

Quality Changes in Indian Oil Sardine (*Sardinella longiceps*) during Storage in Chilled Sea Water

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Indian oil sardine (*Sardinella longiceps*) were stored in chilled sea water (CSW) immediately after catch and kept in a chill room at $2\pm 1^{\circ}\text{C}$. Physical, biochemical, microbiological and organoleptical quality changes were followed at regular intervals during storage. The fish were in excellent condition for 5 days and acceptable condition up to eighth day. There was correlation between organoleptic assessment and biochemical as well as microbiological assessment.

The chilled sea water (CSW) preservation of fish has been used successfully on fishing vessels for many years. This method has been particularly useful for handling huge catches of small pelagic species.

A proper understanding of the changes taking place in fishes in such storage technique is important to assess the efficiency and also to improve the system. So, a detailed study of physical, chemical, microbiological and organoleptic changes taking place during CSW storage of fish was undertaken.

Materials and Methods

CSW medium was prepared by adding sea water to ice in the ratio of 1:2 and the mixture was stirred thoroughly. Freshly caught Indian oil sardine (*Sardinella longiceps* Valenciennes) were stored in CSW in the ratio 4:3 and kept in a chill room at $2\pm 1^{\circ}\text{C}$.

Samples of fish and the surrounding medium were drawn at regular intervals for quality assessment. Rate of belly bursting and change in weight of fish were noted. Proximate composition (AOAC, 1975), volatile base nitrogen and trimethylamine nitrogen (Beatty & Gibbons, 1937), peroxide value (Hill & Thiel, 1946), free fatty acid (AOAC, 1975), salt content of flesh (AOAC, 1975), pH of fish flesh and the surrounding

medium and dissolved oxygen of the CSW medium (Strickland & Parsons, 1972) were determined.

Organoleptic characteristics were assessed by trained panelists using a descriptive chart suggested by Valson & Prabhu (1978) with suitable modifications (Shetty & Setty, 1988). A score of 4 out of 10 was considered acceptable.

Samples of fish and surrounding medium were tested for total aerobic plate counts (TPC). Appropriate dilution of homogenate were made in Butterfield's phosphate buffer and were plated in triplicate on plate count agar (with 0.5% W/V of NaCl) by spread plate method and incubated at $28\pm 2^{\circ}\text{C}$ for 48 h.

Results and Discussion

The number of belly burst fish was found to be 9.0% by 10 days CSW storage. Jensen & Hansen (1983) found that CSW storage of fish helped in reducing belly burst as compared to icing. At the end of the 10 days storage, the weight gain was found to be 4.2%

There was an increase in moisture and ash content and a decrease in fat and protein contents (Table 1) during storage of fish for

Table 1. Proximate composition of fish stored in CSW on 0 and 10th days

Composition	0 day	10th day
Moisture	76.58	79.79
Fat	6.86 (29.29)*	5.80 (28.70)*
Protein	13.14 (56.11)*	11.02 (54.53)*
Ash	3.43 (14.65)*	3.42 (16.92)*

* Figures in brackets represent percentage composition on dry weight basis

10 days in CSW. Loss of protein and fat can be attributed to leaching and increase in ash content to the intake of salt during the storage period.

The volatile base nitrogen (VBN) and trimethylamine nitrogen (TMA - N) increased during storage (Table 2). The levels of VBN and TMA -N reached on spoilage were found to be low when compared to the levels suggested by Connell (1975) for cod stored in ice. This may be attributed to leaching of these compounds in to the surrounding medium. Hansen *et al.*, (1978) and Smith *et al.*, (1980 a) have also opined similarly in case of CSW preserved silver bellies and herrings respectively.

Table 2. Changes in TMA-N, VBN, PV, FFA and salt in fish during storage in CSW

Biochemical parameters	Days of storage				
	0	2	5	8	10
TMA-N (mg%)	0.32	1.86	2.34	4.28	5.70
VBN ..	3.36	5.12	9.75	12.50	20.45
PV (milli eq. of O ₂ /kg fat)	2.70	6.90	9.20	10.50	13.00
FFA (% as oleic acid)	1.30	2.82	3.76	4.28	6.20
Salt (%)	0.25	0.31	0.36	0.40	0.52

Table 3. pH of flesh and surrounding medium during the storage of fish in CSW

	Days of storage				
	0	2	5	8	10
Fish	6.2	6.4	6.8	7.4	7.6
Water	6.4	6.6	6.8	7.2	7.5

Table 4. Dissolved oxygen (ml/l) content in the medium surrounding fish

Days of storage	0	2	5	8	10
Oxygen content	4.6	2.4	0	0	0

The peroxide value (PV) showed a gradual and steady increase during storage (Table 2). However, it was much below the acceptability limits of 20 to 40 milli eq. O_2 /kg fat suggested by Pearson (1970). Such a low level of PV was presumably due to the limited amount of oxygen present in the CSW medium (Table 4). Similar observations have been reported by Smith *et al.*, (1980a and 1980b). The increase in the free fatty acid content of fish during the CSW storage was slow and steady. Salt content in the fish flesh increased slowly and reached a value of 0.52% (Table 2).

As spoilage developed in the stored fish, the pH increased from an initial value

of 6.2 to 7.6 (Table 3). Similar rise in pH during CSW storage of fish have been reported by Curran *et al.*, (1980) Smith *et al.*, (1980b) and Krishnakumar (1983). In case of the medium surrounding the fish, the initial pH was 6.4 which increased to 7.5. This increase in pH is probably due to the effect of leaching of basic nitrogenous substances as well as the bacterial degradation of substances leached into the medium. The type of degradation utilized the oxygen and resulted in decreasing the dissolved O_2 content from 4.6 ml/l to nil from the 4th day onwards (Table 4). Hansen *et al.*, (1974) and Krishnakumar *et al.*, (1986) noticed a similar trend in oxygen depletion.

(Table 5). Total plate count per g of fish and per ml of the surrounding medium during storage.

	Days of storage				
	0	2	5	8	10
Fish	2.10×10^4	3.6×10^4	3.8×10^5	5.7×10^6	7.6×10^7
medium	1.60×10^3	8.40×10^3	9.7×10^4	7.3×10^5	2.8×10^7

Tables 6. Results of organoleptic evaluation of fish stored in CSW

Days of storage	0	2	5	8	10
Raw overall acceptance	9.7	9.2	8.8	4.5	3.2
Cooked Appearance	9.6	9.1	8.7	4.3	3.3
Colour	9.5	8.9	8.3	4.4	3.0
odour	9.6	9.2	8.5	4.4	3.8
Texture	9.8	9.1	8.6	4.1	3.6
Flavour	9.8	9.0	8.6	4.1	3.7
Overall acceptance	9.9	9.0	8.5	4.3	3.8

8-10 Excellent; 6-8 Good; 4-6 Fair < 4 Not acceptable

The initial total plate count of fish immediately after catch was found to be 2.10×10^4 per g of flesh (Table 5). The TPC increased during storage and reached a value of 7.6×10^7 per g on 10th day (Table 5). The initial TPC of sea water, used for the CSW storage of fish, was found to be 1.6×10^3 per ml. During the storage period, the TPC of the CSW medium increased and reached a value of 2.8×10^7 per ml by 10 days storage

Organoleptically, the fish was graded as excellent both in raw and cooked condition till the 5th day, while it was judged as unacceptable on the 10th day (Table 6). The fish was in acceptable condition for 8 days.

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