

Storage Studies on Commercial Salt Cured Dry Fish with Special Reference to Red Discolouration

M.M. Prasad and C.C. Panduranga Rao
*Research Centre of Central Institute of
Fisheries Technology, Kakinada - 553 003, India*

Quality of 80 samples of commercial salt cured dry fish belonging to 23 species groups were stored in polythene bags at ambient temperatures and monitored up to the point of spoilage. Red-discolouration was found to account for spoilage in 55% of the samples followed by rancidity in 38% and fungal growth in 6%. Among those showing red-discolouration 97.7% of the samples were affected within two months of storage. Fish with red-discolouration all over the surface contained very high levels of total volatile nitrogen and total red halophilic counts.

The most common method of utilisation of fish in India is as fresh fish followed by cured and dried fish. It is estimated that over 32 percent of Indian marine fish catch is consumed as cured/dried fish (Francis Thomas & Balachandran, 1989). Cured fish not only provide a rich source of cheap animal protein to low-income groups, especially in the hinterland, but also generate sustainable income to the small scale fishermen. Good quality dry fish can be stored for long periods and can fetch better returns by selling it in the lean season.

Studies on quality of commercial dry fish, both of west and east coasts have been reported (Kalaimani *et al.*, 1988; Basu *et al.*, 1989 and Francis Thomas & Balachandran, 1989). But, detailed storage studies on commercial dry fish of Kakinada area have not so far been carried out and hence the present study was undertaken.

Materials and Methods

Eighty samples belonging to 23 species groups of fish were collected from local market on Fridays. The fish samples were selected on the basis of their relative

commercial importance and regular availability in the market. Fish belonging to one variety and purchased from a single source/shop on a single day constituted one sample. The sample size varied from one to 11. All the samples were collected in the morning hours and packed in polythene bags (200 gauge). The fish samples were stored in the laboratory under ambient conditions and were observed regularly for changes during storage.

Twelve samples of cured and dried fish comprising of two samples each of ribbonfish and spotted croaker; one sample each of seer, flat headed grey mullet, Spiegler's grey mullet, Dussumier's croaker, barracuda, mackerel, silver pomfret and greater lizard fish, were subjected to physical, chemical and bacteriological tests at the initial and final stages of red-discolouration. Initial stage was defined as the appearance of small red spots on the sample surface, while final stage was the appearance of red-discolouration all over the surface of fish. The tests included organoleptic evaluation (Sreenivasan & Joseph, 1966), estimation of moisture and salt (AOAC, 1980), total volatile nitrogen (TVN) (Conway, 1947),

total bacterial count (TBC) (Thatcher & Clark, 1978).

Total red-halophilic count was determined using salt milk agar medium (Sreenivasan & Venkataraman, 1956) with 20% sterile saline as diluent. Samples were inoculated by spread plating and kept in polythene covers, which were incubated at 37°C for 3 weeks.

Results and Discussion

Table 1 shows the cause of spoilage in different types of fish at the time when samples were found unacceptable. Of the different spoilage factors, red-discolouration was the major reason (55%) followed by rancidity (38.75%) and fungal contamination (6.25%). Red-discolouration was reported to occur in 45.77% of the dry fish samples of Malabar and Kanara coasts (Joseph *et al.*, 1983) and in 62% of the dry fish of Maharashtra coast (Joseph *et al.*, 1988).

Usually the red-discolouration started near gills, eyes and some places on ventral side or tail. It appeared initially as red spots. In varying periods of time ranging up to two months, the red-discolouration spread all over the fish which gave foul odours.

The number of samples showing red-discolouration during storage increased with time. Of 44 samples, 68% showed red-discolouration during the first one month, 91% within 50 days and as many as 98% within two months of storage. Shortest time taken for appearance of red-discolouration was one week and the longest time was three months. Red-discolouration was reported after five months of storage by Rao *et al.* (1962) and after 15 days of storage by Joseph *et al.* (1983).

Table 1. Spoilage pattern in fish

Name of the fish	Number of samples affected by			No. of samples observed
	Rancidity	Fungal growth	Red-discolouration	
Ribbonfish (<i>Trichiurus haumela</i>)	1	0	6	7
Ribbonfish (<i>Lepturacanthus savala</i>)	0	1	1	2
Spotted croaker (<i>Protonibea diacanthus</i>)	4	0	2	6
Dussumier's croaker (<i>Johnius dussumieri</i>)	5	1	5	11
Sardines (<i>Sardinella longiceps</i>)	1	0	2	3
Flat headed grey mullet (<i>Mugil cephalus</i>)	2	1	4	7
Mackerel (<i>Rastralliger kanagurta</i>)	0	0	3	3
Indian ariomma (<i>Ariomma indica</i>)	2	0	0	2
False trevally (<i>Lactarius lactarius</i>)	2	0	0	2
Indian threadfin (<i>Polydactylus indicus</i>)	2	0	2	4
Spiegler's grey mullet (<i>Valamugil speigleri</i>)	0	0	4	4
Silver pomfrets (<i>Pampus chinensis</i>)	2	1	2	5
Banded barracuda (<i>Sphyraena jello</i>)	2	0	1	3
Indo-Pacific spanish mackerel (<i>Scomberomorus guattatus</i>)	1	0	2	3
Narrow barred spanish mackerel (<i>Scomberomorus commerson</i>)	1	0	1	2
Indian halibut (<i>Psettodes erumei</i>)	2	0	1	3
Greater lizard fish (<i>Saurida tumbil</i>)	0	0	2	2
Tongue sole (<i>Cynoglossus</i> spp.)	1	0	0	1
Caranx spp.	0	0	1	1
Hamilton's thryssa (<i>Thryssa hamiltonii</i>)	1	0	0	1
Silver sillago (<i>Sillago sihama</i>)	0	0	1	1
Sciaenids	0	1	0	1
Cat fish	0	0	2	2

Moisture, TVN, TBC, total red-halophilic counts (TRHC) and organoleptic evaluation at the initial and final stages of red-discolouration in respect of 12 samples are presented in Table 2. The increase in total red-halophilic counts between the initial and final stages of appearance of red-discolouration was quite striking, the average increase being 3.67 log cycles, compared to 1.9 log cycles in respect of TBC. The red-halophilic counts at the final stage of spoilage ranged from $10^{7.3}$ to $10^{8.7}$ which at the initial stages, was from $10^{3.2}$ to $10^{5.4}$. The increase in moisture from initial to final stages of red-discolouration could be, due to variation in external humidity.

Table 2. Averages of different bacterial counts, moisture and TVN.

	Red-discolouration in fish	
	Initial stage	Final stage
Moisture %	37.59 (27.82-46.37)	41.35 (31.13-50.04)
TVN, mg 100g ⁻¹ of muscle	196.26 (164.60-220.86)	520.30 (315.59-682.33)
TBC	4.10 (2.55-5.54)	6.05 (4.00-7.88)
THC*	5.20 (2.7-6.84)	7.12 (5.9-8.1)
TRHC**	4.32 (3.28-5.49)	7.99 (7.30-8.73)
Organoleptic assessment	All 12 samples unfit for human consumption	All 12 samples unfit for human consumption

Bacterial counts expressed as log₁₀ CFU g⁻¹

* Total halophilic counts exclude red-halophilic bacteria

** Total red-halophilic bacteria

The average salt content was 12%, which was below the salt levels specified (BIS, 1962). Though in *in vitro* studies the same percentage was found to be inadequate for growth of extreme halophiles,

appearance of red-discolouration in the above samples could be due to the presence of adequate levels of salt to the organisms near the minute salt crystals appearing on the skin of fish after curing (Hess, 1942, Castell & Mappleback, 1952). This explains how the 'red' bacteria could cause spoilage of fish even at low levels of salt in the fish muscle.

In the study, the average TVN levels at initial stages of red-discolouration were 196.3 mg 100g⁻¹ of muscle (Table 2). The studies of Venkataraman & Vasavan (1959) and Sreenivasan & Joseph (1966) suggested the acceptable levels of TVN as 200 mg 100g⁻¹ of muscle.

The average increase in TVN levels from initial to final stages of red-discolouration worked out to be 324.0 mg 100g⁻¹ of muscle. High values of TVN correlate with high bacterial activity (Vanderzant *et al.*, 1973). The studies of Joseph *et al.* (1983) have shown that high TVN values have correlation with high spoilage rate resulting in unacceptability of the product for human consumption. This was confirmed in this study by organoleptic unacceptability of the fish in two stages of red-discolouration (Table 2).

The high TVN and TRHC values indicate that in addition to red-discolouration, the dried fish had also undergone considerable amount of biochemical deterioration. This calls for a reevaluation of the commercial practice of scraping up red-patches and redrying the fish for human consumption. The FAO method of keeping the dry fish samples under 10°C to check the growth of red-halophilic bacteria does not appear to be a feasible proposition in third world countries (FAO, 1983) where refrigeration is expensive. This study revealed the need for development of simple and economically

feasible methods for prevention of red-discolouration and enhancing the quality and storage life of the salt cured dry fish.

The authors are thankful to Dr. K. Gopakumar, Director, Central Institute of Fisheries Technology, Cochin for his kind permission to publish this paper and technical assistance provided by Mr. B. Ramaiah & Mr. N. Venkata Rao during the course of this work.

References

- AOAC (1980) *Official Methods of Analysis*, 13th edn., Association of Official Analytical Chemists, Washington DC, USA
- Basu, S., Imam Khasim, D., Gupta, S.S. Panduranga Rao, C.C (1989) *Fish. Technol.* 26, 114
- BIS (1962) *Indian standard specifications for common salt for fish curing (revised)*, IS: 594, Bureau of Indian Standards, New Delhi, India
- Castell, C.H. and Mappleback E.G. (1952) *J. Fish. Res. Bd. Can.* 9, 377
- Conway, E.J. (1947) *Microdiffusion analysis and Volumetric error*, Crossby, Lock Wood and Sons, London, UK
- FAO WHO, Rome (1983), *Recommended International code of practice for salted fish*. Codex Alimentarius Commission-Vol.B, p. 28 AC/Rep-26-1979, (1st edn.).
- Francis Thomas & Balachandran, K.K. (1989) in *Recent Trends in Processing Low Cost Fish* (Balachandran, K.K., Perigreen, P.A., Madhavan, P., Surendran, P.K., Eds) p.1, SOFT (I), Cochin, India
- Hess, E. (1942) *J. Fish. Res. Bd. Can.* 6, 10
- Joseph, K.G., Muraleedharan, V. & Nair, T.S.U. (1983) *Fish. Tehnol.* 20, 118
- Joseph, K.G., Muraleedharan, V. Nair, T.S.U. & Kalaimani, N. (1988) *Fish. Technol.* 25, 120
- Kalaimani, N., Gopakumar, K. & Nair, T.S.U. (1988) *Fish. Technol.* 25, 54
- Rao, S.V.S., Valsan, A.P., Kandoran, M.K. & Nair, M.R. (1962) *Indian J. Fish.* 9 (2B), 156
- Sreenivasan, A. & Venkataraman, R. (1956) *J. Sci. Ind. Res.* 156, 210
- Sreenivasan, A. and Joseph K.G. (1966) *Fish. Technol.* 3, 103
- Thatcher, F.S. & Clark, D.S. (1978) *Micro-organisms in foods*, 2nd edn., University of Toronto Press, Toronto, Canada
- Venderzant, C., Cobb, B.F. & Thompson, Jr. C.A. (1973) *J. Milk Food Technol.* 35, 443
- Venkataraman, R. & Vasavan, A.G. (1959) *Madras Fisheries Station reports and year book, 1955-56*, p. 261