Ice Storage Characteristics of Fresh and Brined Shark Fillets

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Ice storage characteristics of fresh and brined fillets from fresh shark (*Carcharias melanopterus*) were studied in and out of contact with ice for more than two weeks. Changes occurring in biochemical constituents, physical qualities and bacterial counts of the fillets are reported. Shelf life of brined fillets out of contact with ice was considerably longer than that of control samples under similar conditions. Icing of shark fillets is suggested as a method for the removal of urea on a commercial scale.

Elasmobranchs (shark, skates and rays) constitute one of the major fisheries of India, the average annual landings for the years 1971-76 being 53,065 metric tonnes, accounting for 4.35% of the total annual marine fish landings. Because of the high content of urea in the muscle, sharks are not relished as food fishes. However, they are rich sources of valuable liver oil and fins. Detailed studies of proteins of the Indian sharks and skates were reported by Ambe & Sohonie (1957). Attempts have been made to remove urea from muscle of elasmobranchs by various scientists. Kandoran *et al.* (1965) reported a successful method of removing urea by a dry salting and desalting process. But in this case the target was a dried product and the method is more suitable for such products. Some enzymatic methods have also been reported recently, involving mincing of the meat for complete removal of urea. When the muscle or fillets are required in fresh condition these methods are of little use. As shark flesh, free of urea is a cheap and ideal raw material for the preparation of a variety of speciality products, preservation and proper processing of the fish fillets have become important problems demanding the immediate attention of fishery technologists. The present paper reports the ice storage behaviour of shark fillets in and out of contact with ice, with special reference to the effect of brining and the removal of urea.

Materials and Methods

Freshly caught shark (*Carcharias melanopterus*) from a local fish landing centre was immediately brought to the laboratory, washed in cold water and filleted into pieces of uniform size (15 cm x 5 cm x 2.5 cm). The fillets were thoroughly washed in chilled water and divided into two lots. One lot was dipped in saturated brine for 30 minutes and drained. The other lot was used as control. Brined and control fillets were stored individually in crushed ice in the following manner.

Sample Code No.	*Particulars of icing and pakaging*
B1	: Brined fillets stored in direct contact with crushed ice.
B2	: Brined fillets stored in ice after packing in polythene bag.
B3	: Brined fillets stored in ice after packing in polythene bags along with (1:1) ice.
C1	: Control fillets stored in direct contact with ice.
C2	: Control fillets stored in ice after packing in polythene bag.
C3	: Control fillets stored in ice after packing in polythene bag along with (1:1) ice.

Samples from each lot were withdrawn periodically and analysed systematically for total bacterial counts (TBC), moisture, Nacl, urea, total nitrogen (TN), trimethyl amine nitrogen (TMAN), total volatile bases (TVB), alpha amino nitrogen and physical characteristics. Analyses of moisture, TN and Nacl were carried out according to the methods of AOAC (1960), urea, TMAN and TVB by microdiffusion method of Conway (1947), alpha amino-nitrogen by the method of Pope and Stevens (1939) and TBC by using sea-water agar media.

Results and Discussion

Results of analyses for TN and Nacl are presented in Table 1. A gradual decrease in TN occurs in brined as well as control samples stored in contact with ice, whereas a very slight increase is observed in the case of samples packed in polythene bags. In the former case, decrease of TN can be attributed partly to the increase of the moisture contents (Fig. 1) of the muscle and partly to the leaching out of the water soluble fractions from the muscle along with the ice melt water. In the latter case, leaching out was not possible due to leak proof packing of the fillets in polythene bags. Slight increases in TN were observed in this case along with a very slight fall in moisture. The retention of the spoilage products by the muscle reveals early signs

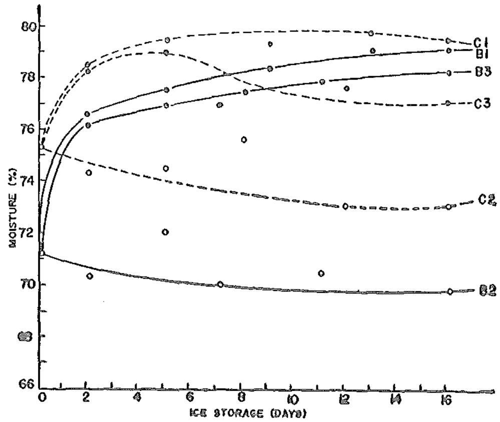

Fig. 1. *Variations of moisture in shark fillets during ice storage*

Table 1. *Variation in Nacl and TN in control and brined shark fillets during ice storage*

(Nacl in control : 0.15% OWB)

Storage in ice (days)	TN % (OWB) B1	B2	B3	C1	C2	C3	Nacl % (OWB) B1	B2	B3
0	3.72	3.72	3.72	3.78	3.78	3.78	5.80	5.80	5.80
2	3.51	3.78	3.58	3.17	3.83	3.28	3.51	4.92	2.58
5	3.26	3.80	3.51	3.15	3.75	3.14	2.06	3.93	1.67
7	..	3.82	3.55	..	..	..	..	3.84	1.63
8	..	..	..	..	3.81	3.25	..	..	..
9	..	..	..	3.25		..	1.18	3.65	1.56
11	..	3.86	3.41	..	..	..	..	..	..
12	..	..	..	..	3.76	3.19	..	..	..
13	3.11	..	..	3.15	..	..	0.56	..	..
16	3.02	3.85	3.46	3.11	3.81	3.24	0.44	3.56	1.53

Table 2. *Physical observations of control and brined shark fillets stored in ice*

Sample code number	Quality chara-cteristics	Ice storage in days: 0	2	5	8	9	12	13	16
C1	Colour	BPR	BP	SB	..	SYB		HB	..
	Odour	CSF	SRO	VRO	..	FOO	..	DOO	..
	Texture	QF	F	F		SS		VS	..
C2	Colour	BPR	BP	DP	DY	..	DYB	...	VD
	Odour	CSF	CSF	A	SA	..	VSA	...	DOO
	Texture	QF	F	SS	SS	...	S	...	VS
C3	Colour	BPR	BP	SB	B	..	SYB	..	YB
	Odour	CSF	SRO	VRO	SLA	..	SA	..	P
	Texture	F	F	S	SS	..	S	..	VS
		Ice storage in days: 0	2	5	7	9	11	13	16
B1	Colour	BP	SB	B	..	YR	..	YB	DYB
	Odour	CSF	CSF	SRO	..	A	..	VP	DOO
	Texture	QF	QF	F	..	SS	..	VS	VS
B2	Colour	BP	BP	SB	DYB	..	YB	DYB	DY
	Odour	CSF	CSF	FA	SA	..	P	VP	DOO
	Texture	QF	QF	F	SS	SS	S	VS	VS
B3	Colour	CP	SB	SB	SB	..	B	DYB	DYB
	Odour	CSF	CSF	CSF	SLA	..	FA	SA	A
	Texture	QF	QF	F	F	..	S	S	VS

BPR-Bright pinkish red, BP-Bright pinkish, SB-Slightly bleached, SYB-Slightly yellowish brown, HB-Hightly brownish, DP-Dull pinkish, DY-Dull yellowish DYB-Dull yellowish brown, VD-Very dirty, YR-Yellowish red, B-Bleached, YB-Yellowish brown, DY-Dirty yellow, DYR-Dull yellowish red, CSF-Characteristic of fresh shark fillets, SRO-Slightly reduced odour, VRO-Very reduced odour, FOO-Faint off odour, DOO-Distinct off odour, A-Ammoniacal, SA-Strong ammoniacal, VSA-Very strong ammoniacal, FA-Faint ammoniacal, SLA-Slightly ammoniacal, P- Putrid, VP-Very putrid, QF-Quite firm, F-Firm, SS-Slightly soft, S-Soft, VS-Very soft.

of deterioration as seen from the physical observations of the samples given in Table 2. Salt content of the brined fillets stored out of contact with ice decreased gradually to about 60% of the initial value, whereas almost all the salt was leached out when they were stored in contact with ice for 16 days.

Changes observed in moisture contents of the shark fillets under investigation are shown in Fig. 1. Dipping of the fillets in saturated brine for 30 min reduced the moisture content by about 4 per cent, which got further reduced slightly on storage out of contact with ice. Increases in moisture contents were noted in control as well as brined fillets stored in contact with ice, obviously due to absorption of water by the muscle.

Fig. 2 reveals that brining of the shark fillets reduced the urea content by almost one-third of the initial value.

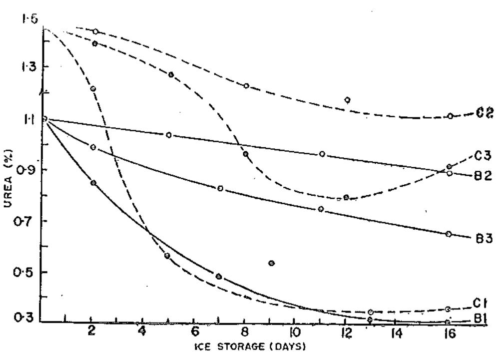

Fig. 2. *Reduction of urea in shark fillets during ice storage.*

Appreciable quantity of urea was removed on simple storage of the fillets in contact with ice. In a weeks time urea content was reduced to about 25 percent of the initial value. Considerable reduction in the content of urea was also observed in the case of samples packed in polythene bags along with ice. It has been reported by Kandoran *et al.* (*loc cit.*) that complete removal of urea in shark fillets is possible by repeating the process of salting and desalting. If the fish is required in an unsalted condition, simple icing in finely crushed ice for few days can be resorted to as a method for reducing the urea content to an acceptable level.

Variations in alpha amino N, TMAN and TVB contents of the shark fillets during storage are shown in Figs. 3, 4 and 5 respectively.

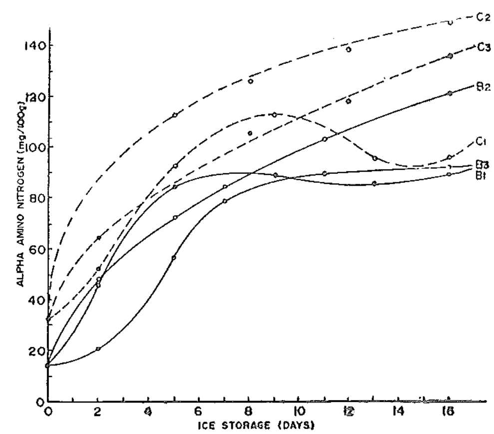

Fig. 3. *Variations of alpha amino nitrogen of shark fillets during ice storage.*

Steady increases in alpha-amino nitrogen were observed in all cases though the rate of increase varied from sample to

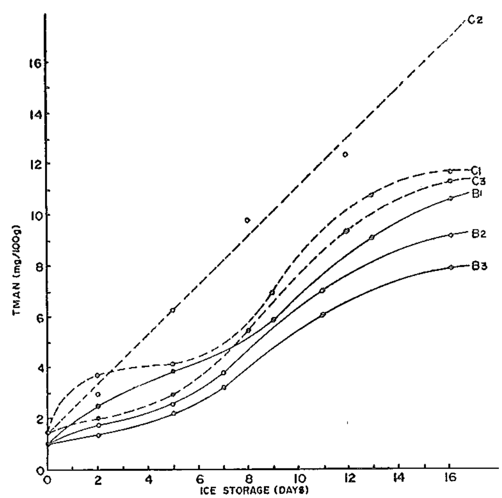

Fig. 4. *Variations in TMAN of shark fillets during ice storage.*

sample those in contact with ice showing only marginal increases while those out of contact with ice showed higher rates of increase. Higher values of TMAN and TVB also occurred in the case of packaged fillets, especially the control. Brining of the fillet showed some preservative effect during the storage compared to the control. Increase in TMAN, changes in physical characteristics and bacterial counts (Fig. 6) gave good correlations of the quality of the fillets. It is interesting to note that increase in TMAN of the control sample out of contact with ice was almost linear (Fig. 4.). Rise in TVB of all the samples was almost steady except that of packaged control sample (Fig. 5).

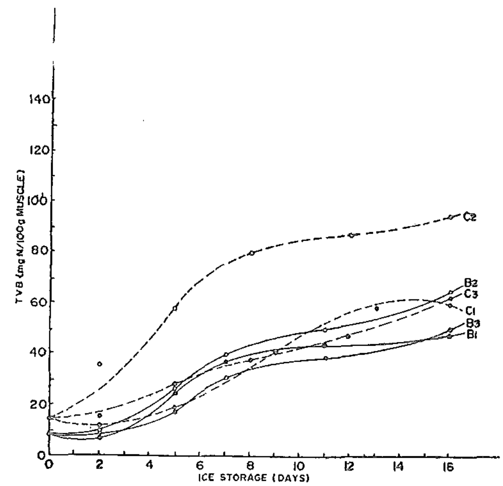

Fig. 5. *Variations in TVB of shark fillets during ice storage.*

It is seen from Fig. 6 that the marginal differences observed between the total bacterial counts of the brined and control fillets at the initial stages of ice storage disappeared after 4 to 5 days. The lowest rate of increase in the total bacterial counts observed in samples in contact with ice may be due to the washing effect of ice melt water on the bacterial flora during storage. There were fairly steep increases in the total bacterial counts of samples during the first week of storage after which they were less pronounced.

The physical observations of the fillets given in Table 2 show that in the fresh condition, they had very attractive appearance, firm texture and characteristic fresh odour.

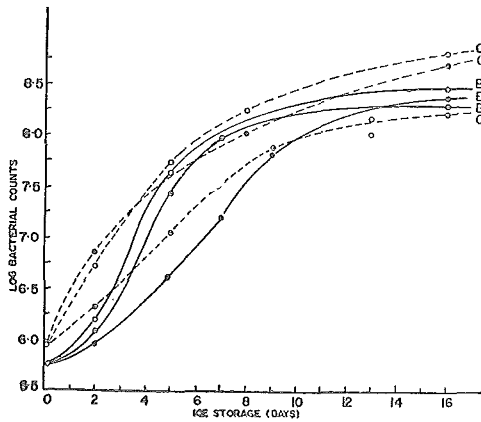

Fig. 6. *Variations in total bacterial counts of shark fillets during ice storage.*

Brining of the fillets prior to ice storgae improved the quality and enhanced the shelf life of the fillets considerably, especially under the packaged condition. Packaging of the control fillets with polythene bags did not improve their storage life; instead the samples showed early signs of spoilage with a very short shelf-life of only 5 days, whereas brined fillets under similar conditions had extended storage life upto 11 days. Brined as well as control samples stored in contact with ice had almost the same shelf-life of about 9 days, whereas those packed along with ice in the polythene bags had shelf-life of 13 and 10 days respectively.

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