

The Preservation of Some Indian Freshwater Fish

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Quality changes in *Labeo rohita*, *Cirrhinus mrigala* and *Tilapia mossambica* were studied during storage in ice and at ambient temperature (29–32°C). After 10 h at ambient temperature *L. rohita* and *T. mossambica* were completely spoiled, while *C. mrigala* became unacceptable within 11 h.

Organoleptic examination, total volatile base nitrogen and total bacterial counts showed that *L. rohita* (0.5 kg and above) and *C. mrigala* (0.5 kg and above) were acceptable upto 7 to 8 days of storage in ice in popular container (Bamboo basket) lined with palmyrah mat) at ambient temperature while *T. mossambica* (30–40 g) was acceptable upto 6 days.

Influence of size of fish on shelf life in ice studied with reference to *L. rohita* showed that fishes below 500 g were acceptable upto 6 days of storage in ice in popular container at ambient temperature while those above 1000 g size were acceptable upto 8 days. Provision of an alkathene lining to the popular container extended the storage life of *L. rohita* from 6 days to 8 days. Pre-chilled and iced *L. rohita* had a longer shelf-life (9 days) than merely iced sample (7 days).

Catla, rohu and mrigal are important commercial fishes in India. Besides, tilapia also is landed in significant quantities in Tamilnadu for wet fish trade. A shelflife of 3 to 4 weeks was reported by Tropical Products Institute, London for African freshwater fishes and 5 weeks for Indian freshwater fishes during iced storage (Disney *et al.*, 1969; Hoffman *et al.*, 1974; Amu & Disney 1973; Nair *et al.* 1971). Storage life of 22 days for *C. catla* and *C. mrigal* and 17 days for *Labeo calbasu* in ice has also been reported in India. (Anon, 1981). But none of these studies was conducted in actual trade conditions prevalent in India. Bamboo baskets lined with palmyrah leaf mat are commonly used for packing and transporting freshwater fish with ice. The entire basket is covered with gunny piece. Storage, transport and distribution of such freshwater fishes packed in ice in the popular containers mentioned above are carried out at ambient temperature with the result the fish temperature often reaches more than 10°C. Spoilage characteristics and shelflife of freshwater fishes under such conditions of storage and distribution and an alkathene lining to the popular container and pre-chilling of the fish prior to icing on the shelflife are reported in this communication.

Materials and Methods

L. rohita weighing between 0.25 and 1.35kg, *C. mrigala* weighing 0.5 kg and above and *T. mossambica* weighing between 30 and 40 g were collected from Nagapattinam. The time lapse between capture and arrival at the laboratory varied between 3 to 4 h. Also *L. rohita* and *C. mrigala* caught from Madras, Chetpet fish farm were also used. In this case time lapse between capture and examination was only a few minutes.

The fishes on arrival at the laboratory were divided into two lots. One lot was kept in polythene bag and examined for physical, chemical and bacteriological indices of quality every 2 h at ambient temperature (29–32°C) till the fish spoiled. The other lot was packed in alternate layers of ice and fish (ratio 1:1) in bamboo baskets with an inner lining of palmyrah leaf and wrapped in gunny bag. Reicing was done at 12 h interval. Storage studies were conducted at ambient temperature.

The effect of size of fish on shelflife was studied in *L. rohita* below 500 g and above 500 g. The difference in species on shelf life was studied in *L. rohita*, *C. mrigala* and *T. mossambica*.

The effect of an inner lining of alkathene (200 gauge) to the popular trade container was studied with reference to extended shelf-life. The effect of prechilling on the fishes prior to icing was studied in relation to shelf-life by using fish previously chilled in ice water till the body temperature attained 2°C. The temperature of the fish was measured by inserting a thermometer into the fish flesh.

Organoleptic assessment of fishes was carried out by assigning 5 marks each to appearance, cooked, texture, cooked flavour and cooked taste. When the overall score fell from 20 to 5 and below the samples became unacceptable.

The total volatile base nitrogen (TVBN) was determined using the microdiffusion method of Conway (1947) Bacteriological assessment was carried out using 10g flesh for pour plating using a fresh water based agar (APHA, 1962).

Results and Discussion

Spoilage at ambient temperature

Rohu, mrigal and tilapia when kept at ambient temperature without ice spoiled within 11 h (Table 1).

Table 1. Storage of rohu, mrigal and tilapia at room temperature without ice

Species	Storage hours	Organoleptic score	TVBN mg/100g	Log ₁₀ TBC
<i>L. rohita</i> (0.25 kg)	10	4	28	5.8
<i>C. mrigala</i> (0.25 kg)	11	4	20	5.4
<i>T. mossambica</i> (0.17 kg)	10	4	24	5.4

Table 2. Influence of species difference on ice-stored fish in popular container

	Days of storage		Organoleptic score (Maximum 20)		TVBN mg/100g Mean	Log ₁₀ TBC Mean	Log ₁₀ TBC Range
	Mean	Range	Mean	Range			
<i>Labeo rohita</i> (0.5 kg above)	6	7.5	5-10		23	6.58	6.26-6.76
	7	8	8		24	6.78	6.78
	8	5	5		28	6.95	6.95
<i>Cirrhinus mrigala</i> (0.5 kg above)	7	5	5		29	6.90	6.90-6.91
<i>Tilapia mossambica</i> (0.03-0.04 kg)	6	5	5		27	6.56	6.34-6.69

When the organoleptic score fell below 5 the fish was found unacceptable. The corresponding TVBN values and total bacterial count have not risen to the expected limits.

Ilyas & Nasran (1972) have also reported on three species of fish in Indonesia which were rejected by organoleptic and objective tests after approximately 11 h. African freshwater fish are also considered unacceptable after 24 h of capture (Hoffman *et al.* 1974). It is also reported by Disney *et al.* (1968) that levels of bacteria on tilapia after 24 h when the fish were completely spoiled were between 10³ and 10⁶ per g of tissue.

Spoilage of fish during iced storage at ambient temperature

While reviewing the spoilage characteristics and acceptable shelflife of cold water species as well as tropical species Disney *et al.* (1973) have reported that cold water fish remains acceptable for 5 to 15 days depending upon the species but the tropical fish kept for 7 to 45 days. Curran *et al.* (1981) reported that threadfinbream when stored at 0°C, 5°C and 10°C had an acceptable shelflife of 30, 12 and 7 days respectively. Curran *et al.* (1980) have assessed a shelflife of 30 days in ice (0°C) and 5 to 6 days at 10°C for gold lined sea bream.

Iced storage shelflife of 22 days has also been reported for mrigal and catla (Anon 1981).

The results of the present study reveal a shelflife of 6–8 days for different sizes and species of fish, when stored in popular trade containers in ice at ambient temperatures (29–32°C) with reicing at 12 hours interval (Tables 2 and 3). The fish temperature in iced storage was found to be generally below 5°C but at times it crossed 10°C just before reicing, reflecting the conditions prevailing in the fresh fish trade in India.

Delays prior to icing

Ice should be applied to fish as soon as possible after capture. But in small scale fisheries, this is often not possible due to limitations of boat size and sometimes non-availability of ice. In such situations catch is landed within 6 to 9 h after capture. Disney (1976) has stated that delays upto 9 h prior to the application of ice are permissible. In the present study the time lapse between capture and preservation in ice was between a few minutes to 4 h. Delays of upto 4 h prior to icing did not have adverse effect on shelflife of fishes. Nair *et al.* (1974) have also reported that delay upto 7 h before icing did not affect storage life.

Species difference in shelflife

L. rohita, *C. mrigala* and tilapia were studied for shelflife in popular container. Shelflife of 6 to 8 days for *L. rohita*, 7 days for *C. mrigala* and 6 days for tilapia are reported (Table 2). The short shelflife for tilapia may also be due to the use of small size specimens used for the study.

Influence of size on shelflife

L. rohita of two sizes below 0.5 kg and above 0.5 kg were studied for comparative shelflife in popular containers and the results are given in Table 3. When the organoleptic score fell below 5 (maximum 20) the fish became unacceptable. The corresponding TVBN value and total bacterial count at the time of spoilage of fish were closer to 30 and 10^6 – 10^7 respectively. The results of the study are given in Table 3. *L. rohita* weighing less than 500 g had an acceptable shelflife of 6 days while the bigger fishes weighing more than 500 g had a longer shelflife of 8 days under similar conditions of storage. Amu & Disney (1973) are also of the view that small sized fish tend to spoil more quickly due to easy penetration of bacteria into the tender flesh.

Table 3. Influence of size on shelflife of ice stored *L. rohita* in popular container

	Size	Days of storage	Number of experiment	Organoleptic score (Maximum 20)		TVBN mg/100g		TBC log ₁₀	
				Mean	Range	Mean	Range	Mean	Range
<i>Labeo rohita</i>	Below 500g (250–500g)	0	2	18	16–20	15	8–22	4.50	4.43–4.71
		1	2	16	13–19	18	10–26	4.72	4.64–4.70
		2	2	14	11–17	18	12–24	4.80	4.77–4.82
		3	2	11	8–14	20.5	16–25	5.40	4.97–5.69
		4	2	7.5	5–10	22	18–26	6.67	5.51–6.95
		5	2	6	4–8	25	22–28	5.93	5.81–6.03
	6	1	5	5	28	28	6.08	6.08	
	1000 g and above (1000–1255 g)	0	4	20	20	5.25	3–8	4.30	3.01–4.59
		1	4	18.7	17.20	7.5	4.12	4.65	4.57–4.72
		2	4	16.25	13–18	12	8–14	5.19	4.58–5.29
		3	4	13.25	9.16	14.5	10–18	5.40	4.74–5.79
		4	4	10.75	7–14	18.6	12–24	5.92	4.91–6.67
		5	4	9.33	5–12	20	18–22	7.25	5.79–7.36
		6	4	7.00	4–10	25.5	18–30	6.37	5.78–6.76
7		2	6	4–8	26	24–28	6.67	6.51–6.78	
8	1	5	5	28	28	6.95	6.95		

Table 4. Storage studies of *L. rohita* in popular container/improved container

	Con- tainer used	Days of storage	No. of experi- ments	Organoleptic score (Maximum 20)		TVBN mg%		Log ₁₀ TBC	
				Mean	Range	Mean	Range	Mean	Range
<i>Labeo rohita</i> (0.250 kg to 1.370)	Popular	0	4	19	16-20	12	6-22	4.54	4.43-4.59
	conta- iner	1	4	16.3	13-18	13.5	8-26	4.60	4.42-4.75
		2	4	13.8	11-16	13.5	10-24	4.95	4.58-5.29
		3	4	13.3	8-14	19.3	16-25	5.50	4.73-5.66
		4	4	8.0	6-10	23.5	20-26	6.41	4.91-6.95
		5	4	6.0	4-8	26	22-28	5.82	5.70-5.81
		6	2	5.0	4-6	28	26-30	5.91	5.78-6.10
<i>Labeo rohita</i> (0.250 kg to 1.370kg)	Impro- ved	0	4	19	16-20	12	6-22	4.54	4.43-4.59
	conta- iner	1	4	18.25	15-20	12.5	8-24	4.50	4.27-4.37
		2	4	15	12-17	14	10-24	4.74	4.48-4.97
		3	4	13	10-15	16	12-24	5.41	4.68-5.56
		4	4	10.75	9-12	20	16-26	6.27	4.79-6.82
		5	4	7.3	6-10	22	18-26	5.76	5.65-5.87
		6	4	5	2-8	24.3	18-28	5.80	5.35-5.94
		7	2	6	5-7	23	22-26	5.83	5.70-5.93
		8	2	5	4-6	26	24-28	6.17	5.80-6.37

Advantage of improved container

The improved container is the same as the popular bamboo basket used in trade except for the provision of an inner lining of an alkathene sheet (200 gauge). In the popular trade container melting of ice was more rapid (10 h) compared to improved container (12 h) due to the alkathene lining when stored at ambient temperature. Hence the rise of fish temperature was less prominent compared to the popular container. Thus the fishes packed in improved container had an extra shelflife of 2 days. The results of organoleptic assessment, TVBN values and bacterial count are given in Table 4.

Effect of pre-chilling prior to icing

Pre-chilling of fishes in ice-water brings down the body temperature rapidly to less than 2°C. Application of ice thereafter preserves the fish for a longer time. *L. rohita* directly preserved in ice had a shelflife of 7 days at ambient temperature storage while the pre-chilled and iced-fish had a shelflife of 9 days under similar conditions of storage. Results of the study are given in Table 5. Pre-chilled and iced-fish had correspondingly lower bacterial counts than the fishes directly iced. Pre-chilling technique has got great commercial application

in wet fish trade. Its effect on fish quality was found to be excellent for the first 2 to 3 days of storage; thereafter the course of spoilage of prechilled-iced fish and directly iced-fish was almost same. The initial check on the bacterial growth by pre-chilling was responsible for the extended shelflife of the pre-chilled and iced-fishes.

L. rohita, *T. mossambica* and *C. mrigala* spoiled after 11 h when stored at ambient temperature. Delays of upto 4 h before icing did not affect the storage life of fresh-water fishes studied.

Storage life of fishes was also dependent on species. While tilapia had 6 days shelf-life *L. rohita* had 6-8 days and *C. mrigala* had 7 days of shelflife in ice at ambient temperature storage. Size of fish is also observed to contribute to variations in shelflife. *L. rohita* (< 500 g) had a shelflife of 6 days while the same fish weighing more than 500g was acceptable upto 8 days.

The incorporation of an alkathene lining in the inner side of the popular container was observed to extend the shelflife of *L. rohita* by 2 days. Similarly introduction of pre-chilling before icing extended the shelf-life for *L. rohita* by 2 days from 7 days for fishes without pre-chilling.

Table 5. Storage studies of *L. rohita* in direct icing vs. pre-chilling and icing

	Mode of icing	Days of storage	No. of experiments	Organoleptic score (Maximum 20)		TVBN mg/100g		Log ₁₀ TBC	
				Mean	Range	Mean	Range	Mean	Range
<i>Labeo rohita</i> (0.5 kg to 1.2 kg)	Direct icing	0	4	20	20	4.75	3-8	4.50	4.30-4.71
		1	4	19.3	18-20	7.00	4-10	4.78	4.60-4.91
		2	4	16.8	14-18	11.30	8-14	5.29	4.82-5.64
		3	4	13.8	11-16	14.50	10-20	5.58	4.94-5.87
		4	4	11.0	8-14	13	12-22	6.12	5.01-6.27
		5	4	8.5	5-12	22.6	18-28	7.03	6.03-6.92
		6	3	7.0	4-10	24.6	18-28	6.47	6.08-6.76
<i>L. rohita</i> (0.5 to 1.2 kg)	Prechilling and icing	0	4	20	20	4.8	3-8	4.50	4.30-4.71
		1	4	20	20	7.8	3-8	4.64	4.31-4.73
		2	4	18.5	18-19	8.6	6-10	4.79	4.62-4.91
		3	4	16.5	16-17	13	6-16	5.23	4.49-5.40
		4	4	14	13-15	10.5	10-18	5.66	5.18-5.85
		5	4	11.8	11-14	18.6	16-22	6.29	5.78-6.53
		6	4	10.3	8-13	18.6	16-20	6.32	6.06-6.59
		7	4	8.3	6-10	23.5	20-30	6.73	6.12-6.91
		8	3	7.0	5-9	24	22-26	6.76	6.28-7.00
		9	2	5	5	28	26-30	7.31	6.83-7.53

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