Coastal Fishery Resources of India

Conservation and Sustainable Utilisation

Society of Fisheries Technologists (India)

Cochin ◆ India

Coastal Fishery Resources of India: Conservation and Sustainable Utilisation

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URL : www.fishtech.org
Phone : 91 (0)484-2666845
Fax : 91 (0)484-2668212
Telegram : FISHTECH / MATSYAOUDYOGIKI
E-mail : cift@ciftmail.org
enk_ciftaris@sancharnet.in

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Editors

B. Meenakumari
M.R. Boopendranath
Leela Edwin
T.V. Sankar
Nikita Gopal
George Ninan

Society of Fisheries Technologists (India)
P.O. Matsyapuri, CIFT Junction, Cochin - 682 029, India

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Shelf Life Assessment of Ready to Cook Indian Mackerel under Iced Condition

Sunil Hassan, Anju, C.S. Jyothi, A.A. Zynudheen*, T.V. Sankar C.N. Ravisankar, K.V. Lalitha and M. Nasser

Central Institute of Fisheries Technology
P.O. Matsyapuri, CIFT Junction, Cochin - 682 029, Kerala, India
**E-mail: zynu@rediffmail.com*

In India, fisheries sector has a vital role in income enhancement, poverty alleviation, and food security. A range of value added products like ready to cook and ready to fry products are slowly becoming popular as convenience food in the wake of changing lifestyle of consumers. Fish is a highly perishable product subject to spoilage during storage. During chilled storage of fish, significant deterioration of sensory quality and loss of nutritional value have been reported as a result of changes in chemical constituents leading to diminishing commercial value (Ashie *et al.,* 1996; Olafsdottir *et al.,* 1997; Whittle *et al.,* 1990). This degradation process is carried out in the initial stage by muscle enzymes and later by microbial enzymes. The rate of alteration depends on factors such as the nature of the fish species, size, lipid content, and condition of fish during capture, nature of the microbial load, and storage temperature.

The present study was undertaken to develop value added chilled convenience products from mackerel and to assess the shelf life of product in chilled conditions by evaluating the chemical, microbiological and sensory properties.

Materials and Methods

Indian mackerel (*Rastrelliger kanagurta*) was purchased in early post rigor condition from the local market and brought to the laboratory in iced condition. Mackerel (weight 160±20 g and length of 22±4 cm) were immediately washed, gutted and divided into two lots. Lot-I was taken as control without any treatment whereas lot-II was treated with condiment mixture (chilly, turmeric and salt in 2:2:1 proportion). Both the lots were packed in polyethylene bags (25x20 cm) and stored in iced condition. Periodically samples were drawn from both lots for biochemical, sensory

and microbiological analyses. Moisture, crude protein, fat and ash were determined according to the methods of AOAC (1995). Free fatty acid value and peroxide value were estimated according to AOAC (1995) and thiobarbituric acid was determined according to Yu and Sinhuber (1957). Ten per cent tri-chloro acetic acid extract was used to estimate non-protein nitrogen (AOAC, 1995), total volatile base nitrogen (Conway, 1947), and alpha amino nitrogen (Pope and Stevens, 1939). Microbiological analyses were carried out using USFDA (2001) method. Sensory evaluation was carried out using overall acceptability score on a nine point hedonic scales (Joseph, 2003) where the product was considered unacceptable if score was below 4.

Results and Discussion

Proximate composition of Indian mackerel is given in Table 1. The composition of a particular species often appears to vary from one fishing ground to another, and from season to season, but the basic causes of change in composition are usually variation in the amount and quality of food that the fish eats and the amount of movement it makes.

Table 1: Proximate composition of Indian mackerel

Proximate composition	%
Moisture	70±1.02
Protein	22.6±0.19
Lipids	6.3± 0.12
Ash	1.4±0.09

Change in PV during chilled storage of lot-I and lot-II sample are given in Fig. 1a. The PV of both the samples remained steady till 5th day of the storage period. Lot-II showed an initial PV of 12.28 meq $O_2.kg^{-1}$ of fat which increased to 20 meq $O_2.kg^{-1}$ of fat on the third day and then decreased to 18.6 meq $O_2.kg^{-1}$ of fat on the fifth day. Similar pattern was observed in the lot-I where PV decreased from initial 17.72 meq $O_2.kg^{-1}$ of fat to 8.26 meq $O_2.kg^{-1}$ of fat. The decreased PV observed with extended storage time was presumed to be due to the decomposition of hydro peroxide. PV of lot-II showed higher values in comparison with lot-I. This may be due to the antioxidant property of condiments incorporated

in the sample. Lipid oxidation is a complex process in which unsaturated fatty acids react with molecular oxygen, usually via a free radical mechanism, to form hydro peroxides, the primary oxidation products (Simic and Taylor, 1987). Hydro peroxides break down in several steps, yielding a wide variety of decomposition products, including aldehydes (Nawar, 1996).

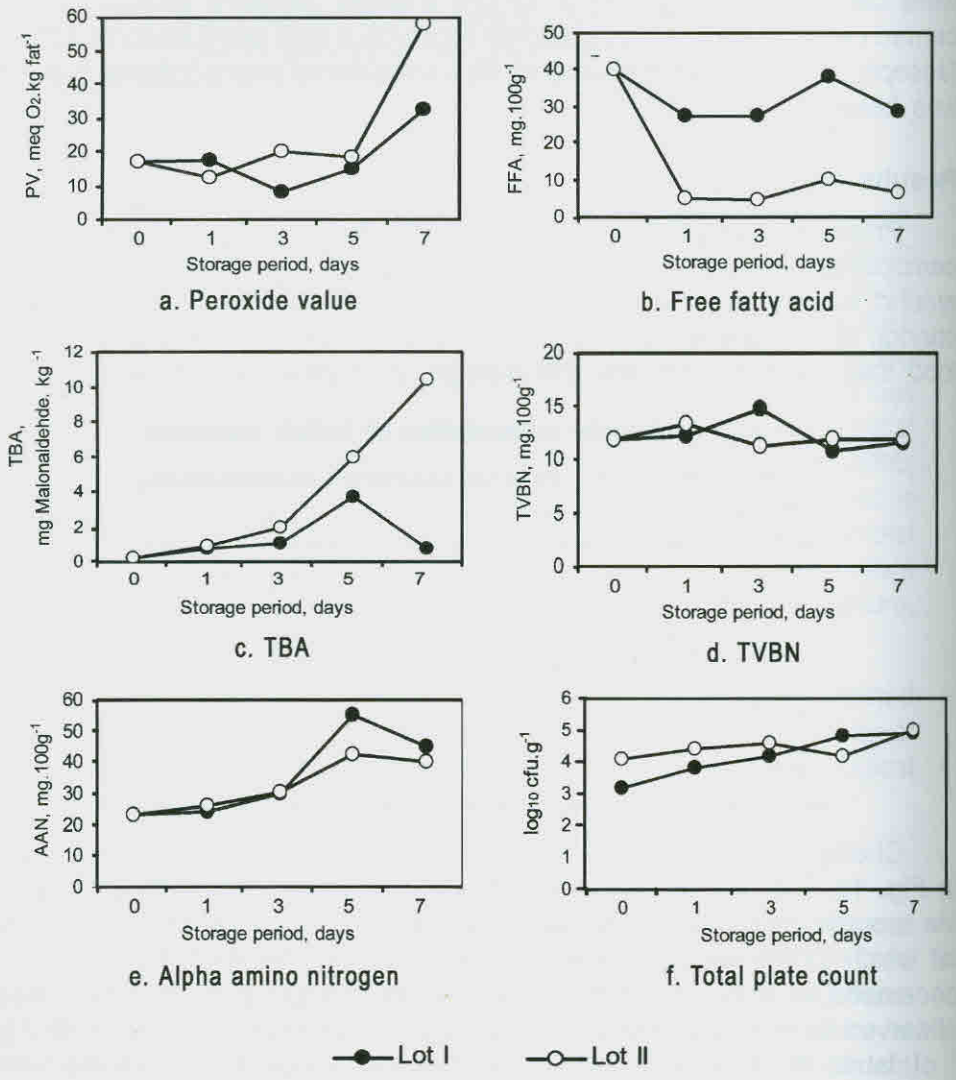

Fig.1: Changes in (a) Peroxide Value, (b) Free Fatty Acid, (c) TBA, (d) TVBN, (e) AAN, and (f) TPC of Indian mackerel during chilled storage

Changes in FFA of two lots during iced storage are depicted in Fig.1b. During the initial day sample shown 40 mg.100g^{-1}. Lot-II showed 5.04 mg.100g^{-1} on 1st day which increased to 10.17 mg.100g^{-1} on 5th day. Lot-I showed similar pattern of increase from 27.49 to 38. mg.100g^{-1}. This might be due to higher rate of lipid hydrolysis in lot-II than lot-I. In the case lot-II incorporation of condiments could have inhibited the hydrolytic reaction in processed fish. Possibly, lipid hydrolysis occurred to a great extent at the end of the storage period. Hydrolysis of glycerol–fatty acid esters is one important change that occurs in fish muscle lipids post-mortem with the release of free fatty acids. This is catalyzed by lipases and phospholipases (Pacheco-Aguilar *et al.*, 2000). In general, lipase activity is greater in dark muscle than in ordinary muscle of the same fish species (Foegeding *et al.*, 1996). Since the whole fish were stored in ice, lipases from internal organs might be released into muscle, where lipids are localized. Intestinal lipase was found in sardine oil (*Sardinella longiceps* Linnaeus) (Nayak et al., 2003). Kolakowska *et al.*,(2002) also found active phospholipase in fish pyloric caeca. In addition, extra cellular lipase, produced by certain micro organisms such as *Pseudomonas fragi* also contribute to the lipolytic breakdown of fish lipids (Nayak *et al.*, 2003).

The changes in TBA during chilled storage of both samples are represented in Fig 1c. TBA test gives an indication of extent of oxidative rancidity. In the present study, TBA value of both the samples increased during storage. TBA value of lot-I is lower than lot-II. The marked increase in TBA for lot-I from 3rd to 5th day and lot-II from 1st to 3rd day was coincidental with the decrease in PV. This was probably due to the destruction of hydro peroxide into secondary oxidation products, especially aldehydes in later stages of lipid oxidation. Schonmuller, (1968) reported that maximum level of 5 mg malonaldehyde.kg^{-1} of TBA value indicates good quality of chilled and frozen fish while fish may be consumed up to 8 mg malonaldehyde.kg^{-1} of fish. Chaijan *et al.*, (2006) reported increase in TBA of sardine meat during iced storage.

TVB-N values of both the samples are given in Fig. 1d. TVB-N values for both the samples did not show much variation. Values ranged between 11.0- 14.0 mg.100g^{-1}. This might be due to the low bacterial count during storage period. Many workers reported good correlation between total bacterial count and TVB-N levels. TVB-N is mixture of compounds produced during spoilage of fish and may more nearly indicate the decomposition of mixed bacterial flora. TVB-N reflects only stages of advanced spoilage and is considered unreliable for the measurement of

spoilage during the first 10 days of cod's ice storage as well as for several other species (Huss, 1999). The TVB-N at which fish becomes unacceptable has been determined for some fish species. Some of the values reported are 25–35 mg.100g^{-1} for sardines (Ababouch *et al.,* 1996; Marrakchi *et al.,* 1990). Level of 30–35 mg.100g^{-1} flesh are generally regarded as the limit of acceptability for ice stored cold-water fish (Connell, 1995 and Huss, 1988)

Fig. 1e represents the changes in alpha amino nitrogen (AAN) of both the samples during chilled storage. In both the lots, there is gradual increase of AAN. Lot-II showed an increase from 23.45-42.5 mg.100g^{-1} during the 1st five days. Lot-I showed comparatively higher value of 54.95 mg.100g^{-1} on the fifth day and then decreased to 44.8 mg.100g^{-1}. This may be due to breakdown of protein into polypeptides and free amino acids.

Bacteriological profiles of both lots are represented in Fig. 1g. In both lots initially a slight decrease was observed. Lot-I showed decrease in total plate count (TPC) from 3.2x10^5 cfu.g^{-1} to 3.84x10^4 cfu.g^{-1} whereas lot-II showed decreased TPC of 4.10x10^4 cfu.g^{-1}. In the case of lot-I reduction in TPC may have been due to the lowering of temperature which would have eliminated the mesophilic microorganisms. In lot-II combined action of condiments and low temperature would have arrested growth of microorganisms. There was steady increase in TPC from 1st to 7th day. Compared to control treated sample showed higher TPC. This might be due to microbial contamination in spices purchased from market. Another observation was absence of fungus in raw material and lot-I but its presence in lot-II. This might be due to the quality of spices used. Majority of oils and spices are classified as generally recognized as safe (Kabara, 1991). Their use in food is limited due to flavor considerations, as effective antimicrobial doses may exceed organoleptically acceptable levels.

The pattern of scoring for both samples is given in Fig. 2. Acceptance testing was used to determine how much each sample was liked based on a 9-point hedonic scale for a set of attributes: overall liking, flavor, and texture where 9=like extremely and 1=dislike extremely. The rate of scoring is correlated with storage time. The score of the product greater than 5 is considered as acceptable. Lot-II showed higher score than lot-I. The score of the lot-I showed 4.33 on 5th day while lot-II showed 5.56 which is an acceptable score. Shelf life of lot-I was found to be 5 days and lot-II was 7 days.

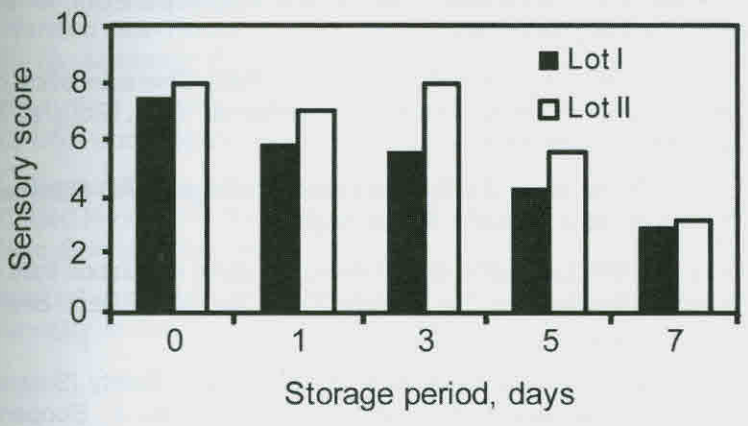

Fig. 2: Changes in sensory score of Indian mackerel during chilled storage

Conclusion

Shelf life of dressed Indian mackerel (*Rastrelliger kanagurta)* was found to be 5 days and that of condiment incorporated was 7 days, under iced conditon. The study finds out condiment incorporation can enhance the shelf life of product.

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