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Quality Changes in Pangus (*Pangasius hypopthalamus*) in Relation to Size and Season During Storage in Ice

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Abstract: The investigation was carried out to evaluate the shelf life of Pangus (*Pangasius hypopthalamus*) stored in ice in relation to size and season. Samples collected from different ghers in Khulna region of Bangladesh during April 2002 to January 2003 were assessed both in summer and winter for three sizes of fish (large, medium and small). Quality deterioration was studied for 18 days by organoleptic and biochemical (TVB-N, TMA-N and pH) parameters. In summer, for large fish, the keeping time varied between 10 to 12 days when the value of TVB-N, TMA-N and pH ranged between 17.88±0.97 to 24.12±0.08, 4.43±1.47 to 5.23±1.05 mg N/100 g and 6.75±0.50 to 7±0.08; while the acceptability limit in winter was the 10th day. Within this period, the value of TVB-N, TMA-N and pH was 17.04±1.02, 4.03±0.84 mg N/100 g and 6.64±0.09, respectively. In case of medium fish during summer, the shelf life was 12 days when the value of TVB-N, TMA-N and pH was 22.46±1.36, 5.47±0.54 mg N/100 g and 6.8±0.08. The shelf life in winter season was found on the 10th day. At that time, the value of TVB-N, TMA-N and pH was 15.08±0.06, 4.78±0.84 mg N/100 g and 6.2±0.04. For small fish, in summer, the rejection time was on the 10th day and the value of TVB-N, TMA-N and pH was 19.71±1.05, 4.61±0.74 mg N/100 g and 6.86±0.05. However in winter, the just acceptability limit was found on the 10th day. The value of TVB-N, TMA-N and pH was 18.32±0.58, 4.52±0.68 mg N/100 g and 6.78±0.50 during this period.

Keywords: *Pangasius hypopthalamus*, shelf life, organoleptic assessment, TVB-N, TMA-N, pH

INTRODUCTION

A substantial number of fresh water cultured species like Rui, Catla, Mrigal and Thai Pangus are available in Bangladesh. Among them, Thai Pangus (*Pangasius hypopthalamus)* is an important species because of its rapid growth rate, high adaptability in any adverse condition and high market demand. The ultimate target of culturing any fish is to supply good and fresh fish to the consumer. Freshness of fish can be determined by organoleptic and biochemical assessment. Organoleptic methods are universally accepted for estimating the quality of fish. Measurement of Total Volatile Basic Nitrogen (TVB-N) and Trimethyl Amine (TMA) is the reliable and popular method to be used as a practical index of freshness of fish[1]. The measurement of pH is a rapid test for detection of spoilage of fish.

Quality of fish is dependent on the storage temperature and length of storage time. The International Code of Practice for fresh fish prepared by the Codex Alimentarius Commission recommends that fish should be chilled to the temperature of melting ice (0°) as soon as possible after capture and should be maintained at this temperature until it reaches the consumer. The practice of icing immediately after capture and throughout the distribution chain retards spoilage and the shelf life of fresh fish can be extended quite considerably[2]. Some fish species have the longer shelf life when stored in ice[3]. However, there is no regular and definite pattern of degradation for ice stored fish. It may vary due to species, size and season[4,5].

In Bangladesh, a few studies have been carried out on the quality of fish during ice storage[6]. But less study has been done on the Pangus. However, the objective of the this investigation was to assess the quality changes in Pangus (*Pangasius hypopthalamus*) in relation to size and season during ice storage.

MATERIALS AND METHODS

Fish were collected from different ghers (ponds) in Khulna region of Bangladesh during April 2002 to January 2003. Fish were harvested with tana jal (Drag net) in the early morning and placed in a drum and transported by van in live condition to the Quality Control Laboratory of Fisheries and Marine Resource Technology Discipline of

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Table 1: Organoleptic score sheet for fresh fish[7]

Eye		Pupil	
Characteristics	Score	Characteristics	Score
Bright, clear and full	10	Bright and transparent	10
Slight dull	9	Slight dull/ milky	8
Moderately dull	8	Slight milky white	7
Dull	7	Watery colour /whitish	6
Slightly sunken	6	Milky white	4
Moderately sunken	4	Pale / white	2
More sunken	2	Extremely pale / more white	0
Completely sunken	0		
Gill		**Body surface**	
Characteristics	Score	Characteristics	Score
Bright red	10	Shining bright	10
Slight dull red	9	Slight loss of brightness	8
Slight pale	7	Loss of brightness	6
Moderately pale	6	Slight dull	5
Pale / whitish	4	Dull and slight reddish	3
Dark colour	2	Moderately dull	2
Blackish	0	Completely dull	0
Belly wall		**Texture**	
Characteristics	Score	Characteristics	Score
Normal fresh	10	Farm and Elastic	10
Slightly discoloration	8	Rigor stage	9
More discoloration	6	Just post rigor stage	7
Slightly digested	4	Slightly soft	5
More digested	2	Moderately soft	3
Completely digested	0	Just retaining impression Imprints	1
		Very soft and loose	0
Odour		**Overall acceptability**	
Characteristics	Score	Characteristics	Score
Fresh fishy odour	10	Highly acceptable (HA)	10
Loss of fishy odour/sweety	8	Acceptable (A)	8
Slightly spoilage odour	7	Moderately acceptable (MA)	6
Spoilage odour	5	Just acceptable (JA)	5
Slightly off odour	3	Just Unacceptable (JU)	4
Off odour	2	Unacceptable (U)	3
Extremely off odour	0	More unacceptable (MU)	2
		Extremely unacceptable (EMU)	0

Khulna University. The fish were kept in two insulated ice boxes with additional crushed ice. Quality deterioration of fish was studied during ice storage for 18 days. Fish were kept in ice at a ratio of 1:1 in insulated boxes. During the experiment, ice was changed every day. Three sizes of pangus (*Pangasius hypopthalamus*) (750-850 g for large, 550-650 g for medium and 350-450 g for small fish) were used.

The investigation was conducted in two seasons, summer (April-May, when water temperature was 27-28°C and air temperature 30-32°C) and winter (December-January, when water temperature was 19-21°C and air temperature 22-24°C).

Organoleptic evaluation was carried out according to the procedure of Shewan and Ehrenbreg[7] as shown in Table 1. TVB-N, TMA-N and pH were determined according to procedure of Conway[1] as modified and stated in the manual of Siang and Kim[8]. pH was measured in an electronic pH meter with a glass electrode using expanded scale.

RESULTS

Organoleptic assessment: It is clearly evident from the Table 2 that the score decreased steadily with time. The average score for large, medium and small fish in summer and winter season on the zero day were same and fish were Highly Acceptable (HA). These score decreased gradually in the same pattern over the range of 18 days iced storage trials. However, on the 10th day, the score in summer and winter for small fish were 5 and 5.3, which indicated Just Acceptable (JA) condition. The shelf life of large and medium fish in summer season lied between 10th to 12th day and 12th day, respectively whereas in winter season, it was same on the 10th day. Statistical analysis ($p=0.05$) showed significant differences between summer and winter season in iced storage.

TVB-N content: The average score for large, medium and small fish in summer and winter season on the zero day were 4.25±1.05 and 4.05±0.25 mg N/100 g, 5.15±0.89 and 5.64±1.06 mg N/100 g, 3.35±1.05 and 4.21±0.96 mg N/100 g (Table 3 and 4). These score increased gradually in the same pattern over the range of 18 days iced storage trials. Statistical analysis ($p \leq 0.05$) showed significant differences between summer and winter season for TVB-N content.

TMA Content: The Table 3 and 4 indicate that the average score for large, medium and small fish in summer and winter season at the zero day were almost similar which was Highly Acceptable (HA) quality. These score also

Table 2: Changes in organoleptic qualities of pangus (*Pangasius hypopthalamus*) during ice storage for large, medium and small fish in summer and winter season

	Average acceptability score					
	Summer			Winter		
Storage days	Large	Medium	Small	Large	Medium	Small
0	HA 10	HA 10	HA 10	HA 10	HA 10	HA 10
3	HA 9	A 8.3	HA 9.3	A 8.3	A 8.6	A 8.6
6	MA 6.7	MA 6.7	A 7	MA 7	MA 7	MA 6.7
10	MA 5.7	MA 5.7	JA 5.3	JA 5.3	JA 5	JA 5.3
12	JU 4.3	JA 4.7	JU 4.3	JU 4	JU 3.7	JU 4.7
14	UA 2.6	UA 2.7	MU 2	MU 2.3	MU 2	UA 2.7
18	EU 0.7	EU 0.7	EU 1	EU 0.6	EU 0.7	EU 1

*HA= Highly acceptable A = acceptable MA= Moderately acceptable JA= Just acceptable JU= Just unacceptable, U=Unacceptable, MU= More unacceptable, EU= Extremly unacceptable

Table 3: TVB-N, TMA-N and pH content of large, medium and small fish stored in ice during summer season

Storage days	TVB-N (mg 100 g^{-1})			TMA-N (mg 100 g^{-1})			pH		
	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
0	4.25±1.05	5.15±0.89	3.35±1.05	1.13±0.86	0.95±0.05	1.04±0.25	6.75±0.05	6.90±0.01	6.65±0.08
3	3.39±1.01	4.49±1.41	3.94±0.85	1.70±1.03	1.01±0.52	0.94±1.08	6.60±0.09	6.50±0.06	6.56±0.07
6	9.22±0.68	8.04±1.47	6.86±1.07	3.86±0.52	3.97±1.04	3.73±0.98	6.57±0.23	6.73±0.04	6.65±0.06
10	17.88±0.97	16.05±0.84	19.71±1.05	4.43±1.47	4.79±1.29	4.61±0.74	6.75±0.50	6.65±0.09	6.86±0.05
12	24.12±0.08	22.46±1.36	23.29±0.85	5.23±1.05	5.47±0.54	5.71±0.25	0.07±0.08	6.80±0.08	6.95±0.07
14	31.52±1.25	34.78±0.98	33.15±1.46	10.57±0.07	6.81±1.08	8.69±1.06	6.90±0.07	7.16±0.02	0.07±0.08
18	46.75±1.56	47.36±0.97	47.97±1.01	12.64±1.39	12.89±1.07	12.39±1.08	7.30±0.07	6.90±0.03	7.1±0.04

Note: The highlighted value indicated the score on the day of rejection

Table 4: TVB-N, TMA-N and pH content of large, medium and small fish in iced storage in winter season

Storage days	TVB-N (mg 100 g^{-1})			TMA-N (mg 100 g^{-1})			pH		
	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
0	4.05±0.25	5.64±1.06	4.21±0.96	1.58±0.69	0.88±0.64	1.21±0.05	6.62±0.05	6.06±0.05	6.60±0.06
3	3.93±1.02	4.02±1.04	4.14±1.06	1.92±1.26	1.12±0.69	0.84±0.98	6.48±0.05	0.06±0.07	6.53±0.08
6	8.68±0.05	7.09±0.94	6.07±1.23	3.21±0.85	3.66±0.35	3.86±0.08	6.22±0.36	6.63±0.06	6.58±0.21
10	17.04±1.02	15.08±0.06	18.32±0.58	4.03±0.84	4.78±0.84	4.52±0.68	6.64±0.09	6.20±0.04	6.78±0.50
12	22.46±1.06	21.43±0.05	20.28±0.65	5.23±1.08	5.32±0.64	5.48±0.08	6.84±0.01	6.62±0.23	6.86±0.07
14	30.50±1.25	32.67±0.56	31.54±0.25	9.88±1.58	6.68±0.25	8.24±0.02	6.64±0.08	7.04±0.69	6.92±0.06
18	44.40±0.65	46.24±0.87	45.31±1.05	11.94±0.65	12.86±0.87	12.02±0.05	0.07±0.21	6.43±0.08	6.98±0.03

Note: The highlighted value indicated the score on the day of rejection

increased similarly over the range of 18 days of iced storage trials. But the Just Acceptable (JA) condition for large fish in summer season lied between 10 to 12 days while in winter season was on the 10th days and for medium fish the self life was on the 10th and 12th day, respectively. The Just Acceptable (JA) condition for small fish was same on the 10th day both in two seasons. Statistical analysis ($p \leq 0.05$) showed significant differences between summer and winter season for TMA-N content in iced storage and for all sizes of Pangus (Table 3 and 4).

pH: Table 3 and 4 imply that the average score for large, medium and small fish in summer and winter season on the 0th day were 6.75±0.05, 6.9±0.01, 6.65±0.08 and 6.62±0.01, 6.06±0.05, 6.6±0.6 which were within the range of Highly Acceptable (HA) quality. For large fish in summer season the score decreased until 6th day and the score was 6.57±0.23 and in the same storage day in winter, it was 6.22±0.36 and almost the same decreased pattern was found in case of medium and small fish. However, after slight decreasing pH started increasing and on the 18th day the highest score were found and the score in summer and winter for large fish were 7.3±0.07 and 7±0.21, for medium fish were 6.9±0.03 and 6.43±0.08 and for small fish were 7.1±1.04 and 6.98±0.03. Statistical analysis ($p \leq 0.05$) showed significant differences in pH between summer and winter season for all sizes of fish.

DISCUSSION

Organoleptic assessment: In the present study shelf life of the large fish in summer season lied between 10 to 12 days, medium fish 12 days and small fish 10 days. In winter season all the fish had the shelf life of 10 days. The shelf life of some fresh water species, pejerry (*Basilichthys bonariensis*), carp (*Cyprionus carpio*) and trout (*Salmo gairdneri*) in crushed ice were 15, 20 and 15-16 days, respectively[9]. These fresh water species indicate slightly longer shelf life compared to *Pangasius hypopthalamus* in the present investigation. The variation between the shelf life of the same species may occur due to sizes, keeping method, geographical location, catching method, individual differences in the same species[10].

Total Volatile Basic Nitrogen (TVB-N): Connell[11] stated that TVB-N content in fresh fish has highly positive and highly negative correlation ship with storage time indicating that TVB-N is a good indicator of spoilage and result of the present study agreed it.

Huss[12] reported that a good quality cold-water fish contains 30-35 mg TVB -N 100 g^{-1} of sample. TVB-N value increased progressively with increased storage time for both summer and winter seasons. However, with increased storage time, in some species, TVB-N content was found to decrease[13]. This may be attributed to volatile bases leached out due to melting ice during storage. If the leaching could be prevented, TVB-N value would show regular increase with storage time.

Trimethylamine (TMA): Huss[12] reported that a good quality cold water fish contains < 1.5 mg TMA-100 g^{-1} of sample and that the limit of acceptability is 10-15 TMA-N 100 g^{-1} of sample. The initial score of Pangus is similar to this report but the score at the limit of acceptability were lower and it varied between 5-6 mg N/100 g for all sizes fish in both season. Beatty and Gibbons[14] suggested the acceptable limit of TMA was 4-6 mg N/100 g. Present findings are well agreement with this report.

The TMA values of *Sardina sirm* during iced storage did not indicate actual spoilage pattern of fish and did not seem to be useful as index of freshness[15]. When fish (*Restrallier faughni*) spoiled during iced storage, TMA values ranged from 1.44-1.82 mg N/100 g and showed no significant correlation with storage time and sensory results[16]. These findings differed from the present investigation for both seasons and for all sizes of fish as TMA-N showed highly negative correlation with organoleptic score. Statistical analysis also supported the significance of TMA-N as a good spoilage indicator in the present investigation.

pH: The muscle of living fish, in general, is approximately neutral in reaction and after catching, the pH value decreases, due to formation of lactic acid from glycogen by series of reaction[17]. As spoilage advances, the pH value of the muscle rises first slowly and later quite rapidly. This is due to the accumulation of the basic end product of bacterial spoilage and pH rises up to 7.5 to 8.0[18].

pH value of pejerry (*Basilichthys bonariensis*), carp (*Cyprinus carpio*) and trout (*Salmo gairdneri*) increased during 17-20 days of iced storage. The initial pH of the muscles of these fish were in the range of 6.3-6.4. The value obtained for trout was exceptionally erratic and would not provide a useful index of fish freshness with this species[9]. In the present investigation for both season for all sizes of fish the initial pH of the muscles ranged between 6.06 to 6.9.

Abdullah and Yean[19] reported that pH had little influence on the textural deterioration of chub mackerel under storage in ice. This is in agreement with the present investigation for all fishes for both seasons.

It can be concluded that there were slight differences on the quality changes of iced fish in summer and winter season. The organoleptic assessment showed that during ice storage in winter season, fish had the shorter shelf life compare to summer season and no apparent difference was found due to variation in size.

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