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Effect of delayed icing on the quality of tiger shrimp (*Penaeus monodon* Fab.)

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Abstract
Effect of delayed icing on the quality of *Penaeus monodon* iced after three hours of harvest was studied in plastic and bamboo baskets. After harvest of three hours at ambient temperature (28^0-32^0C), ice was added to the shrimp at a ratio of 1:1 (shrimp: ice) and stored for 21 hours in both the baskets. Quality evaluation was carried out through visual assessment, biochemical analysis and microbial analysis for 24 hours. The organoleptic evaluation and scoring was done from the time of harvest treated as 0 hour and the average score was 10. At 9^{th} hour after iced condition quality of shrimp was found reduced to the next stage (acceptable) with a score ranged from 8.4-6.5 in both baskets. This acceptable stage was observed throughout the experiment for bamboo basket whereas in the plastic basket the quality was reduced to a small extent with a score of 6.4 (moderately acceptable). Till the end point of the experiment the quality of shrimp was acceptable in respect to biochemical analysis. The microbial load was found $\log_{10}$ 3.99±0.12 cfu/g to $\log_{10}$ 4.33±0.21 cfu/g and $\log_{10}$ 4.01±0.12 cfu/g to $\log_{10}$ 4.83±0.19 cfu/g in the bamboo and plastic basket respectively. The importers or buyers suggests for immediate icing to maintain good quality but results of the present experiment suggest that the quality does not vary drastically for first three hours.

Key words: Organoleptic assessment, Delayed icing, TMA-N, TVB-N

Introduction

Shrimp culture prospective is mostly recognized as the main exportable fisheries product after garments now and development of this sector is increasing day by day. Besides it plays a dominant role in foreign exchange earnings, employment, education, nutrition, poverty alleviation and other socio-economic development of the country. Though in Bangladesh, shrimp production is increasing, shrimp farmers do not get expectable amount of return from their harvest due to lack of proper handling and management of shrimp after catching, which results both qualitative and quantitative losses. Qualitative losses occur through spoilage or microbial attack and due to lack of proper preservation during the transportation of shrimp from Gher to processing center

whereas quantitative loss consists of losses in commercial value, but not in physical biomass through loss of quality. The spoilage process in shrimp results in the changes of organoleptic, biochemical and microbiological parameters (Ali *et al.* 2008, Coulter and Disney 1988). Bangladesh is facing many serious problems in fresh shrimp trade because of its perishable nature.

Preservation is particularly necessary during the period of abundance when all the shrimps are not possible to be consumed and if there is no efficient system for handling and transportation. It is generally agreed that at 0^0C fish and shrimp become unacceptable organoleptically, biochemically and microbiologically within two weeks (Cobb *et al.* 1976). TMA can also be used as an index of spoilage (Clucas and ward 1996). After harvesting the shrimp from the gher, the farmers usually use bamboo basket or plastic basket insulated with hogla mat or banana leaves for packing shrimp with or without ice during transportation and distribution. Quality of shrimp mainly depends on storage temperature (0^0C, 10^0C, 20^0c, and 30^0C). The higher the storage temperature, the greater the spoilage of shrimp. There are a great variation in the usage of ice (ratio of ice to shrimp), usually the ratio varies i.e., 1:0.5, 1:1, 1:2. However it is necessary to know the effect of plastic and bamboo basket on the quality of shrimp. Again information on the changes of ice-stored shrimp under various conditions is therefore needed in order to avoid qualitative and quantitative losses and also to ascertain or predict its quality standard (Ali *et al.* 2008). The present investigation was undertaken to assess the quality of shrimp during stored at delayed icing where ice was added after three hours of harvest with considering the effect of the medium (plastic and bamboo baskets) in which they are stored.

Materials and methods

Sample collection and preparation: In total twenty eight (28) shrimps were collected from the gher beside the river Shoalmari at Koiya under the Batiaghata thana in Khulna district of Bangladesh. Shrimps were kept in plastic and bamboo baskets immediately after harvesting using banana leaves. During sample collection water temperature of the gher was 28^0C. After three (3) hours of harvesting, shrimps were stored in ice at 1:1 ratio for 21 hours. After collecting and storing, they were immediately brought to the Quality Control Laboratory of Fisheries and Marine Resource Technology Discipline of Khulna University. From each basket, 5 shrimps were assessed for organoleptic evaluation intermittently for each hour until the end of study period. 3 shrimps from each basket were taken out and muscles were pooled for biochemical and microbiological analyses at different intervals during the 21 hour storage.

Organoleptic analysis: Organoleptic score sheet (Table 1) was used for the organoleptic quality assessment of shrimp developed by Ali *et al.* (2008). From the developed organoleptic score sheet, an overall acceptability ranking was done (Table 2). The organoleptic characteristics emphasized on odour, carapace color, carapace texture, eye

and shell color characteristics. While conducting the organoleptic analysis, the room temperature ranged between 28 ^{0}C to 31^{0}C.

Table 1. Organoleptic score sheet for shrimp developed by Ali *et al.* (2008).

Odor	Score	Carapace Color	Score
Fresh odour	10	Greenish(fresh)	10
Slightly fresh odour	9	Moderately greenish	9
Sweetly odour	8	Slightly greenish	7
Slightly spoilage odour	7	Slightly darken	5
Moderately spoilage odour	6	Moderately darken	3
Spoilage odour	5	Darken	0
Slightly off odour	4		
Moderately off odour	3		
Off odour	2		
Extremely off odour	0		
Carapace Texture		Eye	
Hard	10	Bright and transparent	10
Slightly hard	9	Moderately transparent	9
Moderately hard	8	Slightly transparent	8
Slightly soft	7	Slightly dull	7
Moderately soft	5	Moderately dull	5
Soft	3	Dull and opaque	3
Very soft	0	Fully dull and opaque	0
Shell Color	Score		
Bluish white	10		
Moderately bluish	9		
Slightly bluish	8		
Slight loss of brightness	7		
Loss of brightness and opaque	5		
Slightly reddish	3		
Radish (spotted)	0		

Table 2. Organoleptic score sheet of overall acceptability for shrimp.

Overall acceptability characteristics	Score range
Highly acceptable (HA)	8.5 – 10.0
Acceptable (A)	6.5 – 8.4
Moderately acceptable (MA)	4.5 – 6.4
Just acceptable (JA)	3.6 – 4.4
Just unacceptable (JU)	2.6 – 3.5
Unacceptable (U)	1.5 – 2.5
More unacceptable (MU)	0 – 1.4

Biochemical and microbiological analysis: TVB-N (Total Volatile Base Nitrogen) and TMA-N (Tri Methyl Amine Nitrogen) were determined according to the procedure of Siang and Kim (1992). Microbial analysis was done according to the procedure of ICMSF (1988). It involves the determination of standard plate count (SPC).

Results

Organoleptic changes of Penaeus monodon at delayed icing

Fig. 1 illustrates the organoleptic changes in *Penaeus monodon* during a period of 24 hours and 21 hours storage in ice. Shrimp were assessed 0 hour (immediately after arriving at the laboratory), 3rd hour (i.e. at that moment when ice was added to the sample after three hours of harvest), 4th hour, 5th hour etc up to 24th hour. The organoleptic evaluation and scoring had been started at the time of harvest of shrimp treated as 0 hour and the average score was 10. The initial average score on the 3rd hour (i.e. second observation of the experiment) was also 9.4 both in plastic and bamboo basket. However, the score gradually decreased over the range of time.

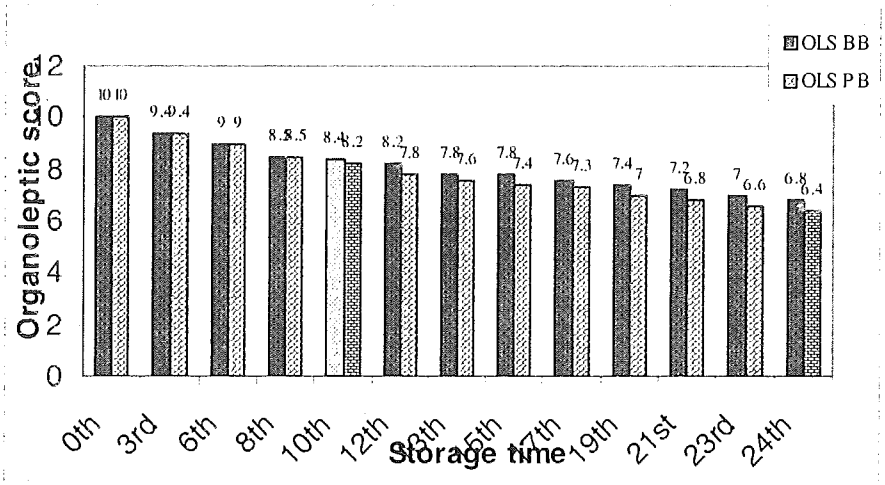

Fig. 1. Organoleptic score of shrimp stored at plastic and bamboo basket at delayed icing.

It was apparent that the quality of shrimp was under highly acceptable (HA) limit till 10th hour of observation and the quality was drastically changed soon after the 10th hour. It was 8.4 in the bamboo basket and 8.3 in the plastic basket. The difference of score was little but the quality attribute changed into another state.

Bio-chemical changes of Penaeus monodon at delayed icing

Total Volatile Base Nitrogen (TVB-N) in bamboo and plastic basket: The Fig. 2 shows the obtained TVB-N values for three different times and also shows the comparative values of the baskets in the same storage time period. In the present study the amount of

TVB – N was obtained over 24 hours storage including 21 hours in ice ranged between 2.56±0.32 mg-N/100g to 5.21±0.61 mg-N/100g whereas in the plastic basket it was 2.58±0.36 mgN/100g to 5.37±0.37 mgN/100g. In the 12th hour of the experiment the value was 3.64±0.66 mgN/100g in the bamboo basket and 3.73±0.58 mgN/100g in plastic basket.

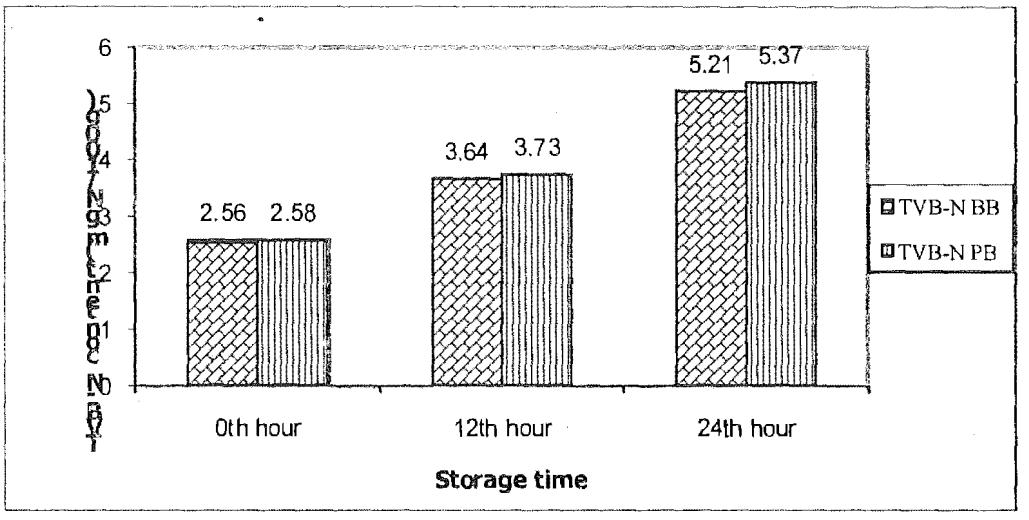

Fig. 2. Comparison of TVB-N in plastic and bamboo basket with storage time.

Trimethylamine Nitrogen (TMA - N) in bamboo and plastic basket: The Fig. 3 shows the obtained TVB-N values for three different times and also shows the comparative values of the baskets in the same storage time period. From the 0th hour to 24th hour of experiment the TMA-N content was 2.68±0.21 mgN/100g to 5.02±0.41 mgN/100g. This result was for the bamboo basket whereas in the plastic basket it was 2.72±0.23 mgN/100g to 5.16±0.47 mg-N/100g respectively.

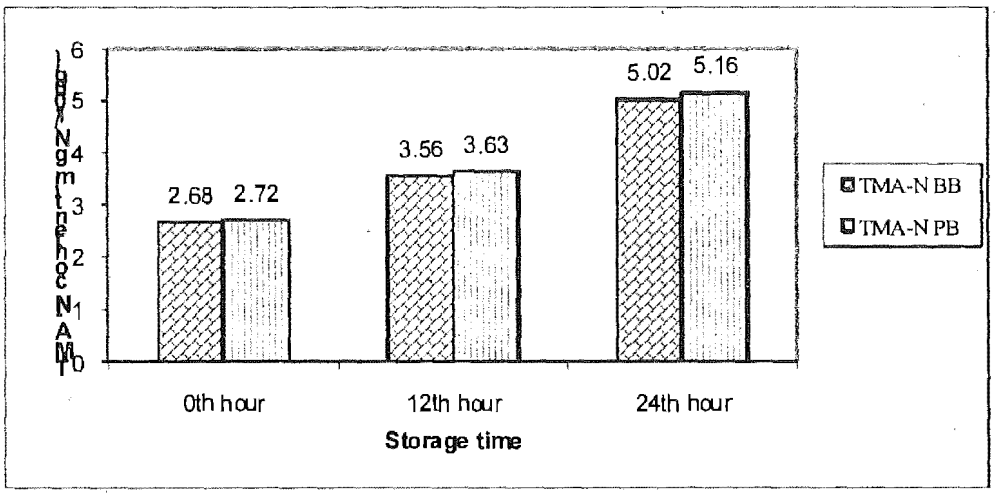

Fig. 3. Comparison of TMA-N in plastic and bamboo basket with storage time.

Microbiological (SPC) analysis of shrimp in plastic and bamboo baskets: Fig. 4 shows the microbiological quality changes in shrimp with storage time in both baskets. The average SPC counts obtained from these experiments varied between $\log_{10}3.93\pm0.12$ cfu/g to $\log_{10}4.33\pm0.21$ cfu/g respectively in the bamboo basket and in the plastic basket it was $\log_{10}4.01\pm0.12$ cfu/g to $\log_{10}4.83\pm0.19$ cfu/g respectively. SPC count was increasing in respect of storage time and relatively high in plastic basket.

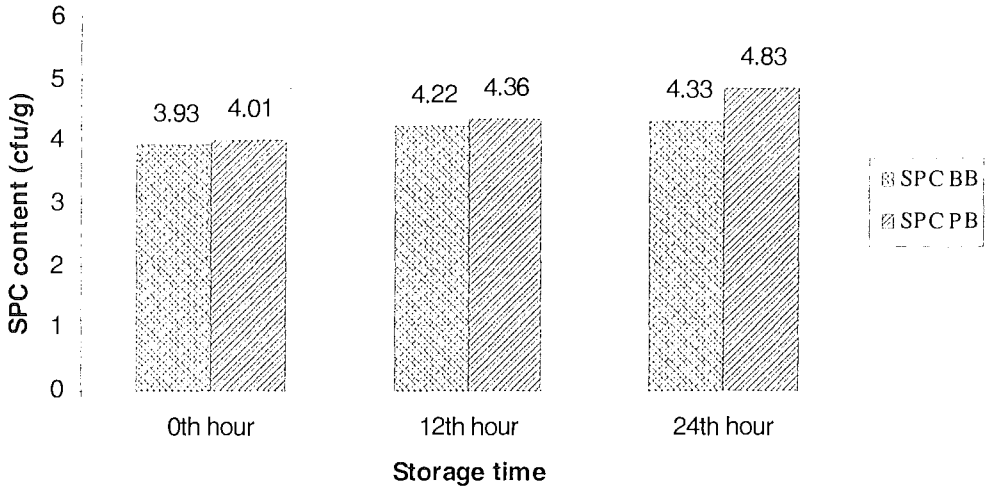

Fig. 4. Comparison of SPC in plastic and bamboo basket with storage time.

Discussion

Organoleptic changes in *Penaeus monodon*: The organoleptic evaluation and scoring had started after half hour of harvesting considered as 0^{th} (zero) hour and the average score on 0^{th} hour was 10 for both baskets. Then for each hour after 0^{th} hour was considered as 1^{st}, 2^{nd}, 3^{rd}, 4^{th} hour etc. From the Fig. 1, it was apparent that the quality of shrimp was under highly acceptable (HA) limit up to 10^{th} hour and values were 8.5 in both the baskets. Farooqui *et al.* (1978) reported that shrimp in ice maintained good quality for 0-2 days as judged by organoleptic quality was acceptable up to 7 days and rejected after 9 days. Reilly *et al.* (1985) has observed that shrimp lost their value as prime quality head-on produces after 2 days, during storage at 0^0C. They also found that shrimp iced immediately kept for 17 days, while 4h, 8h and 12h delayed iced shrimp kept for 16, 13 and 11 days respectively. Ali *et al.* (2008) conducted a similar experiment on quality changes in *P. monodon* at ambient temperature and reports that shrimp are rejected after 14^{th} hour in plastic basket but in bamboo basket after 15^{th} hour. However, the result of the present investigation assumed similarity with the above authors. After 10^{th} hour of storage time the result gradually changed in both the baskets and it was 8.4 and 8.2 in bamboo and plastic basket respectively. In the 13^{th} hour it was 8 and 7.6 respectively

whereas in the 15th hour storage time it was 7.6 and 7.4. Again in the 19th hour storage time it was 7.4 and 7. Here within four hour range the score in bamboo basket decreased a little in respect to plastic basket. Again in the 23rd hour storage time the score was 7 and 6.6 where the difference was same and it is in an acceptable range. But after within one hour there was a significant difference in the overall acceptability. In the last hour or 24th hour of experiment the score was 6.8 and 6.4 in which the score of the bamboo basket was in acceptable (A) region. On the other hand the score of plastic basket was in moderately acceptable (MA) region. Organoleptic characteristics of Shrimp stored in both plastic and bamboo basket indicated almost similar results for all shrimps. But the quality of shrimp stored at bamboo basket indicated a little bit better quality than that stored at plastic basket.

Total Volatile Base Nitrogen (TVB-N): Measurement of Total Volatile Base Nitrogen (TVB-N) is probably the first chemical method to be used as a potential and widely used index of freshness and it still the most popular indicator (Stansby *et al.* 1994). The level of total volatile nitrogenous bases increases after spoilage begins, both enzymically and bacterially and thus can be used as an index of spoilage. The low value of TVB-N initially is an indication of quality of fresh shrimp or fish while the high value may be due to autolysis and spoilage bacteria (Adebona 1982).

In the present study the amount of TVB – N was 2.56±0.32 mg-N/100g in the 0th hour of the experiment in the bamboo basket and 2.58±0.36 mgN/100g in the plastic basket. In the 12th hour of the experiment the value was 3.64 ± 0.66 mgN/100g in the bamboo basket and 3.73±0.58 mgN/100g. Again in the last observation (24th hour of the experiment) the result was 5.21±0.61 mgN/100g in the bamboo basket and 5.37±0.37 mgN/100g in the plastic basket, which was also a little bit higher than that of the two. Here the obtained results between the baskets were almost similar but compared to storage time it was little bit high and also a little bit high in plastic basket. So, it can be suggested that preservation of shrimp in bamboo basket may give a better result.

Ali *et al.* (2008) found that the amount of TVB – N ranged between 2.68±0.19296 mg/100g to 12.46±0.3396 mg/100g for a storage period of 15 hours at ambient temperature and TVB-N values show a strong positive correlation with storage time. Putro *et al.* (1990) suggested that TVB-N of *gher* shrimp varied between 7 and 28mgN/100g. Connell (1975) stated that TVB-N content in shrimp has highly positive and highly negative correlation with storage time indicating that TVB-N is a good indicator of spoilage. The value of TVB-N in both condition indicated an acceptable limit as suggested by Connell (1975). Reilly *et al.* (1985) stated that TVB-N is not reliable as indices of quality. Boee *et al.* (1982) working on the storage of shrimp has observed on the storage of shrimp has observed that TVB-N increased evenly. Matches (1982) working on shrimp stored at 5 different temperature, found that TVB-N increased both with increase in time and temperature. Cann (1974) have found the increase in TVB-N to be low during the initial period of storage, with a rapid increase noted afterwards. This result supports clearly Cann (1974) as TVB-N content gradually increased over the range of storage time and shows a strong positive correlation.

Trimethylamine Nitrogen (TMA - N): Under the local conditions TMA was found to be a good indicator of freshness for white pomfret, Chinese pomfret and grouper (Siang and Kim 1992). TMA-N was also detected three times in the experiment at 0^{th} hour, 12^{th} hour and 24^{th} hour. The average results obtained in the present experiment were 2.68±0.21 mgN/100g, 3.56±0.53 mgN/100g and 5.02±0.41 mgN/100g respectively in the bamboo basket and in the plastic basket it was 2.72±0.23 mgN/100g, 3.63±0.53 mgN/100g and 5.16±0.47 mg-N/100g respectively. TMA-N values are slightly higher in plastic basket than in bamboo basket. The results clearly indicate that storage of shrimp in bamboo basket is better than plastic basket. Connell (1975) recommended 10 – 15 mg/100g of TMA-N in fishes or shrimp for human consumption. There is also wide variation in critical values suggested for individual species, like 5 – 7 mg/100g for herring and 1 –5 mg/100g for haddock (Castell and Triggs 1955).

The accepted limit of TMA-N is 12-15 mgN/100g (Monotgomery *et al.* 1970). Ali *et al.* (2008) observed the TMA-N level was 4.35±0.2089 mg/100g to11.78±0.141774 for a storage period of 15 hours at ambient temperature. The results found in the present investigation indicated much lower value during the storage period. Reilly *et al.* (1985) has observed that the level of 5mg/100g was never reached during ice storage of shrimps. However the result of the present investigation agreed with Reilly *et al.* (1985). Though the results were increasing gradually with respect to storage time, it was within in the front of acceptable range from the view of the writers above.

Standard Plate Count (SPC): The value of SPC ranged between $\log_{10}$ 3.82±0.29436 to $\log_{10}$ 5.11±0.16453 cfu/g in plastic basket for a storage period of 14 hours and between $\log_{10}$ 3.78±0.3629 to $\log_{10}$ 4.98±0.6226cfu/g in bamboo basket for a storage period of 15 hours, at ambient temperature (Ali *et al.* 2008). SPC was also detected three times in the experiment like as TVB-N and TMA-N at 0^{th} hour, 9^{th} hour and 24^{th} hour of the experiment. The average results obtained in these experiments were $\log_{10}$3.93±0.12 cfu/g, $\log_{10}$4.22±0.53 cfu/g and $\log_{10}$4.33±0.21 cfu/g respectively in the bamboo basket and in the plastic basket it was $\log_{10}$4.01±0.12 cfu/g, $\log_{10}$4.36±0.04 cfu/g and $\log_{10}$4.83 ±0.19 cfu/g respectively. Preservation of shrimp in bamboo basket showed lower microbial (SPC) count which will ensure better storage result in bamboo basket.

The accepted limit of SPC is 10^6 cfu/g (ICMSF 1988). SPC of freshly harvested shrimp ranged from 6.8×10^4 to 1.5×10^5 as observed by Lobrerra *et al.* (1990). These counts are within the range of reputed values (10^3-10^5) of shrimp from temperature environments (Lannelongue 1982, Matches 1982). Counts reported from tropical countries also ranged from 10^3 to 10^6 (Varma *et al.* 1982, Surendran *et al.* 1985). A report by De Silva (1985), however, indicated counts as high as 10^8/gm. Result of this present study showed that freshly harvested shrimps could meet existing standards for SPC, which is 10^6/g (ICMSF 1988).

Shrimp collected from all the three districts (Bagerhat, Khulna and Satkhira) and from all the points (Gher, Depot, Agent and Processing Plant) indicated value within 10^5cfu/g, is acceptable limit even when being practiced normally (Azam 2004). However, the result of our present investigation clearly supports the mentioned value. Besides

SPC contents gradually increased for both baskets over the range of storage time up to the completion of the spoilage of the sample.

Shrimp need to be produced to a level of quality, which will satisfy both the customer and statutory food legislation. The experiment here for the rural deprived shrimp farmer mainly because after harvesting, they cannot afford to preserve shrimp in immediate ice storage. Storage in ice into near market, it takes at least two or three hours. The experiment delayed icing after three hours has conducted to detect various quality measuring methods. Here the bamboo and plastic basket provided almost similar result. From the result of this experiment, it can be recommended that it is not very necessary for the rural farmers to apply ice on shrimp immediately after the harvest.

References

Adebona, M.B., 1982. 'Studies on the preservation of fish by ice' in "*Progress of the FAO Fisheries Report*", *FAO publication*. pp. 27-31.

Ali, M. Y., W. Sabbir, M. L. Rahi, M. M. R. Chowdhury and M. O. Faruque, 2008. Quality changes in shrimp (*Penaeus monodon*) stored at ambient temperature in plastic and bamboo basket. *International J. Ani. & Fish. Sci.*, 1(1): 07-13.

Ali, M. Y., M. F. Moyaduzzaman, M. L. Rahi and M. B. Islam, 2007. Variation in rigor mortis progress of Rohu (*Labeo rohita*) and Mrigal (*Cirrhinus cirrhosus*) in relation to size. *South Asian J. Agric.*, 2(1&2): 29-32.

Azam, K., 2004. Quality of Shrimp in the Distribution Channel: An Approach in Improving the Livelihood of Fisher Community. *UGC, DFID-SUFER Project Report*, Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna, Bangladesh. ISBN9843213971.

Boee, B., N. Losnegrad and X. L. Xu, 1982. Determination of indole as a freshness assessment of shrimp. *Fiskeridir Skr.*, 2(2):35-38.

Cann, D. C., 1974. Bacteriological aspects of tropical shrimp. *In:* Fishery Products (ed., Kreuzer, R.) West Byfleet, Fishery News. pp. 338-344.

Castell, C. H. and R. E. Triggs, 1955. Spoilage of Haddock in the Trawler at sea: The measurement of spoilage and Standards of Quality. *Journal of Fish. Res. Bd. Can.* 12(3): 329-341.

Clucas, I. J. and A. R. Ward, 1996. Chemical Methods of Quality Assessment, Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality. Chatham Maritime, Kent ME4 4TB, United Kingdom. ISBN: 0-85954-441-9, 391pp.

Cobb, B. F., 1976. Effect of iced storage on microbial and chemical changes in shrimp and melting ice in a model system. *Journal of Food Sci.*, 41:29.

Connell, J.J., 1975. Control of Fish Quality. *Fishing New Books* Ltd. London: pp.127-129.

Coulter, J.P. and J. G. Disney, 1988. The handelling, preservation and marketing of fish in Bangladesh. ODNRI Bulletine No. 1 ISBN 0859 54231 or ISBN 0952 8285.

De Silva, S. L., 1985. Water quality and shrimp value. INFOFISH Marketing Digest, 2: 39-41.

Farooqui, B., M. R. Siddiqui and M. J. Khan, 1978. Chemical and organoleptic characteristics of trawler caught shrimps from the Karachi-Makran coast. Part I. Changes during ice storage and their possible use as quality indices. *Pakistan J. Sci. Ind. Res.*, 21(1):33-36.

Gibbon, N. F. and A. Labire, 1937. Spoilage of Fish during Iced Storage. *Journal of Biol. Bd. Can.* 3: 439.

ICMSF (International Commission on Microbiological Specifications for Foods), 1988. Micro-organisms in foods. Toronto, Univ. *Toronto Press*.

Lannelongue, M., 1982. Storage characteristics of brown shrimp (*Penaeus aztecus*) stored in retail packaged containing CO_2 enriched atmospheres. *Journal Food. Sci.*, 47(3): 911-913, 923.

Lobrerra, A.T., M. L. Bulalaco and A. Tau, 1990. Effect of farming phase and in-plant processing on the microbiological quality of prawns (*Penaeus monodon*), In: *Papers presented at the seventh session of the Indo-Pacific Commission Working Party on Fish Technology and Marketing*, FAO Fisheries Report, pp.1-4.

Matches, J. R., 1982. Microbial changes in packages. In: *Proceeding of the First National Conference on Seafood Packaging and Shipping*, (R. Martin, ed.). National Fisheries Inst. Seattle, WA, pp 46-70.

Montogomery, W. A., G. S. Sidhu and G. I. Vale, 1970. The Australian prawn industry. *CSIRO Food Preserv. Quart.* 30(2): 21-27.

Nurullah, M., M. Kamal, M. A. Wahab, M. N. Islam, M. S. Reza, H. T. Shakuntala and M. A. Mazid, 2006. Quality assessments of traditional and solar tunnel dried SIS (Small Indigenous Fish Species) products. *Bangladesh J. Fish. Res.*, 10(1):63-72.

Putro, S., M. Saleh and B. S. B. Utono, 1990. Spoilage of live rabbit fish during icing. IN spoilage of tropical fish and product development, edited by Reilly, A., FAO of the United Nations (Rome), pp. 56.

Rahman, M. M., 1980. 'Investigation on some aspects of quality changes during handling and preservation of *Tilapia nilotica* and *Cyprinus carpio*. M. Sc. Thesis, Department of Zoology, Dhaka University.

Reilly, A., M. A. Bernarte and E. Dangla, 1985. Quality changes in brackish water prawns (*Pennaeuss monodon*) during storage at ambient temperature in ice and after delays in icing. Reilly, A. (ed). FAO Fish Rep., (317) Suppl.: 133-145.

Shewan, J. M., and R. T. Ehrenberg, 1957. The bacteriology of Fresh and Spoilage Fish and The Biochemical Changes Induced by Bacterial Action. *In* Handling, Processing, and Marketing of Tropical Fish. Tropical Products Institute, London. pp. 51-66.

Siang, N. C. and L. L. Kim, 1992. Determination of trimethylamine oxide, trimethylamine and total volatile basic nitrogen by Conway's micro-diffusion method. *In* Laboratory manual on analytical methods and procedures for fish and fisheries products (Miwa and Ji, 1992 ed.). Southeast Asia Fisheries Development Center. B3.1-B3.6.

Sikorski, Z., N. Haard, T. Motohiro and B. S. Pan, 1998. Quality. In: *Fish Drying & Smoking. Production and Quality.* (eds. Doe, P. E.) Technomic publishing Co., Inc. Lancaster.

Stansby, M. E., M. E. R. Vancleve and J. A. Stern, 1994. Scaitte Contract Republic V. S. D. I. Bur. Comm. Fish. *In* Spoilage of Tropical Fish and Product Development, edited by Reilly, A. Food and Agricultural Organization of the United Nations (Rome), pp-221.

Surendran, P.K., I. K. Mahadeva and K. Gopakumar, 1985. Succession of bacterial genera during ice storage of 3 species of tropical prawns *P. indicus*, *Metapenaeus dobsoni* and *M. affinis*. *Fish Technol.*, 22:117-120pp.

Varma, P. R. G., C. Mathen and A. Matthew, 1982. Bacteriological quality of frozen seafoods for export with special reference to Salmonella. *Sym. Harvest/Post harvest Fish Technol.*, India, 665-666pp.

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