PRELIMINARY STUDIES ON FREEZING CHARACTERISTICS OF BOMBAY DUCK (HARPODON NEHEREUS)

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Fresh Bombay duck (Harpodon nehereus) can be quick frozen at -40°C. and stored at -10°F. for about 3 months in a very fair and acceptable condition. The maximum drip loss observed was about 24%. Rapid decrease in the extractable protein nitrogen of the fish muscle was noted during the frozen storage.

INTRODUCTION

Bombay duck is the third largest fishery in India averaging an annual catch of about 90,000 tonnes. It forms one of the largest single fishery in Gujarat State, the main landing centres being Jaffrabad, Nawabunder and Rajpara. Sun drying of the fish is the only processing method adopted since time immemorial by the fishermen to preserve the fish on commercial scale.

Attempts have been made to process and utilize the fish in fresh or dry condition. Venkataraman et. al. (1969) have examined the possibilities of extending the ice-storage life by irradiating the fish prior to storage. Sawant et-al. (1967) described the radiation pasteurisation of Bombay duck. Kandoran et-al. (1969) worked on the storage behaviour of laminated and commercial Bombay duck. Prabhu (1972) studied the sundrying characteristics of Bombay duck.

Though Bombay duck has got a characteristic flavour of its own and is available in uniform sizes which makes it quite suitable for commercial freezing, no attempt has so far been made. The main reason, for not attempting large scale freezing of Bombay duck can be attributed to the lack of precise technological data on the amenability of the fish for freezing and frozen storage.

Fresh Bombay duck can be put to a variety of uses, like preparation of soup powder mix, paste, and laminated product.

The present communication reports the work carried out on freezing and frozen storage characteristics of fresh Bombay duck.

MATERIALS AND METHODS

Absolutely fresh Bombay duck landed at Jaffrabad was washed in potable water, immediately iced, and preserved in a thermocole insulated aluminium lined box and brought to the laboratory at Veraval. After 24 hours, it was taken out, washed in ice cold water, gutted, fins, head removed by means of scissors and kept in

TABLE I

PHYSICAL AND CHEMICAL CHARACTERISTICS OF VERY FRESH AND THAWED FROZEN BOMBAY DUCK MUSCLE

Weeks of storage	Moisture %	TN %	£-NH_2N mg%	TMAN mg%	TVBN mg%	PHYSICAL OBSERVATION			
						Appearance	*Odour*	*Texture*	Overall quality
0	90.65	1.366	38.82	1.9	12.0	Pinkish white body	Characteristic	Very firm	Excellent
4	87.35	1.548	37.24	3.604	8.65	White	-do-	-do-	Very good
6	87.47	1.588	31.66	4.011	10.59	White	-do-	firm	Very good
8	87.23	1.50	22.3	4.422	10.47	Dull white	-do-	firm	Good
10	87.10	1.578	20.3	4.799	12.18	-do-	Slightly reduced characteristic odour	firm	Good
12	87.60	1.632	15.16	5.14	14.90	Yellowish white	-do-	firm	Very fair
16	86.70	1.54	11.95	4.66	19.91	-do-	Reduced characteristic odour but no off odour	Sightly soft	Fair
18	86.5	1.58	11.6	5.38	18.15	Bownish yellow	Very reduced characteristic odour	Sponge like	Below fair
21	85.18	1.963	6.397	5.023	19.4	-do	Slight ammonical smell	Soft & mushy	Poor

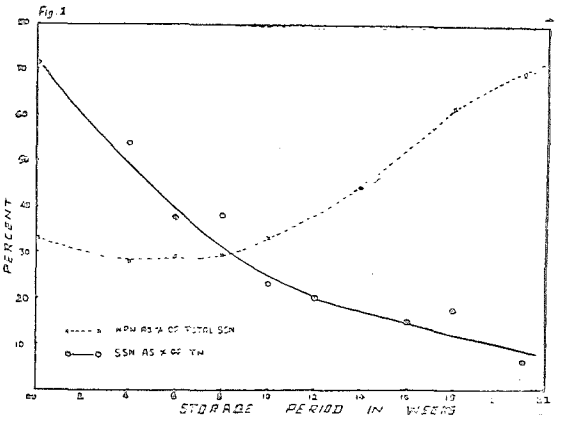
ice. A known weight (about 1 kg.) of the fish was wrapped in polythene sheets to make blocks and frozen at -40°C. in a contact freezer. The frozen blocks were stored in the cold storage room at -10°F. Initial analysis of the samples was done prior to freezing of the fish.

Samples from the frozen storage room were withdrawn at regular intervals and the analysis of the same carried out. Moisture was determined by A. O. A. C. (1960) method. TN and NPN by Micro -kjeldahl method. SSN (salt soluble Nitrogen) was determined by the method of Dyer (1950). α -NH_2N was estimated by the method of Pope and Steven (1939). TVN and TMAN were estimated by the micro-diffusion method given by Conway (1947).

The sample, after removal from the frozen storage was packed in Polythene bag, thawed in running tap water at room temperature and drained. Drip volume was noted and calculated as the percentage of total weight. TN & NPN of the drip were determined. Its physical observation and pH (by universal indicator) were also recorded. Samples for the Bacteriological tests of the frozen fish was drawn prior to its thawing. Total bacterial count was determined by the pour plate method using sea water agar media. E.coli by T_7 agar, coagulase positive Staphylococci by Chapman stone medium and Faecal Streptococci by KF agar. Besides the chemical analysis of the thawed fish, physical and organoleptic tests were also carried out for all the samples.

Results and discussions

The results of the bio-chemical and physical changes in Bombay duck during frozen storage are shown in Table I. The changes in SSN and NPN during



Variation in SSN and NPN contents of Bombay duck during frozen storage

frozen storage are shown in Figure I. The physical and chemical characteristics of the drip are shown in Table II. Bacteriological values obtained are given in Table III.

From Table I it is clear that during frozen storage, Moisture and α-NH_2N decreases steadily while TN increases gradually. Appreciable difference in moisture content between very fresh and frozen fish was noted. The loss of moisture content in frozen fish muscle is very well accounted by the high drip loss (Table II) on storage. The decrease in moisture content in frozen samples was very much less compared to the drip loss on extended period of storage.

If the TMAN, TVN, and NPN (as % of muscle) are taken into account as such, it is difficult to get any correlation with the quality of the muscle, as there are no significant rise in their contents. However, a very good correlation exists between NPN (as % of total SSN) and SSN brought out in figure I. Figure I, brings out clearly that with the increase in frozen storage period there is a

TABLE II

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THAW DRIP

Storage time in weeks	Drip %	Colour & nature	Odour	pH	TN%/100cc drip mg%	NPN as %of TN for 100cc. drip
4	15.0	Clear & white	Characteristic B.D.	Neutral	156.8	17.27
6	18.05	-do-	-do-	-do-	155.37	50.49
8	22.43	-do-	-do-	-do-	158.00	60.24
10	21.03	Clear & slightly brownish	Slightly reduced Char. B. D.	-do-	98.00	71.44
12	24.44	-do-	Slightly reduced characteristic	-do-	109.00	55.13
16	23.54	Brownish white slight turbidity	Reduced characteristic (Neutral)	-do-	217.00	68.39
18	22.82	Very turbid with yellowish brown	No characteristic odour slight fisht.	Slightly alkaline	242.8	74.59
21	24.15	-do-	Slightly ammoniacal	Slight alkaline	276.4	78.22

steep fall in the extractable protein nitrogen, and a rapid rise in the non-protein nitrogen contents of the muscle. The decrease in the SSN is due to the denaturation of the protein during storage. Similar results were obtained by Anderson et.al. (1965) and Shenoy and Pillai (1971) in cod muscle and sardine muscle respectively. The rapid denaturation of the protein in Bombay duck can further be explained in the light of the fact that being a lean fish it is more prone to denaturation than any fatty fish, when held under similar conditions of storage (Dyer and Fraser, 1959). Dyer and his associates (1961) had suggested that the unhydrolysed, neutral lipids were associated with the protein in a manner that protected the molecule against denaturation. This has been confirmed by Hanson and Olly (1965) and Dyer (1967).

Physical observation of the fish reveals (Table I), that the quality of the fish muscle remains in a very fair condition upto three months of frozen storage without loosing much of its orginal characteristics, odour and texture. Further extension of storage beyond three months resulted in the loss of almost all its physical characteristics and hence it is safe to conclude, line of 3 months as the border line of acceptability.

TABLE III

BACTERIOLOGICAL ANALYSIS

Weeks of Storage	Total count/gm.	Faecal streptococci per gm.	C+ve Staphylococci per gm.	E. Coli.
0	9.25×10^5	187	128	Nil
4	7.803×10^5	127	82	Nil
6	4.631×10^5	130	20	Nil
8	8.13×10^4	102	Nil	Nil
10	1.133×10^5	42	Nil	Nil
12	5.79×10^4	40	Nil	Nil
16	9.111×10^4	30	Nil	Nil
18	4.234×10^4	10	Nil	Nil
21	5.06×10^4	Nil	Nil	Nil

From Table II, it can be seen that drip loss is high in the initial stages of storage and gradually increases upto 24.15% as the storage period is extended to 21 weeks. Beyond 21 weeks, there is no significant increase in drip loss. Similar observations have been made by several authors during frozen storage studies of various species of fish, (Reay 1942, Kelly 1967, Pienaar and Thomas, 1964, Good and Stearn, 1955, and Dyer 1967) and in the case of American plaice by Dyer (1968). The higher drip loss noticed in frozen Bombay duck can be attributed to the very high moisture initially present in absolutely fresh fish. It has been reviewed by Miyauchi (1963) that, fish that have a higher water content or low protein content tend to form excessive amounts of drip, and this may be true in the case of Bombay duck also where moisture content is about 89.90%.

It is also clear from the Table II that increase in TN and NPN in the drip are very well correlated with the quality of the fish. They are raised to a higher level after 16 weeks of storage-which shows the border line of the fairness of the fish quality. Also there was no significant change in the pH of the drip during that period.

From Table III it is revealed that there was an initial decrease and a gradual reduction in the total count after freezing. Similar results have been observed by many workers. Exposure to low temperature causes an initial decrease in the number of living bacteria followed by a lag period before development of the survivors occurs, the extent of the initial decrease and the lag depending on the temperature (Stewart, 1934). There was also a gradual reduction in the number of Faecal streptococci count and after 3 months of storage it has been completely eliminated from the muscle. Similarly Coagulase positive staphylococci also failed to survive after two months of frozen storage. The cessation of bacterial growth has been ascribed to various causes, including the toxic effects of

metabolic waste products, the formation of specific growth inhibiting compounds, physical over crowding and the exhaustion of food and energy materials (Cleary et -al. 1935). There is no apparent correlation between the quality of the fish and the number of either pathogenic or total plate count of bacteria.

SUMMARY

Fresh Bombay duck can be quick frozen and preserved at -10°F. in cold storage about three months in a very fair and acceptable condition. There after the quality of the fish deteriorated pretty fast and became quite unacceptable after 4 months of storage. Formation of drip was very fast and reached a maximum level of about 24% within 8-10 weeks of storage. The amount of SSN nitrogen decreased very rapidly due to the denaturation of protein during storage. There was a gradual decrease of total and pathogenic bacterial counts as the storage period increased.

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