# FREEZING CHARACTERISTICS OF TROPICAL FISHES III SPOTTED SEER *(SCOMBEROMORUS GUTTATUS)*

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Skin-on fillets of spotted seer were frozen individually with different prefreezing ice storage periods, and srored at -23°C and -10°C. The frozen storage shelflife was evaluated, with respect to holding time in ice prior to freezing, by examining the extent of oxidative rancidity, protein denaturation, organoleptic changes etc. Fillets with pre-freezing ice storage periods of 0, 3, 5 and 7 days had frozen storage shelf-life of 32, 24, 20 and 16 weeks respectively at -23°C. The fillets stored in ice for more than 7 days is unsuitable for further processing. Storage temperature greatly affected keeping quality of frozen fillets. Freshly frozen fillets stored at -10°C became unpalatable at 16-20 weeks as compared to 28-32 weeks for the fillets stored at -23°C.

## INTRODUCTION

Quality deterioration of frozen fish varies with the characteristics, pre-freezing conditions and freezing and storage conditions of the fish. Most fish processors are aware that fish muscle must be stored at -18°C or below to reduce the quality loss to the minimum. However, surveys have indicated that temperatures above -18°C are frequently encountered during commercial distribution of frozen fishery products (Lane, 1966: Lenz *et al*, 1960). Thus studies on the quality loss of frozen fish muscle should include storage temperatures upto -10°C for a realistic appraisal of the adverse storage conditions. Little definite data on the effects of these factors are available for particular fish products during storage.

Although reports are available concerning quality of spotted seer during pre-process ice storage (Shenoy and James, 1974) and during frozen storage (Bose, 1969) there is a lack of information concerning development of oxidative rancidity, colour changes, and protein denaturation in frozen seer during storage in relation to its holding time in ice prior to freezing. Preliminary investigations have been carried out on the preservation of this fish by freezing and glazing (Jadav and Magar, 1970).

This paper presents information concerning rancidity development, protein denaturation, lipid hydrolysis and organoleptic evaluations in frozen seer fillets in relation to its holding time in ice before freezing, and the variation in these factors in fillets stored at -10°C and at -23°C.

## Material And Methods

Spotted Seer of average weight 5 kg. caught by trawlers off Cochin were brought to the laboratory within 5 hours of catch, eviscerated, beheaded, filleted, washed free of blood and stored in crushed ice in an insulated box. One set of the fillets were frozen immediately, divided into two lots, after wrapping them individually with polythene paper, and stored in corrugated paper board boxes, at two different temperatures of -10°C and -23°C. Freezing of the rest of the fillets were carried out at intervals of 3, 5, and 7 days. All the frozen fillets were similarly stored at -23°C.

Oxidative rancidity in the muscle was determined by organoleptic evaluation of the thawed samples, before and after cooking for 15 minutes in 3% boiling brine, and by determination of peroxide value (PV) of extracted lipids (Tarr 1947). Free fatty acids (FFA) were determined by the method of Dyer and Morton (1956) and protein denaturation by the method of Dyer *et al.* (1950).

The bio-chemical changes taking place in the frozen muscle were followed at regular intervals after thawing for 18 hrs. at 4°C.

## Results And Discussion

Results of the bio-chemical and organoleptic tests in fillets stored at -10°C and -23°C are presented in Table I, while that of the fillets stored at-23°C, with different pre-freezing ice storage periods are presented in Table II.

### Influence of frozen storage temperature

The first indication of storage change was a slight darkening of the flesh followed by yellowing of the flesh under the skin. This yellowing then deepened and accompanied by complete fading of the characteristic colour. The colour fading and yellowing of the muscle were significant at -10°C. Initial fading of the colour was noted after storage for 16 weeks and 24 weeks at -10°C and at -23°C, respectively. These changes then progressed with development of rancid odour. There was marked difference in the texture of the cooked muscle, between the samples held at different temperatures, as judged by organoleptic tests. The texture of the cooked muscle became tough and fibrous after 20 weeks of frozen storage at -10°C, while texture of the samples held at-23°C was only slightly tough at the end of 32 weeks of frozen storage. Samples stored at -10°C were rancid after 16 weeks as suggested by taste panels but those at-23°C, were acceptable even after 32 weeks.

Eventhough organoleptic evaluations revealed that the samples held at -10°C were rancid after 16 weeks of frozen storage, results of the PV determinations indicated that the oxidative changes were not significant. There was rapid increase in PV in the samples at -10°C compared to samples held at -23°C. Rate of development of free fatty acids was faster in samples stored at -10°C than at -23°C (Table I). Dyer and Fraser (1959) reported that FFA development is slower in fish of high fat content

TABLE I

Bio-chemical and organoleptic changes in frozen seer fillets held at -10° and -23°C.

| Storage temperature | | -10°C. | | | | -23°C. | | | |
|---|---|---|---|---|---|---|---|---|---|
| Storage time in weeks | Fresh | 8 | 16 | 24 | 32 | 8 | 16 | 24 | 32 |
| Salt solubility (%TN) | 66.07 | 61.82 | 54.32 | 50.56 | 48.12 | 60.74 | 56.30 | 53.41 | 51.58 |
| PV (milli moles/100 g.) | 7.98 | 13.17 | 19.21 | 24.68 | 29.90 | 10.82 | 15.97 | 15.78 | 19.62 |
| FFA (% oleic acid) | 1.53 | 2.98 | 3.38 | 4 27 | 5.03 | 2.54 | 2.71 | 2.89 | 3.20 |
| Odour | G | G←F | F (Sl. rancid) | P (Sl. rancid) | P | G | G | G→F | F |
| Texture | G | G←F | F (Sl. tough) | P (Tough and fibrous) | P | G | G←F | G→F | F (Sl. Tough) |
| Flavour | G | G←F | F←P | P | P | G | G←F | G→F | F |

TABLE II

Bio-chemical and Organoleptic changes in frozen seer fillets during frozen storage

| Ice storage period before freezing | Storage in weeks | Salt solubility (%TN) | PV (Milli moles) 10 g. | FFA (% oleic acid) | Odour | Texture | Flavour |
|---|---|---|---|---|---|---|---|
| 0 | Fresh | 66.07 | 7.98 | 1.53 | G | G | G |
| | 8 | 60.74 | 10.82 | 2.54 | G←F | G←F | G←F |
| | 16 | 56.30 | 15.97 | 2.71 | G→F | G→F | G→F |
| | 24 | 53.41 | 15.28 | 2.89 | F | F | F |
| | 32 | 51.58 | 19.62 | 3.20 | F (Sl. rancid) | F (Sl. tough) | F |
| 3 | Fresh | 64.71 | 10.90 | 1.57 | F | G←F | G←F |
| | 8 | 61.27 | 15.23 | 2.18 | F | F | F |
| | 16 | 54.82 | 17.21 | 2.97 | F | F←P | F |
| | 24 | 50.91 | 20.16 | 3.78 | F←P (Sl. rancid) | F→P (Sl. tough) | F←P |
| | 32 | 49.82 | 26.51 | 3.87 | P (raacid) | P (tough) | P |
| 5 | Fresh | 60.24 | 13.37 | 2.50 | F | G→F | F |
| | 8 | 56.18 | 15.28 | 3.01 | F | F | F |
| | 16 | 52.31 | 20.19 | 3.35 | F→P | F←P | F←P |
| | 24 | 48.78 | 25.24 | 4.21 | P (rancid) | P (tough) | P |
| | 32 | 49.92 | 32.87 | 4.99 | P | P | P |
| 7 | Fresh | 54.76 | 17.71 | 2.88 | F | F | F |
| | 8 | 48.73 | 21.82 | 3.66 | F | F | F←P |
| | 16 | 49.85 | 26.51 | 3.60 | F→P (rancid) | F→P (tough) | F→P |
| | 24 | 44.38 | 32.87 | 5.11 | P | P | P |
| | 32 | 42.70 | 36.79 | 6.64 | P | P | P |

than in fish of low fat content, but is still temperature dependent. FFA of samples stored at -10°C was 5.03% after 32 weeks of storage while it was 3.20% for samples stored at -23°C, after the same period of frozen storage.

Results of protein denaturation also indicated that there was slight increase in the rate of protein denaturation of the samples stored at -10°C than at -23°C. Similar changes were observed by Dyer *et al* (1956), and Shenoy and Pillai (1971).

Influence of different pre-freezing ice storage periods on subsequent shelf-life at -23°C.

The initial colour fading was noted after 24 weeks for samples frozen fresh as compared to 20, 16, and 12 weeks for samples held in ice for 3, 5 and 7 days, respectively, before freezing. Textural changes were also evident earlier in samples stored in ice for longer periods. Toughness of the cooked muscle was noted after 12 weeks in samples stored in ice for 7 days and after 16 and 20 weeks in samples iced for 5 and 3 days, respectively, while toughness was not significant in uniced samples, even after 32 weeks of frozen storage. Results of taste panel studies of the cooked muscle are reported in Table II. It could be seen that while uniced seer fillets were acceptable even after 32 weeks of frozen storage, the shelf-life of the fillets with pre-freezing ice storage periods of 3, 5 and 7 days was 24, 20 and 16 weeks, respectively.

In spite of the comparatively high fat content in seer the changes in the lipid fraction was not appreciable as in other fatty fishes like sardine and mackeral, during frozen storage. PV and FFA contents progressively increased during frozen storage and these changes were more rapid in samples stored in ice for longer periods before freezing, as is evident from Table II. The development of FFA was faster during the initial stages of frozen storage.

The results of protein denaturation of frozen seer indicated that protein denaturation did occur in frozen seer during storage and that there existed a relationship between the protein denaturation and development of FFA, during storage as suggested by Dyer and Fraser (1959) and Olley and Lovern (1960). Protein denaturation progressed rapidly during the initial period of frozen storage and towards the end the rate of protein denaturation was comparatively slow. The rate of protein denaturation was slightly more in samples stored in ice for longer periods, prior to freezing. Shenoy and Pillai (1971) also reported similar observations in frozen stored sardine.

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