Quality assessment of Pearlspot (*Etroplus suratensis*) in ice and at ambient temperature

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Abstract

Quality changes in biochemical indices like nucleotides, TVBN, NPN and FFA, and variations in the pH and K value were determined in Pearlspot (Etroplus suratensis) in ice and at ambient temperature. The K value increased from 2.8 % to 93.63 % by 21 days in ice storage whereas in ambient conditions it reached 78 % by 10 h. The IMP level showed a sharp decline after three days indicating the loss of flavour of the fish on ice storage. The TVBN value remained below 30 mg [100g]$^{-1}$ on storage. The total viable count has increased from 2.3 X 10 ^{4} cfu g^{-1} to 3.7 X 10 ^{5} cfu g^{-1} after twenty one days in ice and the same was 2.8 X 10 ^{5} cfu g^{-1} after 10 h in ambient conditions. The freshness assessment of whole fish by demerit system and the sensory evaluation of cooked meat were carried out which showed that in ice storage, the species retained the high quality of life up to 7 days and was in acceptable condition for 13 days; at ambient temperature it remained in acceptable condition upto 9 h.

Keywords: *Pearlspot, quality, Ambient conditions, Ice storage, K value, IMP, Organoleptic assessment*

1. Introduction

Studies on the nutritional quality have indicated that Pearlspot has a high and steady calorific value and a good combination of all essential fatty acids (Mukundan and James, 1978). Nair and Gopakumar (1978) have described the fatty acid composition of this species. Shelf life of this species under iced and ambient conditions was studied by Varma *et al.*, 1983, Surendran and Iyer (1985). Lakshmanan *et al.* (1996) have studied the nucleotide degradation and quality changes in Pearlspot under iced and ambient conditions. Modified Atmospheric Packed Etroplus in chilled conditions had a shelf life of about 18 days (Manju *et al.*, 2002). The objective of the present study is to relate the biochemical and sensory quality indices with shelf life of Pearlspot in ice and in ambient conditions.

2. Material and methods

Pearlspot (length 18.2 ± 0.5 cm and weight 130 ± 3.3 g) was brought to the laboratory in live condition from the local landings from Vypeen region of Ernakulam. The fish were killed by dipping in chilled water. The whole lot was divided into two batches and one batch was iced immediately with flake ice in 1:1 (w/w) ratio in insulated box.

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Re-icing was done everyday. The other batch was kept at 30 ± 1 °C for ambient condition studies. Ice stored fish was sampled at different intervals for 21 days and the samples kept at ambient temperature were analysed upto 10 h.

2.1 Biochemical analyses

For biochemical analyses, the minced meat of fish was used. Moisture, fat, Total Nitrogen (TN), Non Protein Nitrogen (NPN) and ash content of the samples were estimated according to AOAC (2000) methods. Total Volatile Nitrogen (TVN) was determined by the micro diffusion method of Conway (1962) and the Free Fatty Acid was analysed according to AOCS (1989). The total plate count was carried out by standard pour plate method (APHA, 1976). The pH was measured on 2:1 water:muscle homogenate using a Cyberscan 510 pH meter.

2.2 Determination of K value

Kvalue and the amount of different nucleotide degradation products were determined in HPLC by the method described by Ryder (1985). Muscle (5 g) taken from the anterior dorsal portion of the fish was homogenized in a T 25 basic Ultra-Turraxä homogenizer (IKA Labortechnik, USA) at low temperature (<5 °C) for 1 minute with 25 ml of chilled 0.6 M Perchloric acid. The homogenate was centrifuged at 6,000 rpm for 10 min at 4 °C in a REMI cooling centrifuge (REMI cooling Compufuge model CPR 30). 10 ml of the supernatant was adjusted to pH 6.8 with chilled 1M KOH immediately. After keeping at 5 °C for 30 min, the solution was filtered through a syringe filter (0.45 m m) and the filtrate was stored at – 30 °C for subsequent HPLC analysis.

A Jasco Borwin Liquid Chromatograph (Jasco Ltd., Japan) with model PU 2089 plus quaternary gradient pump and Jasco 2,015 MD plus multiwavelength detector was used. A Lichrospher ä 100 C – 18 encapped Reverse phase (5 mm) column was used for the separation of nucleotides. The nucleotide separation was achieved by isocratic elution with phosphate buffer solution prepared by mixing equal volumes of 0.04 M KH_2PO_4 and 0.06 M K_2HPO_4 in de-ionised water at a flow rate of 2.4 ml min^{-1} and an injection pressure ranging from 350 M Pa – 355 M Pa. All solutions were passed through 0.45 mm filter prior to the injection onto the column. A 20 ml of the sample was injected into the HPLC. The elute was monitored at 254 nm. Quantification was made by external standard method and K value was calculated as a ratio of the sum of hypoxanthine and inosine to total amount of ATP related compounds as defined by (Saito *et al.*, 1959).

ATP, ADP, AMP, IMP, Inosine and Hypoxanthine standards used for K value estimation was supplied by Sigma Chemical Co., St Louise, USA. KH_2PO_4 and K_2HPO_4 were supplied by B.D.H. Laboratory, England. De-ionized water from Millipore filter system (cat. no. – QTUM 0001X) supplied by Millipore, Bangalore, India was used for HPLC operations.

2.3 Sensory analysis

The freshness of whole fish during storage was assessed based on the demerit score for every sensory attribute (Branch and Vail, 1985). The different organoleptic factors taken in to consideration for sensory assessment were appearance, scale looseness, skin firmness, presence of slime, muscle stiffness, eye condition, gill condition, belly *etc.* The best quality of each factor was graded to zero and most unacceptable quality scores were 2 to 3. The maximum demerit points based on the score for each factor was 39. Dressed fish cooked in 2 % boiling brine for 10 min was assessed for sensory evaluation by a taste panel of five members using a 10-point hedonic scale (Hill and Glew, 1973) and the statistical mean was accepted as the sensory score. A score of 4 was fixed as the limit for acceptability.

3. Results and discussion

The proximate composition of Etroplus (Table1) indicate that it is a lean fish. Higher values for protein (22.5 %) and fat (2.37 %) were reported for the same species by Mukundan & James (1978). Depending on the condition of the specimens *i.e.* size, maturity stages and season, the proximate composition can show variation for the same species.

Table 1.*Etroplus suratensis* - Proximate composition

Moisture	79.52 %
Protein	17.13 %
Fat	1.04 %
Ash	2.68 %

The results of biochemical, microbiological and sensory analysis of ambient stored samples are given in Tables 2, 4 and 6. During ambient storage, pH reached 7.82 at the point of rejection, *i.e.* by ten hours. TVBN value at the point of rejection in ambient conditions reached 29.45 mg %, which was below the limit of acceptability of 30 mg %. The bacterial count was 2.8 X 10^5 cfu g^{-1} in 10 h under ambient conditions. The free fatty acid content which indicates hydrolytic rancidity showed a steady increase in ambient storage and the non protein nitrogen showed a gradual decline. The K value in very fresh condition was 2.87 % and by 10 h at ambient storage it reached 78.99

% at rejection. This corresponds to the rejection limit of 60 % K value proposed by Ehira (1976). Lakshmanan *et al.*, (1996) has observed that K value of 67.76 % in the same species at ambient conditions at the point of rejection (10 – 12 h).The sensory scores corresponded well with K value and by ten hours the meat showed signs of spoilage. IMP showed a rapid decline after the seventh hour of ambient storage indicating loss of flavour. Inosine level showed a gradual increase upto nine hours after which it showed a decline with the corresponding increase of hypoxanthine which reached 1.87 m moles g^{-1} indicating the breakdown of inosine (Fig.1). In this case, at ambient conditions, organoleptic assessment by sensory evaluation of cooked meat and K value can be considered as superior indices for freshness quality evaluation in Etroplus than other spoilage indices. Since the samples retained the apparent freshness even by 10 h in ambient conditions, the demerit score system did not truly indicate the level of spoilage in this species.

Table 2. Etroplus - Changes in biochemical parameters and bacterial count during ambient conditions

Time (hours)	Moisture	pH	TVBN (mg %)	NPN (mg %)	FFA(% oleic acid)	Bacterial count (cfu g^{-1})
0	79.53	6.23	4.90	434	0.75	2.3×10^4
4	80.85	6.38	12.89	412	2.05	0.7×10^5
7	80.44	6.74	20.02	322	5.66	2.1×10^5
9	80.23	6.67	22.98	350	7.9	2.5×10^5
10	80.10	7.82	29.45	308	11.6	2.8×10^5

Table 3. Etroplus - Changes in biochemical parameters and bacterial count during iced storage

DAYS	Moisture	pH	TVBN (mg %)	NPN (mg %)	FFA (% oleic acid)	Bacterial count (cfu g^{-1})
0	79.53	6.23	4.9	434	0.75	2.3×10^4
1	80.31	6.71	7.1	420	1.22	1.3×10^4
3	82.11	6.77	7.0	350	3.33	1.1×10^4
5	81.72	7.13	7.0	336	3.52	1.4×10^4
7	81.47	6.74	7.8	308	6.70	6.8×10^4
9	82.31	7.11	11.2	294	6.23	2.5×10^4
11	82.21	6.91	14.0	294	9.10	2.5×10^4
13	82.14	7.16	14.9	280	9.69	6.8×10^4
15	83.66	6.83	18.9	280	9.66	1.1×10^4
18	82.79	7.01	19.0	252	11.01	1.6×10^4
20	82.34	6.95	22.9	224	12.96	1.19×10^5
21	83.88	7.66	27.3	210	14.87	3.7×10^5

Table 4. *Etroplus suratensis* – Sensory evaluation of cooked meat at ambient conditions

Time (hours)	Sensory characteristics	Overall score
0	Meat intact on cooking, Sweet and juicy flavour, Firm but soft on chewing texture	9.5 ± 0.2
4	Meat intact on cooking, Good flavour not sweet, Firm texture, salty after taste.	8.3 ± 0.2
7	Meat breaks up on cooking, No detectable flavour, disintegrating texture on chewing, salty aftertaste	5.3 ± 0.3
9	Meat disintegrates on cooking, No detectable flavour, prominent salty aftertaste.	4.2 ± 0.5
10	Complete disintegration of meat on cooking, faint spoilt odour and salty aftertaste	2.0 ± 0.7

Table 5. Etroplus suratensis – Sensory evaluation of cooked meat of samples kept in ice

Days	Sensory characteristics score	Overall
0	Meat juicy and intact on cooking, Sweet flavour, Firm but soft on chewing texture	9.5 ± 0.2
1	Meat juicy and intact on cooking, Sweet flavour, Firm but soft on chewing texture, slightly salty after taste.	9.0 ± 0.5
3	Meat intact on cooking, Sweet flavour, Firm but soft on chewing texture, slightly salty after taste.	8.2 ± 0.4
5	Meat intact on cooking, Good flavour not sweet, Firm texture, salty after taste.	8.0 ± 0.2
7	Cooked meat is soft, Good flavour, Firm texture on chewing, salty after tast.e.	7.5 ± 0.4
9	Meat shows signs of breaking up on cooking, detectable flavour, disintegrating texture on chewing, salty aftertaste.	6.2 ± 0.1
11	Meat breaks up on cooking, No detectable flavour, disintegrating texture on chewing, salty aftertaste	5.4 ± 0.3
13	Meat breaks up on cooking, No detectable flavour, disintegrating texture on chewing, salty aftertaste become prominent	4.5 ± 0.5
15	Meat disintegrates on cooking, Faint spoilt odour, prominent salty aftertaste.	2.5 ± 0.7
18	The panel refused to taste the sample	0

Table 6. Changes in demerit score, hedonic score and K value of Etroplus suratensis kept at ambient conditions

Time (hours)	Demerit score	Hedonic score	K value (%)
0	1	9.5 ± 0.2	2.88
4	13	8.3 ± 0.2	19.64
7	20	5.3 ± 0.3	42.08
9	22	4.2 ± 0.5	50.91
10	27	2.0 ± 0.7	78.99

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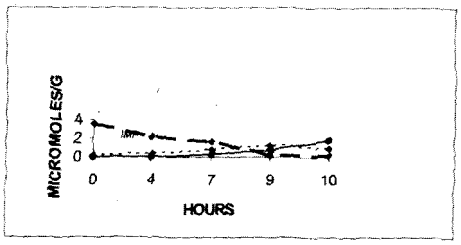

Fig. 1 change in IMP,Hx and HxR of in etroplus

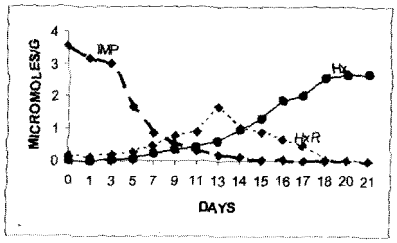

Fig. 2 change in etroplus imp,hx,hxr in ambient conditions during ice storage

The results of biochemical, microbiological and sensory analysis of ice-stored samples are given in Tables 3, 5 and 7. The K value shows a gradual increase during ice storage and IMP showed a rapid decline after three days in ice. By the fifth day IMP was reduced to 52 % of the initial concentration indicating the loss of sweet flavour, which was identifiable during the sensory evaluation of cooked meat. Inosine had an initially higher concentration than hypoxanthine which increased to 1.7 m moles g^{-1} in 13 days ice storage, after which there was a rapid decline indicating its breakdown into hypoxanthine and ribose sugar. Hypoxanthine concentration showed a gradual increase and reached 2.7 m moles g^{-1} by the end of ice storage period (Fig.2). The K value at the limit of prime condition *ie.*, by seven days, increased to 15.61 % and for acceptable limit it was 58.51 %. Lakshmanan and Gopakumar (1999) have reported 50 % K value as the limit of acceptance of this species in ice storage. The moisture increased by 5.4 % during ice storage. After twenty-one days in ice the TVBN has increased from an initial concentration of 4.9 mg % to 27.30 mg %. In iced condition the free fatty acid content increased steadily while the non protein nitrogen has deceased by 50 %. During ice storage the total viable count of the samples did not increase significantly, which could be due to washing off by ice melt water. The final count after 21 days of storage was 3.7×10^{5} cfu g^{-1}. However, the quality of the fish deteriorated significantly by that period.

The demerit score and hedonic score of the samples in ice was 17 and 7.5 respectively by seven days, which was set as the limit of prime condition. By thirteen days the scores were 23 and 4.5, which was set as the limit for acceptable quality. In ice storage also, organoleptic assessment by sensory evaluation of cooked meat and K value estimation were found to be the better indicators for freshness quality evaluation than other biochemical spoilage indices. As in ambient conditions, demerit score system did not truly reflect the freshness of the samples. Ice storage study of Pearl spot has showed

that it remained in prime quality condition upto seven days in ice and in acceptable conditions upto thirteen days. Earlier reports indicated that this species retained the prime quality condition of 8 - 10 days in ice storage and an acceptable condition upto 12 days (Varma *et al.*, 1983, Surendran & Iyer, 1985).

Table 7. Changes in demerit score, hedonic score and K value of Etroplus *suratensis* kept in ice

Days	Demerit score	Hedonic score	K value (%)
0	1	9.5 ± 0.2	2.88
1	8	9.0 ± 0.5	5.26
3	12	8.2 ± 0.4	7.05
5	16	8.0 ± 0.2	10.51
7	17	7.5 ± 0.4	15.61
9	21	6.2 ± 0.1	18.52
11	22	5.4 ± 0.3	27.83
13	23	4.5 ± 0.5	58.52
15	28	2.5 ± 0.7	73.92
18	30	-	87.08
20	31	-	92.79
21	34	-	93.63

4. Conclusion

Organoleptic assessment of whole fish by sensory evaluation of cooked meat together with K value estimation can be considered as effective tools for freshness quality evaluation in Etroplus than other spoilage indices. The demerit score system, which is an effective tool for determining the freshness of whole fish in many species, was found to be insufficient to determine the quality of this species in ambient and chilled conditions.

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References

APHA, 1976. Speck, M.L. (Ed.), *Compendium of Methods for the Microbiological Examination of Foods*, American Public Health Association, New York.

AOAC, 2000. Official Methods of Analysis of AOAC International, 17 th Ed., AOAC International, Gaithersburg. 938.08, 940.25, 948.15.

AOCS. 1989. Official Methods and Recommended Practices of the American Oil Chemists Society, AOCS, Chempaign.

Branch, A.C., Vail, A.M.A., 1985. Freshness quality assessment for round fish. Bring fish inspection into computer age. Food Technol. Aust. 37(8), 352 -355.

Conway, E.J., 1962. *Determination of Volatile Amines, Microdiffusion Analysis and Volumetric Error* 5 th edn, Parch Croskey and Sockwood and Son Limited, London. 467

Ehira, S., 1976. A biochemical study on the freshness of fish. Bull.Tokai Reg.Fish Res.Lab.88, 1 - 132.

Hill, M.A., Glew, G., 1973. Organoleptic assessment of products frozen by two methods, liquid nitrogen and blast freezing. J.Food Technol. 8, 205 - 210.

Lakshmanan, P.T., Antony, P.D., Gopakumar, K., 1996. Nucleotide degradation and quality changes in mullet (*Liza corsula*) and Pearlspot (*Etroplus suratensis*) in ice and at ambient temperatures. Food Control 7, no.6, 2777 -283.

Lakshmanan, P.T., Gopakumar, K., 1999. K - value an index for estimating Fish freshness and Quality. Curr.Sci.76 (3), 400 - 404.

Manju, S., Sonaji, E.R., Leema Jose., Srinivas Gopal, T.K., Ravishankar, T.N., Unnikrishnan Nair, T.N., 2003. In: Surendran, P.K., *et al.*, (Eds.), *Modified Atmosphere Packaging of Whole Pearlspot (Etroplus suratensis) in Seafood Safety,* SOFT (I), Cochin.144 - 149.

Mukundan, M.K, James, M.A., 1978. Nutritional quality of some food fish. Fish.Tech. 15, 85 - 87.

Nair, P.G.V., Gopakumar, K., 1978. Fatty acid composition of 15 species of fish from tropical waters. J.Fd.Sc.43, 216.

Saito, T., Arai, K., Matsuyoshi, M., 1959. A new method for estimating the freshness of fish.Bull.Japan. Soc.Sci.fish. 24, 749 -750.

Surendran P.K, Iyer, K.M., 1985. In: Ravindran, K., Unnikrishnan Nair, N., Perigreen, P.A., Madhavan, P., Gopalakrishna Pillai, A.G., Panikkar, P.A., Mary Thomas (Eds.), *Ice Storage Characteristics of Pearlspot (E.suratensis) caught from Cochin Backwaters in Harvest and Post harvest Technology of Fish,* SOFT (I), Cochin. 370 -372.

Ryder, J.M., 1985. Determination of Adenosine Triphosphate and its breakdown products in Fish Muscle by High - Performance Liquid Chromatography. J.Agric.Food Chem. 33, 678-680.

Varma, P.R.G., Mathen, C., Thomas, F., 1983. Quality Changes and Shelf Life of Pearlspot, Mullet and Tilapia during storage at ambient temperature and ice. J.Fd.Sc. and Tech.20, 219 - 222.