

Indole as an Index of Spoilage of Mackerel (*Rastrelliger kanagurta*) during Storage at Ambient Temperature and in Ice

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A study was conducted to find out any correlation between indole and the spoilage indices such as Tri Methyl Amine Nitrogen (TMAN), Total Volatile Base Nitrogen (TVBN) and Total Bacterial Count (TBC) during spoilage of mackerel (*Rastrelliger kanagurta*) at ambient temperature and in ice. Mackerel had a shelf life of 6 and 9 h at ambient temperature based on the sensory evaluation of whole mackerel and cooked meat respectively. After 9 h of storage at ambient temperature TVBN, TMAN and indole were only 25.2 mg/100, 5.75 mg/100 and 0.3 µg/100g respectively. The bacterial load was 5.55 log CFU/g. Mackerel had a shelf life of 6 and 9 days in ice based on the sensory evaluation of whole and cooked fish respectively. TVBN, TMAN and indole were only 14.35 mg/100, 0.67 mg/100 and 0.4 µg/100g respectively. Total bacterial count was 6.36 log CFU/g. All the indices studied were low when the mackerel was rejected but this was specially true of indole which was detected in negligible amounts through out the storage period and also showed no trend through out. So indole was found to have no significance as an index of spoilage of mackerel kept at ambient temperature and in ice.

Key words: Indole, spoilage, mackerel, storage

Indole is a metabolite essentially present in putrid fish. It is formed by the action of the bacterial enzyme tryptophanase on tryptophan. Indole has been suggested as a satisfactory chemical index of spoilage for raw shrimp (Duggan & Strasburger, 1946) and frozen shrimp (Hellig, 1963). Indole level is used by USDA to validate the sensory evaluation of shrimp decomposition and a level of 25 µg/100g has been established as the limit (Chang *et al.*, 1983; Finne, 1992). As almost no work is available regarding the use of indole as a spoilage index of fish, the present study has been taken up to find out if there is appreciable formation of indole during spoilage of mackerel (*Rastrelliger kanagurta*) and if so, whether there is correlation between indole and the commonly used chemical indices of spoilage viz. Total Volatile Base Nitrogen (TVBN), Tri Methyl Amine Nitrogen (TMAN) and Total Bacterial Count (TBC).

Materials and Methods

Fresh mackerel (*Rastrelliger kanagurta*), in rigor condition, was collected from a nearby fish market and was iced in fish to ice ratio of 1:1 and brought to the laboratory. The sample was de-iced and divided into two lots for zero time analysis and room temperature spoilage study. Zero time analysis was immediately carried out for sensory quality, TMAN, TVBN, indole and total bacterial count. Samples for room temperature spoilage study were drawn every three hours and analysed for the above mentioned parameters.

Fresh mackerel (*Rastrelliger kanagurta*), was brought from Cochin fishing harbour in iced condition. It was again iced in the ratio of 1:1 (w/w) in a thermocole box with a drain hole and was kept in the chilled room until study started. Sample was de-iced and divided into two lots one for zero-time

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analysis and the other for ice storage study. The initial sensory characteristics, total bacterial count and biochemical profile such as TMAN, TVBN and indole were studied after 18 h. The fish from the second lot was immediately iced and kept in the chilled room. Analysis was carried out on randomly drawn samples in every three days. Re-icing was carried out every three days and as required. Changes in the sensory characteristics, total bacterial count and biochemical profile such as TMAN, TVBN and indole were studied during the storage period.

Sensory evaluation of raw whole fish and cooked meat were done by a panel of 6 judges using the score sheets developed for Patagonian hake by FAO (da Encarnacao, 1974) and for rock fish by Liston *et al.* (1961) respectively. The borderline of acceptability for whole fish is 3.5 and that for cooked fish is 3 out of 5. TMAN and TVBN were determined by the method of Conway (1962). TBC was determined as per the method provided by FDA (Maturin & Peeler, 1995). Indole was determined by the Modified Colorimetric Method of Cheuk & Finne (1981).

Results and Discussion

Mackerel used for room temperature storage study had an average total length of 22.21 cm and average weight of 166.70 g. The fish had bright pigmentation and characteristic color of the species, eyes were completely convex with bright pupil and translucent cornea, gills had a bloody red color and sea weedy odor, flesh was rigid and belly intact. The cooked meat had a sweet odor and flavor with no evidence of rancidity. As storage time proceeded and reached the borderline of acceptance after 6 h based on the whole fish sensory analysis, the skin lost its pigmentation and was dull, eyes were plain and faded, gills were dull red and had a neutral sweet odor, flesh was elastic and belly not rigid. The cooked meat did not show any noticeable changes during this time. The fish was acceptable for 3 more

hours based on the cooked meat sensory analysis unlike the whole fish based on which the fish was rejected after 6 h of storage at room temperature.

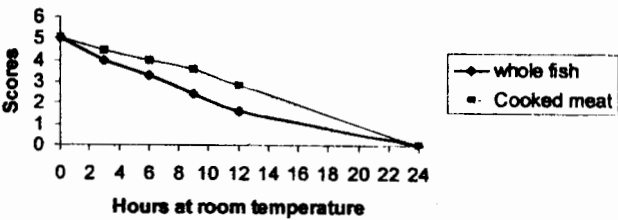


Fig. 1. Changes in sensory quality of mackerel kept at ambient temperature

Mackerel used for the ice storage study had an average length of 18 cm and average weight of 142.86 g. The fish initially had a bright pigmentation with transparent slime, eyes were completely convex and bright, the gills were dull red and had a neutral sweet odor, and flesh was rigid and belly intact. The cooked fish did not have the fresh sweetness but was not rancid. As storage time in ice progressed and reached the borderline of acceptance by the 6th day based on the whole fish sensory analysis, the skin became less bright, eyes plain, gills dull red and had slightly rancid odor, belly was distended and flesh slightly elastic. The fish reached the borderline of acceptance after 9 days based on cooked meat sensory analysis.

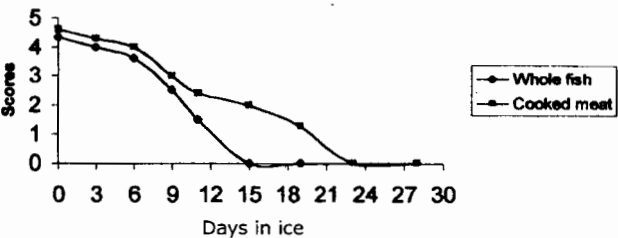


Fig. 2. Changes in sensory quality of mackerel kept in ice

TMAN and TVBN are the commonly used indices of spoilage of fish and shellfish. 10-15 mg/100g TMAN and 35-40 mg/100g TVBN have been recommended as the limits of acceptability for temperate fish species (Connell, 1975). TMAN showed a consistently increasing trend with the total bacterial count for mackerel kept at ambient temperature but it did not show a trend for those stored in ice. Many workers have

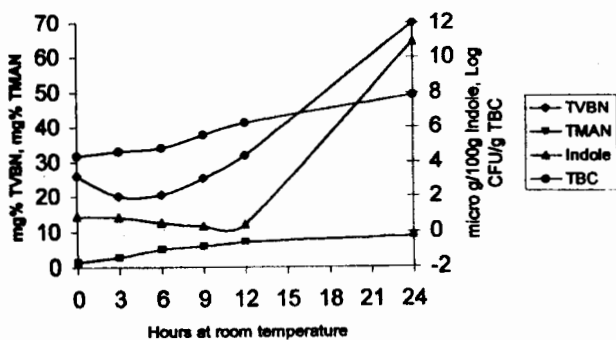


Fig. 3. Changes in TVBN, TMAN, Indole and TBC of mackerel kept at ambient temperature

reported good correlation between TBC and TMAN levels (Fieger & Friloux, 1954, Sidhu *et al.*, 1974). Though TMAN showed an increasing trend, it did not accumulate appreciably when the fish was judged unacceptable. Farber (1963) compared sensory judgments and TMAN determinations on a number of white and red fleshed fish species and reported that TMAN correlated well with white fleshed fish but was not related to the stage of spoilage of herring. TVBN increased with TBC both at ambient temperature and in ice after an initial drop. Indole was detected in limited quantities through out the storage period in ice and at room temperature. The maximum detected indole was 10.88 $\mu\text{g}/100\text{g}$ after 24 h of storage of the fish at ambient temperature when it was completely putrid. Thus indole was of limited significance to show the spoiled condition of mackerel kept at ambient temperature and in ice. *E. coli* and *P. morganii* are reported to be the main indole producers (Chambers & Staruszkiewicz, 1981). Farber (1952) reported that indole was of limited significance as an index of spoilage

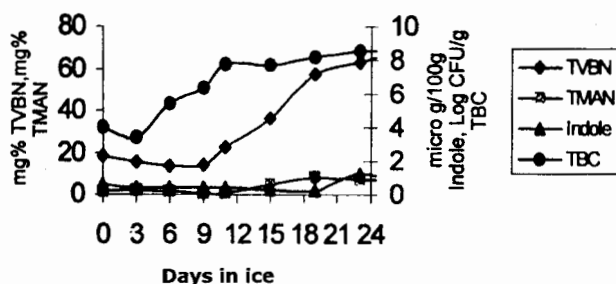


Fig. 4. Changes in TMAN, TVBN, Indole and TBC of mackerel kept in ice

of tuna, mackerel and sardines because relatively few of the spoilage flora formed the compound. The low amount of indole recorded could be due to the absence of the main indole producers as was found with *E. coli* or their inhibition by other microbial flora.

Taking into consideration the sensory analysis of the whole fish and cooked meat the shelf life of mackerel was found to be 6-9 h at ambient temperature and 6-9 days in ice. At the borderline of acceptance after 9 h of storage at ambient temperature, mackerel had TVBN, TMAN, indole and TBC levels of 25.2 mg/100g, 5.75 mg/100g, 0.3 $\mu\text{g}/100\text{g}$ and 5.55 log CFU/g respectively. And at the borderline of acceptance after 9 days of ice storage, mackerel had 14.35 $\mu\text{g}/100\text{g}$, 0.67 $\mu\text{g}/100\text{g}$, 0.4 $\mu\text{g}/100\text{g}$ and 6.36 log CFU/g respectively. Thus, TMAN, TVBN, indole and bacteria counts were still low when the fish was rejected. The short sensory shelf life recorded thus could be due to oxidation of fats leading to rancidity.

None of the indices used to determine spoilage of mackerel had accumulated appreciably to show the condition of the fish at the point of rejection and even when the fish was completely decomposed. This was explained by some workers that fat oxidation products are better indices of spoilage of mackerel and other fatty fishes than the other indices (Nair & Lahiry, 1968; Surendran, *et al.*, 1985). Indole was observed to accumulate only in negligible quantities during the entire storage period. Thus, indole can not be used as an index of spoilage and decomposition of mackerel (*Rastrelliger kanagurta*) kept in ice and at ambient temperature.

The author is grateful to Dr. Francis Thomas, Principal Scientist, Quality Assurance and Management Division, Central Institute of Fisheries Technology, for his valuable guidance in carrying out the work. She is also thankful to Dr. Jose Joseph, Principal Scientist, Central Institute of Fisheries Technology, for his advice and critical suggestions.

References

- Chambers, T.L. & Staruszkiewicz, W.F. (Jr.) (1981) *J. Assoc. Off. Anal. Chem.* **64**, 592
- Choang, O., Cheuk, W.L., Nickelson, R., Martin, R. & Finne, G. (1983) *J. Food Sci.* **48**, 813
- Cheuk, W.L. & Finne, G. (1981) *J. Assoc. Off. Anal. Chem.* **64**, 783
- Connell, J.J. (1975) *Control of Fish Quality*, 176 p. Fishing News (Books) Ltd., Surrey, England
- Conway, E.J. (1962) *Microdiffusion Analysis and Volumetric error*, 5th Ed. 467 p. Parch Crosby and Lockwood and Sons Ltd., London
- da Encarnacao, J.D. (1974) Fisheries Development Project-FAO Argentine. Tech. Co. No.39
- Duggan, R.E. & Strasburger, L.W. (1946) *J. Assoc. Off. Anal. Chem.* **29**, 177
- Farber, L. (1952) *Fd Technol.* **6**, 319
- Farber, L. (1963) *Fd Technol.* **17**, 476
- Fieger, E.A. & Friloux, J.J. (1954) *Fd Technol.* **8**, 35
- Finne, G. (1992) in *Advances in Seafood Biochemistry*, (Flick, G.J. and Martin R.E. eds.), p.393, Technomic Publishing Company Inc. Lancaster
- Hellig, F. (1963) *J. Assoc. Off. Anal. Chem.* **46**, 22
- Liston, J., Chapel, J.G. & Stern, J.A. (1961) *Fd Technol.* **15**, 19
- Maturin, L.I., & Peeler, J.T. (1995) in *Bacteriological Analytical Manual*, 18th ed., (Tomlinson, L.A., Ed.) p.301, AOAC International, USA
- Nair, R.B. & Lahiry, N.L. (1968) *J. Fd Sci. Technol.* **5**, 107
- Sidhu, G.S., Montgomery, W.A. & Brown, M.A. (1974) *J. Food Technol.* **9**, 371
- Surendran, P.K., Iyer, K.M. & Gopakumar, K. (1985) *Fish. Technol.* **22**, 117