3	1.29	1.72	2.58
6	2.10	1.37	1.61
9	1.30	7.13	1.14
12	1.31	5.49	1.31
15	1.98	15.68	—
19	4.55	18 20	2.76
22	7.73	19.79	3.96

The results indicate that there are no adverse effects in storing *Lutjanus* sp (even after a delay of about 6–8 hours after catching) in chilled fresh water except that external appearance is lost in about 6 days of storage. Though it loses external appearance, it is acceptable (taste panel) for about 15 days. This fish species cannot be stored in chilled sea water for long, because, before it spoils the intake of salt from the medium, makes the flesh unpalatable.

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