

PRESERVATION OF FISH BY FREEZING AND GLAZING:

II. KEEPING QUALITY OF FISH WITH PARTICULAR REFERENCE TO YELLOW DISCOLOURATION AND OTHER ALLIED ORGANOLEPTIC CHANGES ON PROLONGED STORAGE

M. G. JADHAV AND N. G. MAGAR

Department of Biochemistry, Institute of Science, Bombay-32

Organoleptic observations of quick, slow and block frozen, glazed and stored fish were recorded at regular intervals. Glazing was renewed at intervals of four weeks. Development of yellow discolouration in the case of white pomfret was followed. Keeping quality of glazed fish was better than unglazed frozen fish. Yellow discolouration could be controlled by ascorbic acid for $4\frac{1}{2}$ months and by a mixture of sodium chloride and glucose for $5\frac{1}{2}$ months.

INTRODUCTION

Value of fish as a consumer product depends not only upon its output but also on its organoleptic condition from the time it is caught till it is sold in the market. Organoleptic changes involve development of undesirable discolouration (especially yellow), formation of unpleasant odours and deterioration in texture, condition of eyes, gills etc. Hence, the present work was undertaken to study the extent of these changes occurring in fish during preservation by freezing, prolonged frozen storage with and without glazing and packed in containers like gunny bags.

EXPERIMENTAL

Fishes selected for the study were

white pomfret (*Stromateus cinereus*) Surmai (*Cybbium commersonii*) and mackerel (*Rastrelliger canagurta*). Of these, white pomfret and surmai were quick frozen individually, glazed and stored at -15°C . Pomfrets were divided into six groups: 1) Control (without glaze), 2) Ice water glaze, 3) Packed in gunny bag with polythene lining, 4) Ascorbic acid glaze (0.1%), 5) Sodium chloride and glucose glaze (0.5% each) and 6) Sodium chloride and glucose glaze (0.5% each) and packed in gunny bag. Surmai were divided into four groups: 1) Control (without glaze), 2) Ascorbic acid glaze (0.1%), 3) Citric acid glaze (1.0%), and 4) Sodium nitrite glaze (1.0%). Mackerel was slow frozen

in blocks by packing them in trays with glazing water to cover them. Individually slow frozen mackerel without glaze was used as control.

Glazing with ascorbic acid, citric acid, sodium nitrite and mixture of sodium chloride and glucose was renewed at intervals of four weeks during frozen storage. No reglazing was done in the other cases. Storage lives in the case of white pomfret and surmai were $5\frac{1}{2}$ and 5 months respectively, whereas, it was 6 months in the case of mackerel. Samples were examined organoleptically for external appearance of body, gills and eyes, texture and odour at intervals of 4 weeks after thawing them completely. The results are presented in Table I.

DISCUSSION

According to organoleptic observations recorded from time to time at intervals of 1 month, it was noticed that white pomfret subjected to quick freezing without any chemical treatment and stored were acceptable for only $3\frac{1}{2}$ months after which the yellow discolouration became very much prominent in addition to thick irremovable white membrane upon the eyes and an undesirable odour on thawing. Similarly, pomfrets quick frozen and stored in gunny bag without any chemical treatment showed the same trends of keeping quality. Ice water glaze was also little effective in extending keeping time of pomfret. It developed the same undesirable and unacceptable changes after storage of $3\frac{1}{2}$ months. Pomfrets that were given ascorbic acid glaze and those packed in gunny bag after treatment with sodium chloride and glucose, had good and acceptable quality upto $4\frac{1}{2}$ months. Later on, yellow discolouration of skin occurred and thick white membrane developed upon eyes. Sodium chloride and glucose glaze was the most effective in extending the keeping time of pomfret over $5\frac{1}{2}$ months

as no prominent and well marked yellow discolouration could be observed and texture was also satisfactory.

Although no discolouration could be observed in the case of surmai during frozen storage, other factors such as loosening of texture and thick membrane formation in eyes caused unacceptability in the fourth month when stored without any chemical treatment. Surmai which had been given ascorbic acid glaze was acceptable for 5 months only. Sodium nitrite glaze could only preserve the fish for more than 4 months in an acceptable condition but at the beginning of the 5th month it started developing those undesirable characteristics. Citric acid glaze however, extended the storage life of surmai over 5 months. Mackerels, slow frozen and block frozen could keep well upto 4 months. There was hardly any difference in storage life.

Development of yellow discolouration or browning discolouration in frozen stored fish has been attributed to sugar-amino group interaction. This was later disproved experimentally by workers at Torry Research Station, D. S. I. R (1957). Another view has been found to hold good till to-day. It is the bruising of fish during handling that leads to the rupture of tissue which later on undergoes oxidation because of fat and unsaturated fatty acids present. This causes the yellow discolouration or rusting (Fressler, 1932). This view is further supported by experimental evidence obtained by Empey (1958), who observed that the frozen storage hastened the development of oxidation of fat or rancidity. Freixo (1958) has also observed that glazing retarded oxidation of fat. In the present experiments also it was observed that the process of rancidity was considerably retarded by application of glazes such as ascorbic acid and mixture of sodium chloride and glucose since it

TABLE I ORGANOLEPTIC OBSERVATIONS ON FROZEN FISH STORED OVER A LONG PERIOD

Treatment	Frozen storage in Months										
	1	1½	2	2½	3	3½	4	4½	5	5½	6
WHITE POMFRET											
Control	—	Ib	—	IIa	—	IIb	—	IIIa	—	IIIb	—
Ice water glaze	—	Ib	—	IIa	—	IIb	—	IIIa	—	IIIb	—
Stored in gunny bag with polythene lining	—	Ib	—	Ib	—	IIa-IIb	—	IIIa	—	IIIb	—
Ascorbic acid glaze	—	Ia	—	Ia-Ib	—	Ib-IIa	—	IIa-IIb	—	IIb	—
NaCl + glucose glaze	—	Ia	—	Ia	—	Ib	—	IIa	—	IIa-IIb	—
-do- packed in gunny bag	—	Ia	—	Ib	—	IIa	—	IIb	—	IIIa	—
SURMAI											
Control	Ib	—	IIa	—	IIa-IIb	—	IIb-IIIa	—	IIIa	—	—
Ascorbic acid glaze	Ib	—	Ib-IIa	—	IIa	—	IIb	—	IIb-IIIa	—	—
Citric acid glaze	Ib	—	Ib	—	Ib-IIa	—	IIa	—	IIb	—	—
NaNO ₂ glaze	Ib	—	Ib-IIa	—	IIa	—	IIb	—	IIb-IIIa	—	—
MACKEREL											
Control	Ib	—	IIa	—	IIb	—	IIb-IIIa	—	IIIa	—	IIIb
Block frozen	Ib	—	Ib-IIa	—	IIa	—	IIa-IIb	—	IIb	—	IIIa

- Ia:** Surface fresh with natural colour, lustre and sheen; gills fresh and bright white in the case of pomfret and red in others; similarly, gill fluid, white in the case of white pomfret and red in others; eyes brilliant and normally placed: flesh firm; normal odour which was very much faint in pomfret and surmai but not so in the case of mackerel.
- Ia-Ib:** Surface fresh with natural colour, lustre but no sheen; gills white and gill-fluid brownish in pomfrets; eyes lost brilliancy, flesh firm with natural colour.
- Ib:** Surface fresh with natural colour; gills white in pomfret and red in surmai and mackerel; gill fluid brownish in pomfrets only; in others it was not distinguishable; eyes slightly sunk (+) and their brilliancy lost; flesh slightly soft (+); odour normal in all cases.
- Ib-IIa** Surface fresh with natural colour, no sheen; gills pink and gill fluid dark red in white pomfret only; eyes sunk (++); slime formation observed (+).
- IIa:** Surface dull, sheen lost; gills pink and gill fluid dark red in pomfret only; eyes opalescent and sunk more (+++), and haemorrhagic with thin white membrane (+); slime formation in progress (++). Flesh softer (++), odour normal with fishy tinge.
- IIa-IIb:** Surface dull with a little natural lustre; gills pink; eyes sunk (+++), opalescent with thin white membrane; marked slime formation (+++), flesh softer (+++); yellow discolouration making its appearance in white pomfret only.
- IIb:** Surface has lost natural colour and is seen to be darkened a little; gills red and gill-fluid purplish red in White pomfret only; eyes sunk (+++); opalescent with haemorrhagic edge and thick white membrane, (+) flesh soft (+++); yellow discolouration quite visible (+) in pomfret only, but in other fishes it was absent; odour rather fishy.
- IIb-IIIa:** Surface dull with no natural lustre; gills more red and gill-fluid purple in white pomfret only; yellow discolouration in white pomfret only (++); eyes sunk (+++), opalescent with haemorrhagic edge and thick white membrane (++); flesh soft (++++) with a little fishy intense odour (+).
- IIIa:** Surface darkened and covered with heavy amount of slime (+++), yellow discolouration in pomfret only (+++); gills purple and gill fluid also purple;

eyes sunk (+++), haemorrhagic edge with white membrane turned yellow, odour fishy and a little more intense. (++)

IIIb: Surface dull darkened but covered with large amount of slime (++++) and well marked yellow discolouration (++++), haemorrhagic with dark yellow thick membrane; odour intensely fishy (+++).

formed a thin film on the surface preventing the reaction of oxygen with bruised surface in addition to retardation of dehydration. Mixture of sodium chloride and glucose was more effective against oxidation than ascorbic acid in low concentration as shown by the extension of shelf life of pomfrets by 2 months by the former compared to only one month by the latter.

ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to the authorities of the Quick Freezing Plant and Cold Storage of

Govt. of India, Colaba, Bombay for offering facilities to freeze the fish and store and to the Council of Scientific & Industrial Research, New Delhi, for generous financial assistance.

REFERENCES

- D. S. I. R. 1957 *Food Investigation Rept.* for 1956, 20.
Empey, 1958, *Food preservation quarterly*, 18, 176.
Ferix, J. 1958, *Consewas de Peize*, 13, 27.
Tressier, D. K. 1932, *Ind. Eng. Chem.*, 24 (6), 682.