

Changes in K Value and Biogenic Amines During Storage of Atlantic Mackerel (*Scombes scomberus*) in Ice

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Determination of K value in conjunction with sensory evaluation serves as a good index of the freshness of fish. In this study, the above parameters were used to determine the freshness of Atlantic mackerel (*Scombes scomberus*) during storage in ice. K value showed a steady increase from 23 to 78 during ten days of storage in ice. No biogenic amines such as putrescine, cadaverine, tyramine, spermine and spermidine were detected in the fish during this period

Key words: K value, biogenic amines, demerit scoring, nucleotides

Freshness may be considered synonymous with quality. Many methods are available for estimating the freshness and quality of fish (Uchiyama & Ehira, 1970, Tinker *et al.* 1986). Though objective indices such as volatile base nitrogen and trimethyl amine nitrogen are used to estimate the freshness of fish, these indices can be more useful in the latter stages of spoilage. Nucleotides and their breakdown products such as hypoxanthine have been proposed as indices of freshness in the early stages of deterioration (Jones *et al.*, 1964; Dugal, 1967; Fatima *et al.*, 1981) and according to Ehira (1976), K value is one of the most appropriate indicators of freshness. The K value of a number of species has been determined during post mortem changes (Ehira & Uchiyama, 1986; Ryder, 1984; Lakshmanan *et al.*, 1993) and it was found to be a useful index for estimating the freshness of fish.

Many biogenic amines such as histamine, putrescine, cadaverine etc. are formed during the latter stages of spoilage by the bacterial decarboxylation of amino acids (Taylor & Sumner, 1986; Eitenmiller *et al.*,

1981; Wendakoon & Sakaguchi, 1992). Among these, histamine has been implicated in many instances of scombroid fish poisoning. Though other amines are not toxic, they may potentiate the toxicity of histamine (Wendakoon & Sakaguchi, 1992).

The purpose of the present study was to determine the K value, estimate the level of biogenic amines formed and find out the correlations between these parameters and shelf life of Atlantic mackerel (*Scombes scomberus*) during storage in ice.

Materials and Methods

Mackerel used in this study was collected from a fishing boat operated in the English Channel. All the samples were in rigor and these were packed in insulated boxes with an equal quantity of ice and brought to the laboratory for studies within six hours.

The period of ice-storage was counted from the day of capture. Fish were sampled on 0,3,5,7,9 and 10th day. At each sampling, three randomly chosen fish were selected. The fish were examined for changes in

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general appearance and demerit scoring was carried out (Bremner *et al.*, 1986). The samples were then used for determination of K value and estimation of biogenic amines.

Skinned fillets from sampled fish were packed in individual plastic bags and frozen at -30°C until analysis. Samples were taken from the frozen skinned fillets for analysis of nucleotides and the remainder of each fillet was packed under nitrogen and left to thaw overnight at 4°C . Five grams of frozen muscle were homogenized with 50 ml chilled 0.6 M perchloric acid at 0°C for one minute using an Ultra-Turrax homogenizer. The homogenate was centrifuged at $3000 \times g$ for 10 min and the pH of 10 ml aliquot of supernatant was adjusted to 6.5 - 6.8 with 0.1 M potassium hydroxide. After keeping at 4°C for 30 min, the neutralized extract was made up to 20 ml, filtered through a filter paper and stored at -70°C for further analysis. The extracts prepared as above (after thawing) were passed through 0.45μ millipore filters and 20μ l aliquots were injected into a HPLC system equipped with a Water Bondapak C-8 column. A mobile phase consisting of 0.04-M KH_2PO_4 and 0.06-M K_2HPO_4 was used and fractions were detected by UV absorbance at 254 nm (Ryder *et al.*, 1984). Base line separation of Adenosine 5' monophosphate (ATP), Inosine 5' monophosphate (IMP) and hypoxanthine was accomplished within 20 min. K value was determined according to Saito *et al.*, (1959) and Kennish & Krammer (1987).

Thawed fillets were diced finely and mixed thoroughly. 10g of samples were subsequently used for determination of biogenic amines using HPLC (Suzuki *et al.*, 1990). 10 g diced fillets were homogenized with 90 ml of 5% trichloro acetic acid. The homogenate was filtered and dansyl derivatives of extracted amines were prepared using dansyl (5-dimethylaminonaphthene-1-sulphonyl) chloride (Hayman *et al.* 1985).

They were separated on a HPLC equipped with 5μ C-8 analytical column using methanol and water (70:30) as the mobile phase. Dansylated amines were detected in the eluent at 254 nm.

Results and Discussion

The mean weights of Atlantic mackerel used for this study were 386-437 g and length, 31-35.5 cm. Values of demerit score increased from 17 at the beginning to 33 after 10 days of storage of the fish in ice (Table 1). Demerit scoring is a rapid system in which judgements are made on the products and the score reflects the history of the sample. During storage in ice, the fish underwent noticeable changes in the eyes, surface slime, and the appearance and odour of gill. The samples were in acceptable condition up to seven days and the score was 27 at this stage. The changes that occurred in the eyes and gills and the consequent changes in the score have potential use in the quality assessment of whole mackerel.

Table 1. Demerit score of *Scombes scomberus* during ice-storage

Storage period (days)	Average weight (g)	Average length (cm)	Demerit score
0	344.65	32.06	17.00
3	367.33	33.83	19.65
5	296.65	31.65	24.33
7	392.86	33.83	27.00
10	334.96	31.83	33.00

Fig. 1 shows the levels of ATP breakdown products in the muscle of the fish during storage in ice. The concentration of inosine and hypoxanthine increased gradually over the period of experiment and remained constant during the final stage. However, in the case of IMP, there was decrease in its concentration over the period of ten days. This is similar to change of IMP concentrations found in gourmad

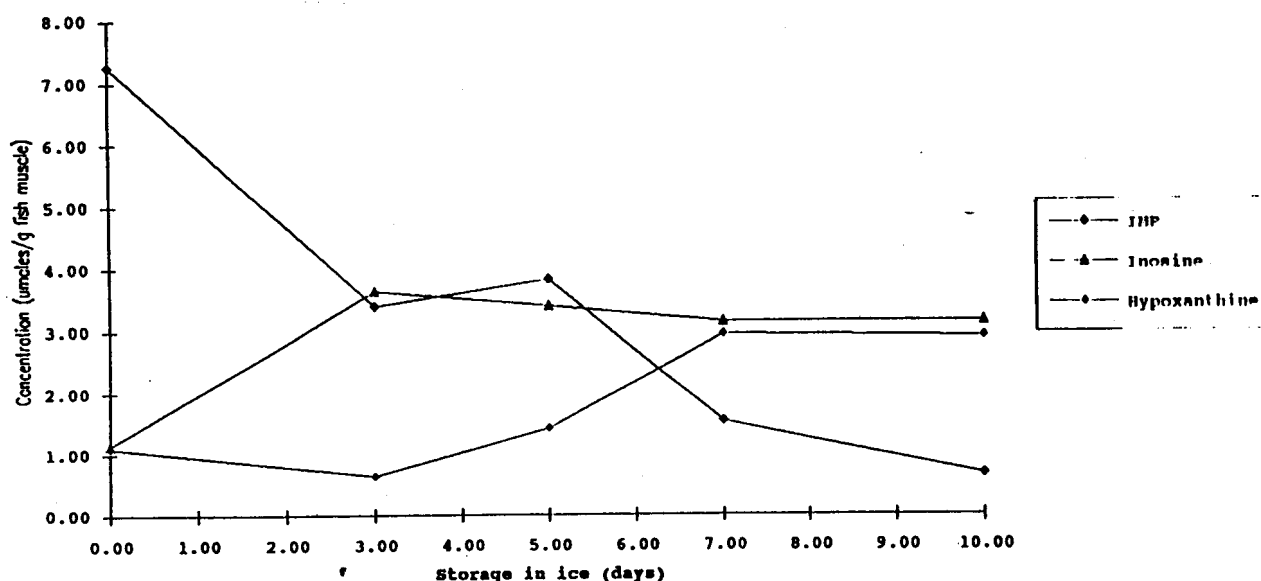


Fig. 1. Changes in the concentration of nucleotides during storage of *Scombes scomberus*.

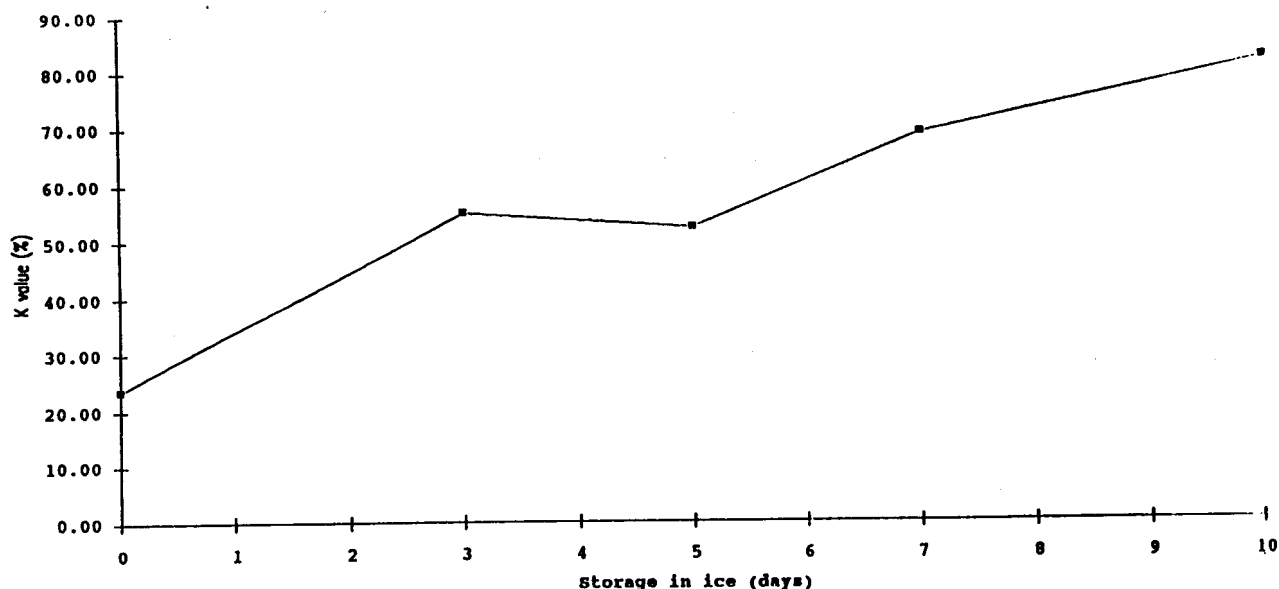


Fig. 2. Increase in K value during storage of *Scombes scomberus*.

(Ryder *et al.*, 1984), rainbow trout (Lakshmanan *et al.*, 1993) and other fishes (Ehira & Uchiyama, 1986). Fig. 2 shows increase in K value of Atlantic mackerel during ice-storage over ten days. This compares favourably with previous work on different fishes (Ochenschlager, 1992). Branch & Vail (1985) reported that relative

rates of increase in K value and demerit score were similar for two tropical species held in ice and at ambient temperatures. In the present study also it was noticed that there was a direct relation between K value and demerit score and it can be concluded that K value is an equally good index as demerit score to determine the freshness of fish.

No biogenic amines except traces of histamine were detected by HPLC during the study. These are formed by the action of bacterial enzymes (decarboxylases) on free amino acids. Biogenic amines present in fish usually do not represent any hazard unless large quantities are ingested. The absence of biogenic amines in these samples even after 10 days of storage in ice shows that these cannot be used as a reliable parameter for assessing the shelf life of Atlantic mackerel.

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