

Storage Characteristics and Histamine Content of Fish Stored at Tropical Ambient Temperature

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During the storage in laboratory, yellow tail scad (*Atule mate*), seer (*Scomberomorus guttatus*), mullet (*Mugil cephalus*), horse mackerel (*Megalaspis cordyla*), bull's eye (*Priacanthus hamrur*), sardine (*Sardinella dobsi*), long billed half beak (*Hemiramphus marginatus*), rainbow sardine (*Dussumieria acuta*) and scad (*Scomberoides tol*) were found to be organoleptically acceptable up to 4-6 h in winter (20-30°C). However, yellow tail scad, seer, mullet, bull's eye, black pomfrets (*Parastromateus niger*) and silver bellies (*Leiognathus dussumieri*) stored in summer (26-33°C) were acceptable up to 4 h only. In summer, the histamine level in all acceptable fish was below 15.0mg.100g⁻¹ muscle which is below maximum admissible limit of 20.0mg.100g⁻¹ muscle. The histamine values in winter days in fish was below 11.0mg.100g⁻¹ muscle, except for long billed half beak. Histamine formation in seer, bull's eye, scad and long billed half beak was more rapid compared to other species under study. Peroxide value in fresh fish such as yellow tail scad, mullet, horse mackerel, scad and silver bellies was nil. An increasing trend in both peroxide value and total volatile base nitrogen (TVBN) was noticed in all samples stored at ambient temperature. TVBN values in organoleptically acceptable fish were between 7.2 and 20.6 mg%.

Key words: Histamine, storage characteristics, volatile base, peroxide value, Visakhapatnam

Shrimp trawling all over the east coast of India is associated with large landings (80-95%) of by-catch, of which the major part is low priced fish (Gordon, 1991). Many species of the by-catch are now being used for human consumption in fresh and dried form and the trend is towards increased utilization of these species. Yellow tail scad (*Atule mate*), seer (*Scomberomorus guttatus*), mullet (*Mugil cephalus*), sardine (*Sardinella dobsi*), black pomfret (*Parastromateus niger*), silver bellies (*Leiognathus dussumieri*), bull's eye (*Priacanthus hamrur*), long billed half beak (*Hemiramphus marginatus*), rainbow sardine (*Dussumieria acuta*), horse mackerel (*Megalaspis cordyla*) and scad (*Scomberoides tol*), are common varieties in the by-catch landed with shrimp (CMFRI, 1986; 1989).

Most of the by-catch is brought to landing centres in un-iced condition. The lengthy exposure to tropical temperature causes rapid spoilage. The scombroid fish such as mackerel is known for causing scombroid poisoning. Histamine formation

in non-scombroid fish at ambient temperatures was reported by many workers (Richie & Mackie, 1980; Yamanaka *et al.*, 1984; Vijayan *et al.*, 1994; Chakrabarti, 1998). The formation of histamine in the muscle of scombroid and non-scombroid fish stored in ice was not significant (Ames *et al.*, 1987; Vijayan *et al.*, 1991; Chakrabarti, 1998). Food and Drug Administration (USA) has established Hazard Action Level for histamine in fish flesh at 50 mg.100g⁻¹ and maximum allowable histamine level of 20 mg.100g⁻¹. European countries have accepted the maximum admissible limit of 20 mg.100g⁻¹ flesh (Anon, 1990). This paper aims to assess the quality of fish available in the landing centres of Visakhapatnam with special emphasis on the level of histamine at the limit of the shelf life at tropical ambient temperature.

Materials and Methods

A. mate (60-80 g), *S. guttatus* (200-300 g), *M. cephalus* (300-450 g), *S. dobsi* (20-30 g), *P. hamrur* (100-250 g), *D. acuta* (30-40 g),

Table 1. Seasonal variation of histamine content and storage characteristics of fish at ambient temperature

Species	Storage condition	Parameters	Storage time (h)			
			0	2	4	6
<i>Sardinella dobsi</i> (Sardine) Fat : 1.1-1.5%	26-30°C RH : 60-70%	Moisture (%)	75.6	76.1	76.2	76.4
		TVBN (mg%)	10.3±0.4	15.4±0.4	19.9±0.5	22.3±0.6
		Histamine (mg%)	5.7±0.2	6.4±0.3	7.2±0.3	7.7±0.7
		Overall quality	4.0	3.0	2.0	1.5
<i>Parastromateus niger</i> (Black pomfret) Fat : 0.6-1.2%	31-33°C RH : 68-75%	Moisture (%)	78.2	78.5	78.7	78.9
		TVBN (mg%)	8.6±0.3	10.4±0.4	12.3±0.4	16.4±0.5
		Histamine (mg%)	5.4±0.3	6.4±0.2	7.4±0.5	10.7±0.5
		Overall quality	4.0	3.0	2.0	1.5
<i>Hemirhamphus marginatus</i> (Long billed half beak) Fat : 1.2-1.4%	26-30°C RH : 60-70%	Moisture (%)	75.9	76.2	76.2	76.3
		TVBN (mg%)	12.3±0.4	14.2±0.4	17.9±0.5	19.9±0.5
		Histamine (mg%)	8.2±0.6	10.8±0.3	12.9±0.8	15.2±0.8
		Overall quality	4.0	3.0	2.0	1.5
<i>Leiognathus dussumieri</i> (Silver bellies) Fat : 4.5-5.4%	31-33°C RH : 68-75%	Moisture (%)	70.5	71.2	71.4	72.5
		TVBN (mg%)	10.3±0.3	12.3±0.4	20.6±0.5	26.5±0.7
		PV	Nil	3.5	8.1	16.5
		Histamine (mg%)	4.3±0.2	5.1±0.3	5.9±0.4	7.1±0.3
		Overall quality	4.0	3.0	2.0	1.0
<i>Dussumieria acuta</i> (Rainbow sardine) Fat : 0.8-1.2%	26-30°C RH : 60-70%	Moisture (%)	76.1	76.5	76.6	76.8
		TVBN (mg%)	10.1±0.4	12.5±0.4	18.4±0.5	22.1±0.6
		Histamine (mg%)	2.5±0.3	2.8±0.3	3.4±0.3	4.6±0.3
		Overall quality	4.0	3.0	2.5	2.0
<i>Scomberoides tol</i> (Scad) Fat : 4.5-5.4%	26-30°C RH : 60-70%	Moisture (%)	74.7	75.1	75.9	76.3
		TVBN (mg%)	8.5±0.3	11.7±0.4	16.6±0.5	18.9±0.5
		PV	Nil	4.8	8.2	11.5
		Histamine (mg%)	3.1±0.2	5.5±0.4	8.1±0.4	10.0±0.6
		Overall quality	4.0	3.0	2.5	2.0

Overall quality score : 5 = excellent, 4 = good, 3 = satisfactory, 2 = fair, 1 = poor, “-” not available

Histamine and TVBN are the average ± SD of four determinations; other values - average of four determinations.

Table 2. Histamine content and storage characteristics of some seasonal fish at ambient temperature

Species	Parameters	Storage time (h) - Winter				Storage time (h) - Summer				Storage time (h) - Rainy Season			
		0	2	4	6	0	2	4	6	0	2	4	6
<i>Atule mate</i> (Yellow tail scad)	Moisture %	77.3	77.8	77.9	78.5	74.5	74.8	76.1	76.6	76.0	77.5	77.1	78.3
Fat : 1.4 - 1.9%	TVBN (mg.%)	9.8±0.3	11.7±0.4	15.8±0.4	19.3±0.5	8.7±0.3	11.1±0.4	15.6±0.5	23.7±0.6	7.8±0.3	9.6±0.4	15.8±0.4	22.9±0.5
	PV	Nil	Nil	12.0	15.5	Nil	10.1	15.5	18.2	Nil	Nil	10.2	13.1
	Histamine (mg.%)	4.1±0.3	6.7±0.4	7.9±0.2	8.7±0.5	5.1±0.4	8.6±0.5	10.7±0.6	15.9±0.4	4.8±0.4	7.6±0.3	8.1±0.3	8.8±0.3
	Overall quality	4.0	3.0	2.0	1.5	4.0	3.0	2.0	1.0	4.0	3.0	2.0	1.0
<i>Mugil cephalus</i> (Mullet)	Moisture %	71.6	72.5	72.8	73.1	72.1	73.3	73.8	74.5	72.2	74.1	74.2	75.1
Fat : 1.1 - 2.4%	TVBN (mg.%)	8.7±0.3	13.0±0.4	20.4±0.5	23.8±0.5	9.2±0.3	15.1±0.4	17.1±0.4	28.8±0.7	8.5±0.3	10.3±0.4	14.6±0.4	19.4±0.5
	PV	Nil	4.2	6.2	10.4	Nil	5.9	20.4	29.4	Nil	6.6	8.5	17.2±0.2
	Histamine (mg.%)	5.6±0.5	6.7±0.4	8.1±0.4	9.5±0.3	9.9±0.3	10.8±0.2	11.5±0.4	14.9±0.4	7.4±0.2	7.8±0.2	9.0±0.2	10.7
	Overall quality	4.0	3.0	2.0	1.5	4.0	3.0	2.0	1.0	4.0	3.0	2.0	1.0
<i>Pricanthus hamrur</i> (Bull's eye)	Moisture %	78.3	78.4	78.6	78.9	79.3	79.4	79.5	79.8	-	-	-	-
Fat : 1.0 - 1.4%	TVBN (mg.%)	7.2±0.2	9.3±0.3	12.3±0.3	19.4±0.5	8.1±0.3	11.3±0.4	15.9±0.5	23.6±0.6	-	-	-	-
	Histamine (mg.%)	3.5±0.3	5.7±0.4	6.7±0.4	9.6±0.3	4.8±0.3	7.4±0.3	9.6±0.5	13.3±0.8	-	-	-	-
	Overall quality	4.0	3.0	2.0	1.5	4.0	3.0	2.0	1.0	-	-	-	-
<i>Megalaspis cordyla</i> (Horse mackerel)	Moisture %	74.7	74.8	74.9	75.2	-	-	-	-	72.6	73.1	73.4	74.1
Fat : 1.9 - 2.1%	TVBN (mg.%)	7.4±0.3	10.1±0.3	12.2±0.4	16.2±0.5	-	-	-	-	7.8±0.2	11.7±0.3	16.1±0.4	21.1±0.5
	PV	Nil	Nil	6.8	8.6	-	-	-	-	Nil	5.3	6.3	10.2
	Histamine (mg.%)	3.9±0.4	5.7±0.3	6.8±0.4	8.9±0.4	-	-	-	-	7.8±0.3	9.9±0.3	10.9±0.3	11.9±0.3
	Overall quality	4.0	3.0	2.0	1.5	-	-	-	-	4.0	3.0	2.0	1.0
<i>Scomberomorus guttatus</i> (Seer)	Moisture %	76.8	76.9	77.1	77.2	76.5	76.7	76.8	77.1	77.3	77.6	77.7	77.8
Fat : 1.4 - 2.2%	TVBN (mg.%)	10.2±0.4	11.1±0.4	12.3±0.5	15.6±0.5	10.8±0.3	12.3±0.4	15.9±0.4	20.6±0.5	10.7±0.3	11.3±0.4	14.2±0.4	19.7±0.6
	PV	Nil	Nil	7.2	9.8	Nil	10.5	20.5	3.1	Nil	Nil	9.6	14.5
	Histamine (mg.%)	3.9±0.2	5.1±0.3	8.4±0.5	10.6±0.3	7.7±0.5	9.8±0.3	12.9±0.7	15.6±0.5	4.8±0.4	8.0±0.2	10.0±0.3	11.9
	Overall quality	4.0	3.0	2.5	2.0	4.0	3.0	2.0	1.0	4.0	3.0	2.0	1.5

Overall quality score: 5 = excellent, 4 = good, 3 = satisfactory, 2 = fair, 1 = poor, "-" not available

Histamine and TVBN are the average ± SD of four determinations; other values - average of four determinations.

M. cordyla (100-200 g), *S. tol* (100-300 g), *H. marginatus* (25-30 g), *P. niger* (210-230 g) and *L. dussumieri* (100-150 g) caught off Visakhapatnam coast by mechanized gillnetters were brought to the laboratory within half an hour of landing. The fish were kept moist at ambient temperature in trays by partly covering with another tray and periodic sprinkling of water on exposed surface, if necessary. Each species was kept in separate trays. The fish was collected throughout the year. The time that elapsed between gill net catch and landing was not included in computing the length of storage life in laboratory at ambient temperature. Overall quality of fish on the basis of change in texture, eye, gill, belly wall, appearance and odour during storage was examined and rated on a five point scale (score of 5 for excellent and 1 for poor) (Table 1) by five trained panelists (Hill & Glew, 1973). Fish stored in laboratory at ambient temperatures were analyzed at an interval of 2 h.

Moisture and fat content in fish muscle were determined by standard methods (AOAC, 1975). Total volatile base nitrogen (TVBN) content in muscle was estimated by Conway micro-diffusion method (Conway, 1950). Peroxide value (PV) of fat in muscle and histamine in muscle were determined by AOAC (1975) methods. Histamine was isolated by cotton acid succinate column and estimated colorimetrically (470 nm) by coupling diazonium salt.

Results and Discussion

P. hamrur, *S. dobsi*, *P. niger*, *D. accuta* and *H. marginatus* contained less than 1.5% fat. *A. mate*, *M. cephalus*, *M. cordyla*, *S. guttatus*, *S. tol* and *L. dussumieri* contained more than 1.5% fat. The midday room temperature at Visakhapatnam in summer and winter were 31-33°C and 26-30°C, respectively. The catches collected at landing centre during winter had slightly better overall quality than that collected in summer. Thus, the average shelf life of stored fish was better in winter than in summer. All fish except

P. niger and *L. dussumieri* were collected in summer and were acceptable up to 4 h.

The level of TVBN increased with storage (Tables 1 & 2). The putrefactive mesophilic bacteria present in gut, skin and gills might be responsible for increase in TVBN, due to their rapid growth at tropical ambient temperature and faster penetration to muscle through belly wall and skin. The extent of accumulation of TVBN in winter was less than that in summer. Peroxides were not present in detectable levels in lean fish but in other samples PV increased during storage (Tables 1 & 2) and was highest in *S. guttatus* in summer.

The accumulation of histamine in all fish in summer was more than that in winter. The histamine level in organoleptically acceptable fish was below 15.0mg.100g⁻¹ muscle in summer at ambient temperature. In winter it was below 11.0 mg.100g⁻¹ muscle except in *H. marginatus*. Histamine level in fish of acceptable quality during the monsoon season was below 12.0 mg.100g⁻¹ muscle. Yamanaka *et al.* (1984) reported that histamine in muscle of sardine, saury, pike, mackerel and tuna, increased rapidly during storage at 35°C. The mesophilic histamine forming bacteria present in viscera and skin of fish might be responsible for histamine formation at relatively higher rate in stored whole fish at ambient temperature (Morii *et al.*, 1988; Salguero & Mackie, 1979).

The extent of histamine formation in *S. guttatus*, *P. hamrur*, *S. tol* and *H. marginatus* was more than that in other species under study, probably due to the difference in the intrinsic composition related to the amount of histidine and histidine decarboxylase in their muscle. The accumulation of histamine in all scombroid species in acceptable condition was also below 20 mg % at tropical ambient temperatures.

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