

Studies on Frozen Storage Characteristics of Fillets From Six Species of Fresh Water Fishes

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Frozen storage characteristics of fillets from six major species of fresh water fishes namely, *Labeo rohita*, *Catla catla*, *Cirrhina mrigala*, *Labeo calbasu*, *Mystus seenghala*, and *Wallago attu* are reported. The biochemical, bacteriological and organoleptic changes in the frozen fillets during storage at -18°C have been followed systematically. Compared to the two species of fresh water cat fishes, the four species of carps studied, had a slightly better storage life. From the organoleptic point of view, fillets of *Cirrhina mrigala* had the best shelf life.

Storage characteristics of many of our major marine fishes have been studied in detail. (Shenoy & Pillai, 1971; Shenoy & James, 1974; Shenoy 1976; Chinnamma George, 1975). But comparatively, very little information is available on the processing characteristics of fresh water fishes. The changes occurring in frozen stored white fish muscle have been reported by Ingalls *et al.* (1950) and Awad *et al.* (1969). In India, Nair *et al.* (1971, 1974) have reported results of studies on the ice storage of some fresh water fishes. Shenoy and James (1972) have studied the frozen storage characteristics of tilapia. Baliga *et al.* (1962 a, b, 1969) and Moorjani *et al.* (1962) have studied the protein fractions of fresh water fish muscle and their changes during storage in ice. As the major fresh water fishes grow to a fairly big size and are costly, their storage as fillets will be of interest for their commercial marketing. The present paper reports results of a detailed study on the frozen storage characteristics of fillets from six major species of fresh water fishes.

Materials and Methods

Samples of six species of major fresh water fishes, namely, *L. rohita*, *C. catla*, *C. mrigala*, *L. calbasu*, *M. seenghala* and *W. attu* were procured in absolutely fresh condition from the fresh water reservoir, Macchu II, near Morbi in Gujarat. The

fish were washed well, immediately packed in insulated boxes with crushed ice, and transported to the laboratory by train. Within 18 hours, the fish were filleted, quick frozen at -40°C , and the frozen fillets stored at -18°C in polythene bags. The fish muscle was analysed before and immediately after freezing and thereafter at regular monthly intervals to follow the changes during storage.

Moisture, total nitrogen (TN), total non-protein nitrogen (TNPN), water soluble nitrogen (WSN) and salt soluble nitrogen (SSN) were determined by the methods of Shenoy & Pillai (*loc cit.*). Alpha-amino nitrogen was estimated by the method of Pope & Stevens (1939). Total bacterial count (TBC) was determined by the standard pour plate method using tryptone glucose agar, *E. coli* using desoxycholate agar and faecal streptococci using KF agar. The samples (cooked in 2% brine for 5 minutes) were judged for their organoleptic acceptability by an experienced panel, who graded them according to the flavour score scale followed by Shenoy & James (*loc cit.*). The electrophoretic patterns of the muscle myogens were obtained by disc electrophoresis in polyacrylamide gel, following the method of Ornstein & Davies (1964).

Results and Discussion

The proximate compositions of the fillets from all the six species are given in

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Table 1. Fillets from different regions of the fish showed some minor variations in their compositions and hence average values are given in the same Table. The four species of carps, namely, *L. rohita*, *C. catla*, *C. mrigala* and *L. calbasu* had slightly higher protein contents compared to cat fishes namely, *M. seenghala* and *W. attu*, which had slightly higher moisture levels in their muscle. *L. calbasu* and

W. attu were richer in fat compared to the other species, though generally all can be taken as lean. *C. mrigala* fillets had a notably low fat content.

In the case of *L. rohita* (Table 2), during storage, TNP showed regular decrease and TN and WSN expressed as percentage of TN, remained unaffected, whereas SSN registered a sharp decrease.

Table 1. Proximate compositions of fillets of six species of fresh water fishes
(Date of catch: 28-4-1977)

Species	Average weight kg	Moisture %	Fat % (DWB)	Protein % (TN x 6.25)	Ash %
<i>L. rohita</i>	3.00	77.71	1.879	18.60	1.3160
<i>C. catla</i>	6.50	76.28	1.325	19.60	0.9320
<i>C. mrigala</i>	2.50	77.47	0.808	17.74	1.1400
<i>L. calbasu</i>	1.65	76.26	2.898	18.72	1.0210
<i>M. seenghala</i>	2.20	80.83	1.191	16.66	0.9105
<i>W. attu</i>	5.00	79.11	3.160	15.76	0.7274

Table 2. Changes in frozen *L. rohita* fillets during storage at -18°C
Storage time in weeks

	0	4	8	12	16	20	24
Moisture %	77.71	78.300	77.540	77.730	78.250	77.850	77.540
TN %	2.97	2.882	2.786	2.780	..	..	..
TNP %	0.56	0.595	0.535	0.455	0.435	0.450	0.495
WSN (% of TN)	28.68	28.720	31.730	27.190	30.860	29.850	30.640
SSN (% of TN)	62.28	57.990	46.060	41.300	41.970	39.390	40.680
Alpha amino nitrogen (mg/100 g)	35.00	42.000	46.200	36.400	40.000	28.6000	24.200
TBC/g	4.38 x 10 ⁵	1.347 x 10 ⁵	6.955 x 10 ⁴	5.211 x 10 ⁴	2.757 x 10 ⁵	..	3.439 x 10 ⁶
<i>E. coli</i> /g	..	Nil	Nil	Nil	Nil	Nil	Nil
Faecal streptococci/g	326	..	181	175	191	..	180
Flavour score out of 10	9	8	7	7	6	5	4

Alpha-amino nitrogen decreased sharply after 16 weeks of storage, which was reflected in the flavour score and in the organoleptic ratings. TBC remained fairly steady during the period of storage. In *C. catla* (Table 3), also the changes followed the same pattern. WSN showed a slight decreasing trend. In *C. mrigala*

(Table 4) a decrease in TNPB was noticeable. But WSN remained unaffected during storage. Changes in other factors followed the same pattern. Table 5 gives the storage characteristics of frozen fillets of *L. calbasu*. The changes in this case also followed the same pattern as in other carps.

Table 3. Changes in frozen fillets of *C. catla* during storage at -18°C
Storage time in weeks

	0	4	8	12	16	20	24
Moisture%	76.280	77.390	76.110	76.260	..	74.73	74.640
TN%	3.136	2.944	2.918	..	2.773	..	..
TNPN%	0.490	0.455	0.475	0.315	0.330	..	0.360
WSN (% of TN)	32.140	28.190	28.880	30.730	28.740	27.86	26.980
SSN(% of TN)	62.820	53.210	52.860	49.540	48.270	53.26	48.270
Alpha amino nitrogen (mg/100 g)	42.000	42.000	44.800	36.800	38.00	27.20	28.600
TBC/g	2.97×10^5	2.889×10^5	9.067×10^4	1.085×10^5	1.583×10^5	..	2.145×10^5
<i>E. coli</i> /g	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal strep- tocooci/g	406	101	31	32	68	..	31
Flavour score out of 10	9	8	7	7	6	4	4

Table 4. Changes in frozen fillets of *C. mrigala* during storage at -18°C
Storage time in weeks

	0	4	8	12	16	20	24
Moisture%	77.470	76.68	75.820	76.690	75.280	74.860	76.840
TN%	2.839	3.070	2.966	2.734	2.826	2.684	2.598
TNPN%	0.665	0.560	0.490	0.490	0.518	0.546	0.490
WSN(% of TN)	..	28.420	33.970	30.730	28.720	27.960	29.640
SSN (% of TN)	67.220	62.770	59.750	56.820	58.260	52.740	49.860
Alpha amino nitrogen (mg/100 g)	38.500	42.000	36.400	30.400	37.600	26.200	32.860
TBC/g	3.12×10^5	1.264×10^5	7.473×10^4	6.123×10^4	..	3.095×10^5	3.097×10^5
<i>E. coli</i> /g	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal strep- tocooci/g	286	210	109	102	129	..	76
Flavour score out of 10	9	8	8	7	7	7	5

In *M. seenghala* (Table 6), the moisture content was high in the fresh state. A definite decrease in the moisture content was observed during storage in this case. A small decrease in WSN was also noticed during storage. *W. attu* fillets also had a

fairly high moisture content. But changes in moisture were less noticeable in this case. WSN showed a decreasing trend during storage. The fillets had a slightly higher percentage of SSN initially (Table 7).

Table 5. Changes in frozen fillets of *L. calbasu* during storage at -18°C

	Storage time in weeks						
	0	4	8	12	16	20	24
Moisture %	76.260	77.470	77.380	75.910	76.640	72.980	75.860
TN %	2.996	3.298	3.088	3.142	..	3.152	3.068
TNPN %	0.560	0.700	0.508	0.490	0.455	0.490	0.455
WSN (% of TN)	31.119	32.500	30.860	25.840	..	26.280	28.640
SSN (% of TN)	72.900	..	57.860	52.640	56.840	53.060	51.760
Alpha amino nitrogen (mg/100 g)	46.500	39.000	34.800	40.400	27.200	37.400	24.860
TBC/g	..	3.119x10 ⁵	1.148x10 ⁵	1.085x10 ⁵	4.126x10 ⁵	..	5.961x10 ⁵
<i>E. coli</i> /g	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal strep- tococci/g	..	180	100	92	118	87	87
Flavour score out of 10	9	8	8	7	6	6	5

Table 6. Changes in frozen fillets of *M. seenghala* during storage at -18°C

	Storage time in weeks						
	0	4	8	12	16	20	24
Moisture %	80.830	78.750	76.790	74.910	74.300	74.280	74.280
TN %	2.666	3.095	2.598	2.600	..	..	..
TNPN %	0.485	0.455	0.390	0.460	0.460	0.390	0.390
WSN (% of TN)	31.960	27.140	28.620	27.680	26.920	27.060	26.920
SSN (% of TN)	62.030	66.280	64.860	56.240	54.460	52.280	49.360
Alpha amino nitrogen (mg/100 g)	35.000	42.000	42.000	36.400	29.400	30.600	26.280
TBC/g	6.81x10 ⁵	4.822x10 ⁵	1.354x10 ⁷	1.625x10 ⁵	1.712x10 ⁵	..	2.677x10 ⁵
<i>E. coli</i> /g	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal strep- tococci/g	514	496	443	357	293	..	157
Flavour score out of 10	9	8	7	6	5	4	4

Table 7. Changes in frozen fillets of *W. attu* during storage at -18°C
Storage time in weeks

	0	4	8	12	16	20	24
Moisture%	79.110	77.340	80.690	77.080	78.810	78.680	77.540
TN%	2.722	2.936	2.747	2.909	2.824	...	2.623
TNPN%	0.525	0.525	0.490	0.455	0.420	0.490	0.420
WSN (% of TN)	29.040	28.680	27.860	28.020	24.680	22.740	26.460
SSN (% of TN)	73.330	69.860	67.640	65.820	58.760	56.280	52.460
Alpha amino nitrogen (mg/100 g)	35.500	35.500	39.200	36.000	28.800	27.400	28.800
TBC/g	...	4.66×10^5	1.559×10^5	1.812×10^5	2.066×10^5	...	3.323×10^5
<i>E. coli</i> /g	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Faecal strep- tococci/g	..	433	360	382	251	..	233
Flavour score out of 10	9	8	8	7	5	4	4

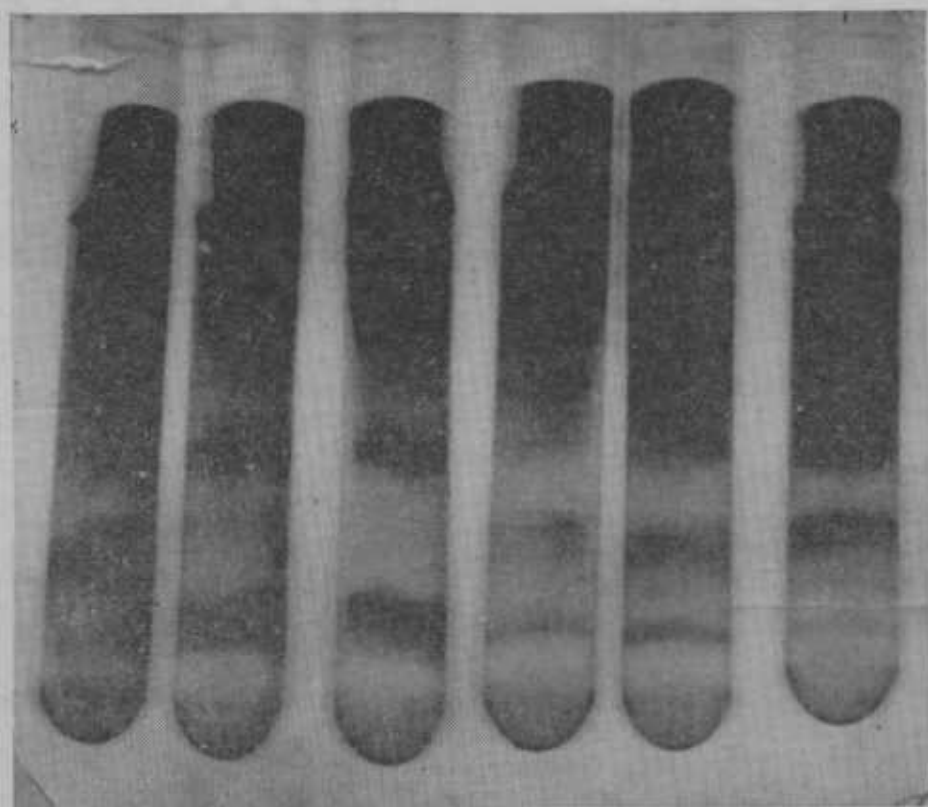


Fig. 1. Disc electrophoretic patterns of the muscle myogens from six species of fresh water fishes.

1. *L. calbasu* 2. *W. attu* 3. *M. seenghala* 4. *C. mrigala* 5. *C. catla* 6. *L. rohita*

The electrophoretic patterns (Fig. 1) of muscle myogens which can be of help in species identification (Devadasan & Nair, 1971) showed basically similar patterns for the four carps. Similarly the patterns for the two cat fishes also had a basic similarity. By careful examination, patterns for individual species can be differentiated from each other. These patterns remained unchanged during storage, though after prolonged storage some of the bands became very feeble. However no new bands were observed after prolonged frozen storage as reported by Awad *et al.* (*loc cit.*) in the case of sarcoplasmic proteins of white fish muscle. Electrophoretic patterns of myogens can thus be used to establish the species in the case of fillets of doubtful authenticity. But for differentiating between the species it is advisable to run a standard each time along with the unknown sample to avoid confusion between the carps which have similar patterns.

In general, the changes during storage followed a general pattern in all the species studied. This was found to be the case in their behaviour during the storage by Nair *et al.* (1974), who used the four carps for the study. Between the carps and cat fishes, the former definitely had a better shelf life, as judged by the organoleptic evaluations. In all cases, the decrease in SSN and alpha-amino nitrogen coincided with a decrease in the organoleptic acceptability also.

Incidence of faecal streptococci was higher in cat fishes which may be due to their well known dirty habitat and feeding habits and the higher resistance of the organisms to destruction by freezing.

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