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Quality Changes during Ice Storage of Fishes Indian Mackerel (*Rastrelliger Kanagurta*) and Pink Perch (*Nemipterus Japonicus*) During Summer Season

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Abstract:
The quality changes of Indian mackerel and Pink perch were examined ice storage for the suitability to prepare final quality products. The fishes were stored in the insulated box by keeping the fishes in iced condition to maintain the temperature 0°C for a period of 48 hrs for canned products and 6 days for smoking and freezing products. The quality changes of fishes were examined at different time intervals 0 day, 2 days, 4 days, 6 days and up to 8 days. The quality assessments of fishes were observed with different Quality Index Method (QIM) which includes sensory evaluation, physical, chemical and microbiological analyses. In the sensorial evaluation after 2 days of storage the fishes which were stored in ice condition; Pink perch was found excellent quality whereas mackerel fishes stored at iced condition was observed with partially degraded quality during the study period. The product prepared using these fishes were found to be excellent quality of end products. The pH values of fishes stored in different temperature were increased slowly during storage up to 6 days in case of mackerel and 8 days in case of pink perch. The pink perch were found less Total Plate Count when compared to that of mackerel. The quality index observed in the sensory evaluation is reflected with microbial observation.

1. Introduction

Indian Mackerel and pink perch is important edible fish with wide distribution in the country, supporting good fishery especially along the South West Coast of India, abundant catches were landed only from the states like Gujarat, Maharashtra and Karnataka. High level of hypoxanthine production in mackerel was found during storage which leads to health problem for consumers when compared to that of pink perch. Increasing demand for seafood products and consumer preferences of sea food quality has called for better quality of seafood products. However, the extremely perishable nature of seafood products makes this difficult (Miget, 1991). Many factors influence consumer acceptance of seafood products, including obvious factors such as taste, odour and appearance (Marshall and Lehigh, 1993). Fish freshness is the most important and fundamental single criterion for judging the quality of fish and fishery products (Rodriguez-Jerez *et al*., 2004). Aquatic food products deteriorate rapidly post-mortem due to the effects of a variety of degradation mechanisms (Pigott & Tucker, 1987; Sikorski & Bonnie, 1994). In developing countries, fishes form an important diet and there is a recognizable trend for the poor to spend proportionately for animal protein such as fish rather than other meat products. Fish has a reputation of being quickly perishable than other protein foods (Bongess and Shewan, 1970). Psychro tolerant spoilage bacteria have the ability to grow during chilled storage; autolysis enzymes are also present which causes the rapid development of undesirable odours and flavors (Dalgaard, 2000 and Silvertsvik *et al*., 2002). The quality of seafood is dependent upon the degree of spoilage or product decomposition. Several methods of evaluating seafood product freshness have been employed including sensory, microbiological, chemical or physical properties (Botta, 1994). Currently, the most common methods used to judge seafood quality are microbiological and sensory analysis (Marshall and Lehigh, 1997). It is important for anyone concerned with fish processing to be able to measure the amount of deterioration that has occurred since it was caught. There are, however, many occasions when it is necessary to assess quality at some intermediate stage of deterioration; absolutely fresh fish commands a better price than fish that is less fresh but still not stale or fish should be checked before packaging to ensure that it will not become stale when distributed and displayed (FAO, 2005). Time passed after catch and the temperature "history" of fish is considered to be the key factor determining the final quality characteristics of a fish product (Olafsdottir *et al*., 2004). However, there has been considerable research carried out on temperate water fish and spoilage patterns of fish have been well-documented (Shewan, 1961; Banwart, 1981; Howgate, 1982; Connell, 1990 and Huss, 1994). There has been little research conducted on spoilage trends and microbiological standard limits in tropical fish. Consequently, there is limited information available on seafood, mostly shrimps in Indian waters. Quality evaluation of fishes has more to do with the determination of its shelf life or storage life which is the amount of time that sea foods remain pleasant.

Shelf lives of individual fish species tends to vary depending on the oil levels, catch area, season, duration of rigor mortis, intrinsic conditions of the fish and the way it was captured and handled (Huss, 1995). The shelf life of most marine fishes have been predicted to range between 2-24 days in ice, 5 days at 5°C and 3 days at 10 °C (Huss, 1995). Developing countries like India can't afford to lose their production of fishes because of the fast growing population. If such losses are avoided by proper storage and strict hygienic measures then it could help in not only in meeting the nutritional requirements of the people but also in earning foreign exchange by exporting the surplus. This will also be helpful to create awareness regarding the losses caused by microbes among the fisher folks, vendors and consumers. During the periods of heavy catch, most of the times the seafood processor can't process the whole lot, the same day they received them. It is essential to keep them in ice or in chilled storage immediately after its catch and also the marketing of fish in India is mostly carried out by the local fish sellers in the chilled or refrigerated condition. Therefore knowledge of spoilage patterns of tropical fishes and their self life determination at various storage temperatures is very essential. Icing the fishes immediately after caught is very important to make the final quality of the product in a better way because they are used by most of the households in India for temporary storage of fishes. Hence, the present study has been focused to monitor the quality changes in its self life in relation to different products prepared using ice stored fishes.

2. Materials and Methods

Indian Mackerel (*Rastrelliger kanagurta*) and Pink perch (*Nemipterus japonicus*) immediately after caught from the Trawler operated along the Mangalore coast off Karnataka was brought to the fish processing laboratory for preservation in the ice storage. Time interval between landing centre to the fish processing laboratory was around 1-2 hrs during which samples were iced in the insulated boxes separately. They were immediately brought to the laboratory in a sterilized container and were washed in potable water (30°C). Fish samples were identified by using FAO fishery species identification sheets. During sensory evaluation the fishes were partially cooked with removed gills and guts, and the flesh was separated. After its sensory evaluation both the variety of fishes were used for different product preparation. A sample has been kept in insulated storage temperatures to maintain 0°C by using ice and potable water to know its shelf life of the final quality products prepared by using these two varieties of fishes during summer season.

3. Experimental Results

Fish Parameters	Mackerel	Pink perch
Average total length (cm)	20.70 (± 0.50)	17.5 (± 0.40)
Average total weight (g)	215.0 (± 3.00)	90.5 (± 0.50)
Dressing Yield (%)	66.10 (± 0.20)	56.11 (± 0.21)

Table: 1 Physical characteristics of the raw material used during summer season
( ) Values in the brackets indicates standard deviation, n=3

3.1. Physical Characteristics of the Raw Material Used During Summer Season:

Physical characteristics of *Rastrelliger kanagurta* and *Nemipterus japonicus* used for the study are presented in the Table 1. Physical characteristics of the fishes such as average weight, total length and dressed yield of mackerel and pink perch were observed to be 215.0 g, 20.70 cm and 66.10 % and 90.5 g, 17.5 cm and 56.11 % respectively found during summer season.

Parameters	Characteristics	Demerit points	Mackerel (Days)				Pink perch (Days)				
			0	2	4	6	0	2	4	6	8
Skin surface	Bright shining Not Lustourus Discolored	0 1 2	1.00	1.00	1.25	1.25	0.50	0.50	0.75	1.00	1.50
Slime	Aqueous transparent Slightly Mucous Milky Mucous Opaque Mucous	0 1 2 3	0.50	1.00	2.00	2.50	0.50	0.75	1.00	1.75	2.50
Eyes	Translucent cornea Slightly Opalescent Opalescent Cornea	0 1 2	0.50	0.75	1.00	1.25	1.00	1.25	1.25	1.50	1.50
Odor	Fresh Oil, Peppery oily Aromatic Musty Slightly rancid Rancid faecal	0 1 2 3 4	1.00	1.50	1.75	2.50	0.50	0.75	1.00	1.50	2.50
Mucous	No Mucous Trace of mucous Excessive mucous	0 1 2	0.50	0.75	1.00	1.25	1.00	1.25	1.25	1.25	1.50
Flesh stiffness	Rigor Post rigor	0 1	0.50	0.75	0.75	0.75	0.50	0.50	0.50	0.50	0.50
Gills	Reddish translucent Less colored Waxy	0 1 2	0.50	1.00	1.50	1.50	0.50	1.00	1.00	1.00	1.00

Table: 2 Freshness quality changes in mackerel and pink perch during ice storage in summer season.

3.2. Freshness Quality Changes in Mackerel and Pink Perch during Ice Storage in Summer Season

Iced fishes were evaluated once in 2 days for sampling by expert panelists from the laboratory, trained in grading fresh fish according to the European Community (EC) grading scheme (Howgate *et al*., 1992). Sensory evaluation was conducted in individual booths under controlled conditions of light, temperature and humidity. The appearance of skin, eyes, gills, peritoneum and internal odours of each fish were assessed into four quality grades. In this EC grading scheme, excellent quality (perfect condition), high quality (slight loss of excellent characteristics), good quality (some deterioration but fit product preparation) and unfit for keeping no longer. The total grade of each fish was estimated from the grades attributed by each panelist and the final grade of each fish species was estimated from the fish examined once in two days of evaluation. Each sensory parameter was also scored on a scale of 0, 1, 2, 3 & 4, before the results of sensory evaluation were subjected. An average score (sensory score) for all observed parameters like Skin surface, Slime, Eyes, Odour, Mucous, Fish stiffness and Gills were made on both the types of fishes.

Storage Days / Parameters	Mackerel (Days)				Pink perch (Days)				
	0	2	4	6	0	2	4	6	8
Proximate composition									
Moisture (%)	71.14 (± 0.86)	73.12 (± 0.70)	74.77 (± 0.87)	76.12 (± 0.43)	76.40 (± 0.95)	77.82 (± 0.54)	79.40 (± 0.50)	80.98 (± 0.02)	82.01 (± 0.46)
Crude protein (%)	21.13 (± 0.62)	20.04 (± 0.06)	19.55 (± 0.25)	18.44 (± 0.24)	20.12 (± 0.65)	19.00 (± 0.22)	17.54 (± 0.41)	16.22 (± 0.24)	15.04 (± 0.08)
Crude fat (%)	6.11 (± 0.09)	5.34 (± 0.12)	4.35 (± 0.09)	4.22 (± 0.01)	1.90 (± 0.02)	1.75 (± 0.05)	1.65 (± 0.03)	1.52 (± 0.07)	1.34 (± 0.06)
Ash content (%)	1.60 (± 0.05)	1.50 (± 0.10)	1.33 (± 0.07)	1.21 (± 0.11)	1.54 (± 0.04)	1.43 (± 0.03)	1.40 (± 0.05)	1.28 (± 0.02)	1.02 (± 0.09)

Table: 3 Changes in the proximate characteristics of mackerel and pink perch stored in iced condition during summer season.

3.3. Changes in the Proximate Characteristics of Mackerel and Pink Perch Stored in Iced Condition during Summer Season

The proximate composition of fresh mackerel and pink perch (0 days) used for the study showed that the moisture , protein, fat and ash levels were 71.14% & 76.40%, 21.13% & 20.12%, 6.11% & 1.90% and 1.60% & 1.54% respectively (Table 3). Where as in case of 6 and 8 days of mackerel and pink perch are concerned the proximate composition found in the form of moisture, protein, fat and ash level was 76.12% & 82.01%, 18.44% & 15.04%, 4.22% & 1.34% and 1.21% & 1.02% respectively during summer season (Table-3).

Storage Days / Parameters	Mackerel (Days)				Pink perch (Days)				
	0	2	4	6	0	2	4	6	8
Chemical characteristics									
TVB-N (mg%)	7.20 (± 0.22)	9.12 (±0.10)	12.85 (±0.41)	17.91 (±0.09)	6.89 (±0.21)	6.88 (±0.12)	10.49 (±0.05)	15.25 (±0.05)	17.92 (±0.10)
TBA(mg malonaldehyde / kg meat	0.242 (± 0.01)	0.292 (±0.01)	0.252 (0)	0.392 (0)	0.214 (0)	0.254 (±0.01)	0.294 (0)	0.344 (±0.01)	0.584 (±0.02)
SSN (% of total nitrogen)	64.45 (± 0.37)	62.10 (±1.00)	61.50 (±0.50)	60.80 (±0.20)	57.23 (±0.25)	55.22 (±0.78)	54.88 (±0.02)	53.66 (±0.46)	52.14 (±0.52)
Total Nitrogen (g / 100 g meat)	3.38 (± 0.06)	3.20 (±0.18)	3.12 (±0.06)	2.95 (±0.07)	3.21 (±0.07)	3.04 (±0.08)	2.80 (±0.05)	2.59 (±0.03)	2.40 (±0.10)

Table: 4 Changes in the bio-chemical characteristics of mackerel and pink perch stored in iced condition during summer season**.**

3.4. Changes in the Biochemical Characteristics of Mackerel and Pink Perch Stored in Iced Condition during Summer Season

The biochemical composition of fresh mackerel and pink perch (0 days) used for the study showed that the TVB-N (mg %), TBA (mg malonaldehyde/kg meat), Salt Soluble Nitrogen (SSN) and Total Nitrogen (g/100 g meat %) levels were 7.20, 0.242, 64.45& 3.38 and 6.89, 0.214 and 57.23 & 3.21 respectively (Table 4). Where as in case of 6 and 8 days of mackerel and pink perch are concerned the biochemical composition found in the form of TVB-N (mg %), TBA (mg malonaldehyde/kg meat), Salt Soluble Nitrogen (SSN) and Total Nitrogen (g/100 g meat %) levels were 17.91, 0.392, 60.80 & 2.95 and 17.92, 0.584 and 52.14 & 2.40 respectively (Table 4).

4. Discussion

The sensory evaluation of freshness of fish stored under iced condition during winter season forms an important factor in the development and standardization of various methods of processing for the preservation of fish and to maintain the quality of fishery products. The prepared products are not discussed in this part.

Changes in physical characteristics of mackerel and pink perch stored in iced condition are tabulated in the Table 2. Physical characteristics of *Rastrelliger kanagurta* and *Nemipterus japonicus* used for the study are presented in the Table 1. Physical characteristics of the fishes such as average weight, total length and dressed yield of mackerel and pink perch were observed to be 215.0 g, 20.70 cm and 66.10 % and 90.5 g, 17.5 cm and 56.11 % respectively found during summer season. Similar observations were made by Aubourg *et al*. (2002), with a total length between 18-24 cm, weight range between 250-280g and dressed yield between 65-72% for mackerel. Whereas, in case of pink perch the total length, average weight and dressed yield of the present study is holds good with the earlier author Reddy *et al*., 1990.

Proximate composition of fish and shellfish depends on several factors like diet, size sex, physiological state of fish and ecological conditions (Conell, 1975). The proximate composition of fresh mackerel and pink perch (0 days) used for the study showed that the moisture , protein, fat and ash levels were 71.14% & 76.40%, 21.13% & 20.12%, 6.11% & 1.90% and 1.60% & 1.54% respectively (Table 3). Where as in case of 6 and 8 days of mackerel and pink perch are concerned the proximate composition found in the form of moisture, protein, fat and ash level was 76.12% & 82.01%, 18.44% & 15.04%, 4.22% & 1.34% and 1.21% & 1.02% respectively during summer season (Table-3). The values were comparable with the result of Suresh Kumar (1984) for pink perch and Aubourg *et al*. (2002) for mackerel.

In the present study the biochemical composition of fresh mackerel and pink perch (0 days) used for the study showed that the The biochemical composition of fresh mackerel and pink perch (0 days) used for the study showed that the TVB-N (mg %), TBA (mg malonaldehyde/kg meat), Salt Soluble Nitrogen (SSN) and Total Nitrogen (g/100 g meat %) levels were 7.20, 0.242, 64.45& 3.38 and 6.89, 0.214 and 57.23 & 3.21 respectively (Table 4). Where as in case of 6 and 8 days of mackerel and pink perch are concerned the biochemical composition found in the form of TVB-N (mg %), TBA (mg malonaldehyde/kg meat), Salt Soluble Nitrogen (SSN) and Total Nitrogen (g/100 g meat %) levels were 17.91, 0.392, 60.80 & 2.95 and 17.92, 0.584 and 52.14 & 2.40 respectively (Table 4) The TVB-N content, TBA, SSN and Total Nitrogen content were close to the result obtained by Suresh Kumar (1984) for pink perch and the values of the above parameters for mackerel were close to the result of Aubourg *et al*., 2002 and Okeyo *et al*., 2009.

5. Conclusion

During summer season the work carried out in the above study reveals that differences were noticed in the fresh and iced fishes like mackerel and pink perch. The evaluation of the fishes stored in ice at different time period with all iced samples under insulated boxes were found better in case of lean variety of fishes when compared to fatty fishes like mackerel. It is due to the fat content which more prone to oxidation when compared to lean variety of fishes. Hence, the time elapses the degradation of the quality of fishes will also

increase due postmortem changes and also due to the microbial activity. The higher the storage temperature, the faster is the spoilage. The freshness of fishes differs from the raw materials to stored one. The maximum freshness and minimal microbial load was observed in fishes stored at for a period between 0-2 days .The quality of fishes was inversely proportional to time and temperature was observed. Hence, the present findings suggest that maintaining of time and temperature during processing and storage is useful to maintain uniform freshness and quality of seafood products during summer season.

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