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Quality Assessment of Shrimp (*Macrobrachium rosenbergii*. De Man, 1879) During Storage in Ice.

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Abstract

With a view to get a pen picture about the trend and extent of quality changes and as well as shelf life of the head off and head on shrimp (*Macrobrachium rosenbergii,* De Man, 1879), the present study have been carried out . Quality changes have been measured by application of sensory score evaluation and changes in chemical indices such as Total Volatile Nitrogen (TVN) value, pH and level of moisture at different time interval and Total Bacterial Count (TBC) at 15^{o}C during the study period. The results of the sensory score evaluation indicates that the shrimp quality decreased to the limits of acceptability at 12th days of ice storage. The head off shrimp kept slight better than corresponding head on shrimps. The bacterial counts determined at 15^{o}C have been found to increase from 10^3 - 10^7 and 10^4 -10^8 cfu/gm for head off and head on shrimp respectively at the limit of acceptability. The moisture level increased from initial 78.85gm% to final 83.80gm% (head off) & 79.0gm% to 84.0gm% (head on) and pH value increases from 7.1 to 8.1 during the whole period of iced preservation . Both head off and head on shrimp remained in acceptable condition for up to 12 and 14 days of storage respectively while the quality of fish deteriorates and become unacceptable. The bacterial count corresponding to unacceptable condition ranges from 10^8-10^9 cfu/gm fish sample. The TVN value corresponding to rejection condition were 45-50mg N/100gm fish sample.

Key Words : Shelf life, Icing preservation, Shrimp, Quality assessment, Evaluation.

Introduction

Fish is a very tasteful nutritionally enriched food item and undergoes a rapid deterioration just from the starting of harvesting period caused by bacterial and enzymatic autolysis. Deterioration of the fish causes both nutritional economical losses. One of our exportable fish item is shrimp which requires a quick icing preservation from the catching centre to the fish processing plants who exports the shrimp. For local home demand the fish are also preserved in ice so that fish wastage may be minimized there by protecting both economical and nutritional loss (Clucas and Ward, 1996 and William and Dennis (2003).

Among the shellfish, shrimp (*Macrobrachium rosenbergi*, De Man, 1879) is one of the most important and perishable food item. Major portion of catches are marketed for internal consumption and as well as for export which remains not always in grade one quality. Microbial and endogenous enzymatic activities are main causes of quality deterioration in fish (Burges *et al*., 1965 and Liston, *et al.*,1963). However, little technological innovation has been adopted to reduce the high losses both in terms of quality and quantity. Icing is the common method used to chill the shrimp during all stages of handling, storage and transportation in our country from landing centers to the processing plants.

Crushed block ice is commonly used at the landing centre of this region. But improper handling, use of dirty ice which has been made from untreated river, lake and pond water, application of insufficient ice results in considerable loss of quality of shrimp. Therefore, these poor practice of icing enhance the short shelf life of fish.

The packing and transportation of fish from the point of landing to the large market centre is also not well organized in Bangladesh. As a result quality of fish deteriorates most rapidly due to the lack of proper technical facilities as at landing center.

Several reports on changes in levels and types of micro flora affecting quality of several species of temperate and tropical fishes are available (Shewan, 1977, Cobb *et al.* 1976 and Lima, 1983). Most temperate species appear to carry a higher phychrophillic micro flora as compared to tropical fishes . Thus the shelf life as affected by bacterial spoilage

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of temperate fishes stored in ice will be shorter than of tropical fishes. This has been reported in case of different species of fishes (Shewan, 1977, Cobb, *et al*. 1976 and Lima, 1983).

Several chemical criteria have been used to measure bio-chemical changes occurring during enzymatic breakdown of muscle protein at cold storage.

Considering the practice of the use of ice during post harvest handling, transportation and marketing of shrimp an investigation have been carried out to find out the effectiveness of the use of ice under ideal storage condition - as a measure for extending the shelf life and to make quality assessment of the ice stored shrimp both head off and head on.

Materials and Methods

The material used for the present study was medium sized (weight 20.34 gm$\pm$1.41, length 9.99 cm$\pm$0.94) shrimp. Fresh and highly acceptable shrimp were collected from the local market and was brought to the Fish Technology Laboratory, IFST, BCSIR, Dhaka to carry out the investigation. At first, shrimp were washed by tap water and the whole fish sample was divided in two equal parts. One was head on and the other part was head off. It was then well iced (1:1) fresh ice and kept in chilled room. Everyday ice were added to maintain the temperature more or less at O^oC and were kept in an insulated fish box.

Physical, Chemical characteristics and bacterial counts were used as the parameters of quality assessment of the ice stored shrimp. The sensory evaluation or organoleptic test of the ice-stored shrimp were assessed by a trained panel of the five judges based on 9-point hedonic scale in terms of apperance, taste, colour, texture and smell used by Peryam and Pilgrim (1957). Cooked samples were prepared by boiling 20-25gm of fish from each group in 2% brine solution for 10 minutes after boiling . The cooked shrimps were also evaluated by the taste panel members in terms of change of texture, smell and taste. At rejection point, fish had a texture which was soft and mushy, an odour which was ammoniacal and off putrid flavour. On the basis of both raw and cooked state of fish evaluation, the shelf life of the ice stored shrimp were determined, denoting score 5 as the margin or borderline of acceptability.

Biochemical composition (moisture, protein, fat and ash) of the shrimp in raw state was determined as per AOAC method (1975). Composite samples of shrimps (16-18) in numbers were analyzed at two days intervals during storage in ice . Total Volatile Nitrogen (TVN) were determined on trichloroacetic acid extracts taken from 30 gm of shrimp flesh by Conway micro diffusion method (1933) , Pearson *et al.* (1970).

pH and moisture were used as criteria to measure quality deterioration of iced shrimp using the methods indicated by Pearson's composition and Analysis of Food (Ronald and Ronald 1991).

Total bacterial count was determined by taking 10gm of muscle tissue from 5-8 shrimps into 90ml of sterile distilled water. Fish tissues were blended in a sterile blender for one minute for plating. Aerobic plate counts were carried out on total plate count agar. Appropriate dilution of the sample in 1ml aliquates were pipetted into sterile petridishes and cool melted agar were poured over it and the contents were thoroughly mixed . Duplicate plates were inoculated at 37^oC for 2 days. Viable counts that developed on the plates after incubation were counted by a colony counter (Harrigen *et al.* 1976). The number of bacteria per germ of muscle were calculated depending on the dilution of the plate and amount of muscle taken initially. Data were analyzed by using SPSS for windows-12 statistical programme with one percent level of significance.

Results and Discussion

Bio- chemical composition of the shrimp in its raw state has been represented in a bar diagram Figure-1.It is evident from the result that the bio-chemical composition of the shrimp under study are in good agreement with published data of C.

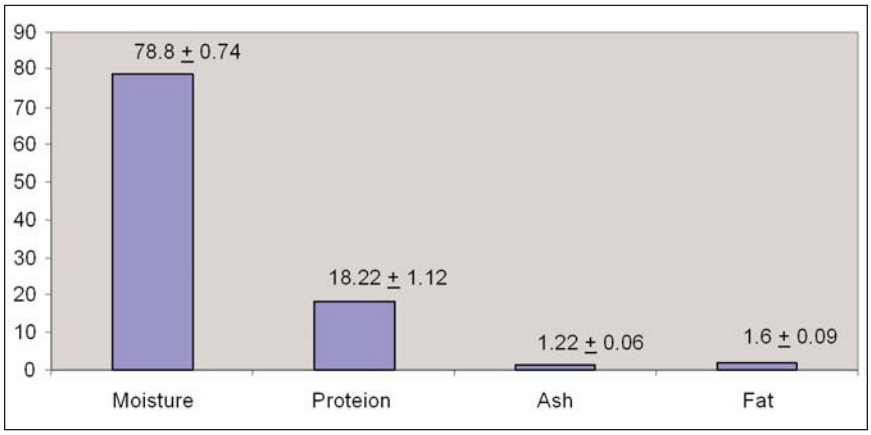
(Regression Analysis for Ffigure- 4.

For establishing relationship between storage time and moisture content simple linear regression technique was used. Two regression line was fitted here, one for moisture content with head of head of shrimp and another for without head.

In the first model storage time was considered as dependent variable and moisture content with head as independent variable. After running the regression equation through statistical software SPSS the regression line became

$$Y = -202.344 + 2.55X$$

Where the R^2 value was 0.958.



(Mean ± Standard deviation)

Fig. 1: Bar diagram showing variation in bio-chemical composition of the shrimp in freshly acceptable condition (Raw fish)

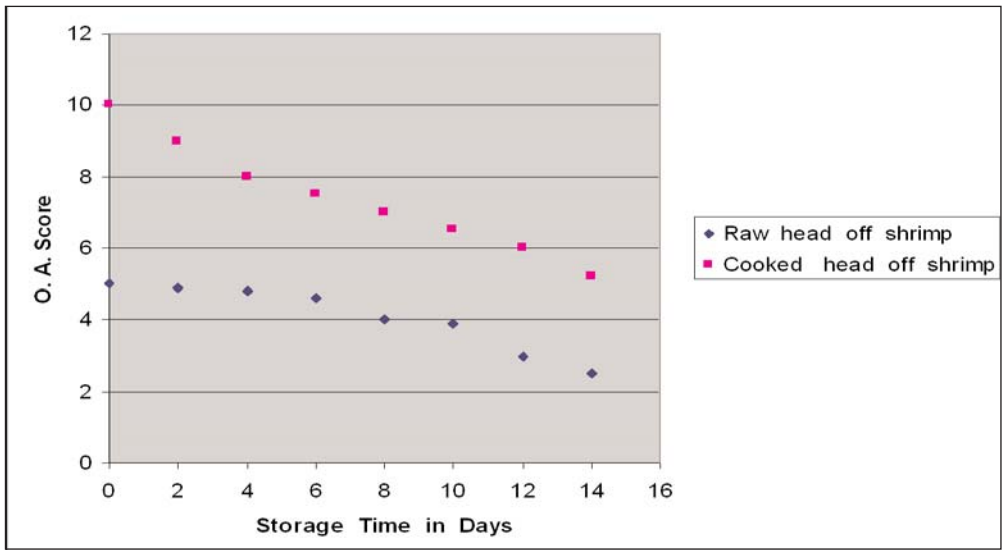


Fig. 2 : Showing scatter diagram indicating score for raw and cooked head off shrimp.

The regression shows that for every unit change of moisture content (gm%), the storage date changes 2.55 days.

In the second model, storage time was considered as dependent variable and moisture content without head as independent variable. After running the regression equation through statistical software SPSS the regression line became

$$Y = -199.82 + 2.51X$$

Where the R^2 value was 0.910.

The regression shows that for every unit change of moisture content (gm%), the storage date changes 2.51 days.) Gopalan *et al.* (1974) for many fresh water fishes and marine fishes including shrimp, similar statement has also been made by Stansby , (1963) for fish in general.

The quality assessment of the ice- stored shrimp, both head off and head on were determined by sensory evaluation method which have been represented in Fig 2 & 3 respectively. The gradual changes in the sensorial perceptible characteristic like general appearance, texture and odour of the uncooked fish and discoloration of the body surface, formation of rancid spoiled odour, flavor and texture of the cooked fish were observed with the progress of the storage time.

The overall acceptability score (OA) of raw and cooked shrimp as described dropped down from initial score point 9 of fresh fish to 5 at the border line of acceptability, which was noted at a definite time interval by the trained panel of judges. On the basis of these scores the mean values had been compared with other quality indices and it indicates that the quality of the ice-stored shrimp crossed the borderline of acceptability limit on the 12th day of storage (OA 5), both for the head on and head off shrimp. It also appeared that all the sensory characteristic of raw and cooked flesh of shrimp gave significant co-relation at the 0.01 level (2-tailed). The stored samples became completely unacceptable on the 14th day of storage in ice while the OA dropped down to less than 5. Rejection of raw samples by the panelists were mainly due to gradual changes from bright fresh appearance through slightly reddish to dark reddish discoloration of flesh and slimy feeling by touch on the surface of the fish. It was rated below the acceptable limit on the 14th day of iced storage.

Similar findings on different commercial important species of both marine and fresh water fish of cold and temperate regions on the shelf life were carried out by their sensory judgment in different parts of the world (Lima,1983).

The quality of the ice stored shrimp has also been assessed by the physico-chemical indices during the study period. The moisture content of the ice stored shrimp have been found to increase with the increase of storage time in ice. The observed increase in moisture content which has been represented in Fig. 4 has a direct relationship with the change in texture from crispy to soft watery condition at the rejection level (head off shrimp (84.10) and head on shrimp (84.20) of the ice stored shrimp, that is, on the 12th day storage .

This might be due to absorption of water by the muscle during the storage period (Hans (1988).

The pattern of increase in TVN (Total Volatile Nitrogen) value with the increase of storage period have been represented in Table I and II.

The TVN value increased fairly from 18 to 30mg/100g of fish (head off shrimp) and 20 to 35mg/100g of fish (head on shrimp) with the increase of storage time.

But due to leaching out of volatile bases at the logarithamic rate from shrimp at the first stage of storage no apparent change in TVN value was observed and it is supported by the finding of Pearson *et al.*(1970). The present investigation shows an initial decrease in TVN value up to 6th days of storage which might be due to leaching action of the volatile nitrogenous compounds from the ice stored shrimp (Muslemuddin *et al.* 1984) . But in the later stage of storage the quality deterioration is entirely due to bacteria and in that case the spoilage rate become faster and even though there may be continued leaching and the increased production of TVN value due to bacterial spoilage compensates the loss and gradually shows high TVN value (Table I and Table-II). At the rejection level the fish sample showed TVN value 45mgN/100gm to 50mgN/100gm for head off and head on shrimp respectively. Weirhchwki suggested that the range of 30-40mgN/100gm of fish muscle as acceptable limit.

The pH value have been found to increase generally from 7.1 to 8.1 during the storage period (Table I and Table II). This finding of increased pH value is parallel to those of A Reilly *et al* (1985) who made comment that the increased

Table I : TVN value, pH and Total bacterial count of head off shrimp

Storage time in days	TVN value (mg/100g of fish	pH	Total bacterial count (cfu/g)
1	18	7.1	10^3
2	16	7.2	10^4
4	15	7.3	10^5
6	18	7.5	10^6
8	22	7.7	10^7
10	28	7.9	10^7
12	30	8.1	10^7
14	45	8.3	10^8

Table II : TVN value, pH and Total bacterial count of head on shrimp

Storage time in days	TVN value (mg/100g of fish	pH	Total bacterial count (cfu/g)
1	20	7.2	10^4
2	15	7.3	10^5
4	13	7.4	10^6
6	20	7.6	10^7
8	25	7.8	10^7
10	30	7.9	10^7
12	35	8.2	10^8
14	50	8.4	10^9

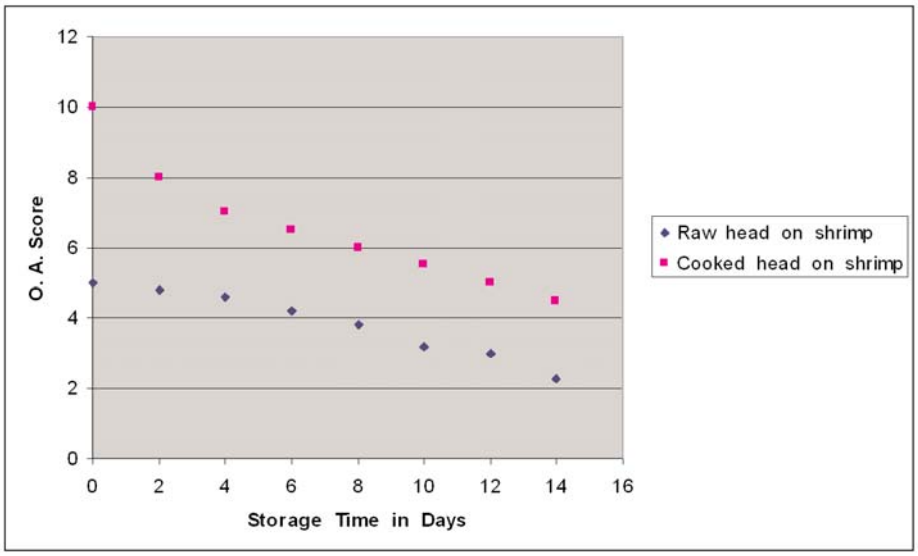


Fig. 3 : Scatter diagram indicating score for raw and cooked head on shrimp

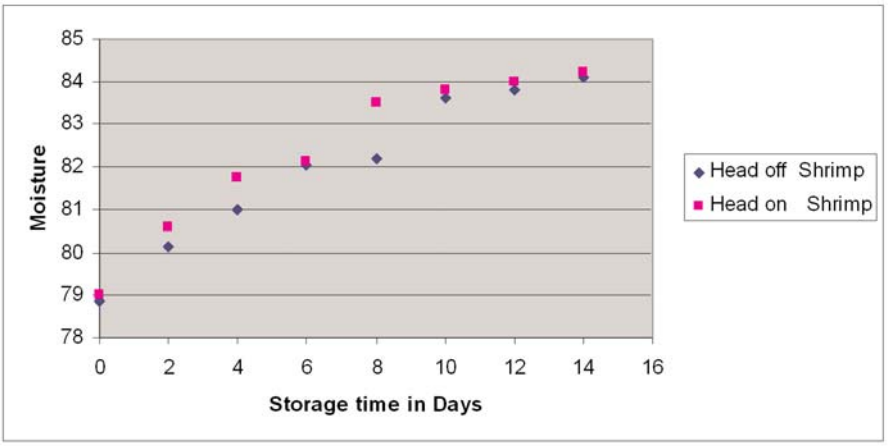


Fig. 4 : Showing variation in moisture content of the Shrimp (Head off and head on) during icing preservation

pH value can be attributed to the higher levels of volatile nitrogen compounds produced by bacteria and tissue enzymes in prawns.

It is evident from the result that the bacterial count of the ice stored shrimp shows a gradual increase from 10^3- 10^8 cfu/gm fish for head off shrimp and 10^4-10^9 for head on shrimp respectively(Table I and II). It may be due to the fact that with the increase of storage period in ice mesophilic bacteria decreases giving way to psychrophiles. Same type of observation was found by Reilly *et al* (1985) and Caun (1977) has commented on higher bacterial count obtained on tropical fish compared to those of temperate or cold water fish immediately on capture. Bacterial load (head on and head off) is also significant at the 0.01 level (2-tailed). The total bacterial counts are similar with the findings of Shewan (1977) and Gillespic *et al* (1975). At the rejection level the observed count is 10^8-10^9 cfu/gm fish. This finding coincides with maximum microbiological limit 10^7 cfu/gm for fresh fish recommended by the International Commission of microbiological standards for foods.

Conclusion

The overall observation made by the present investigation reveals that the keeping quality of the shrimp may be prolonged for about two weeks while the fish is stored in ice. The result has been confirmed by the quality parameters

used in our study as well as by the findings of other researchers of the country and abroad in the same subject area. That the ice stored shrimp (head off and head on) remain in acceptable condition up to 12 days of storage. At the 14 days quality of the fish shows deterioration and become unacceptable.

The bacterial count corresponding to unacceptable condition ranges from 10^8-10^9 cfu/gm fish sample. The TVN value corresponding to rejection condition is 45-50mgN/100gm fish.

References

AOAC (1975). Official Methods of Analysis 12 th Edition (Association of official Agricultural Chemists, Washington DC),pp 832.

Burges CHO., Cutting C. I., Lovern J. A. and Wakman J. J (1965) Fish handling and processing (Her Mayestys Stationary office), pp 346-356.

Cobb B. F. (1976). Effect of ice storage on microbiology and chemical changes in a model system, *Journal of Food Science.* **41**: 29-34.

Conway E. J . and Byrne A. (1933). An absorption apparatus for the micro determination of certain volatile substances, *Biochem. J.* **27**: 419-429.

Clucas I. J. and Ward A. R. (1996). Post-harvest Fisheries Development: A Guide to Handling, Preservation, Processing and Quality.Chatham Maritme, Kent ME4 4TB, United Kingdom, pp 84-142.

Caun D. C. (1977). Bacteriology of Shelfish with reference to international trade . In procedings of the conference on handing, processing and marketing of tropical fish. London, Tropical Products Institute, pp 377-394.

Gopalan C., Rama Sastri B. V. and Subra-manian B. (1974). Nutritive value of Indian Foods, National Institute of Nutrition, Hydorabad -7(AP).

Gillespic N. C. and Mac I. C. (1975). The bacterial flora of some queeusl and fish and its ability to cause spoilage. *Journal of Applied Bacterial,* **39**: 91-100.

Harrigan W. F., Margaret E. and Cann M. C. (1976). Revise Edition prepared by W.F. Harrigion, Academic press London. pp165-168.

Hans H. H. (1988). Fresh fish - quality and quality changes, Assessment of fish quality- Measuring water-binding capacity. Food and Agriculture Organization of the United Nations, Danish International Development Agency, Rome, 1988. pp 69-72.

Liston J., Stansby E. and Olcott H. S. (1963). Bacteriological and chemical basis of deteriorate changes. Industrial Fishery Technology, Edited by Stansby (Reinhold. Publishing Corporation, N.Y. London) pp350-362.

Lima D. S.(1983). The storage of tropical fish in ice- a review in *Tropical Science,* FAO. **23**: 97-127.

Muslemuddin M., Wahed M. A., Khatun S. and Rahman M.A. (1984) Investigations on the cold storage deterioration of different species of fishes and shell fishes of Bangladesh. part II . Some aspects of degradative changes in Hilsha fish during storage in ice. *Bangladesh Journal of Scientific & Industrial Research.* **XIX.**.(1-4):11-17.

Peryam D. R. and Pilgrim F. J. (1957). The Methology of sensory testing, IFST sykp. Pittsburg, U.S.A. Food *Technology Champaign* II. pp: 9-14.

Pearson D. and Muslemmuddin M. (1970) The accurate determination of TVN in meat fish. *Journal of Association Public Analyst,* **6**: 117-123.

Reilly A., Bernarte M. A. and Dangla E. (1985). Quality changes in brackish water prawns (peaa cus) during storage at ambient temperature in ice and after delay in icing , FAO Fisheries Report No. 317:71-73.

Reilly A. and Bernarte M. A.(1984). Storage stability of brackish water prawns during processing for export, Food Technology, Australia. pp366-283.

Ronald S. K. and Ronald S. (1991). Pearson's composition and Analysis of Foods, Ninth Edition, pp 8-42.

Shewan J. M. (1977). The bacteriology of fresh and spoiling fish bio-chemical changes induced by bacterial action - In handling, processing and marketing of tropical fish- London (Tripical Products Institute) pp51-66.

Stansby M. E.(1963). Industrial Fishery Technology, Reinhold publishing corporation, pp339-349.

Weirzchowski J. (1956). Some chemical indication in fish spoilage in polish, **4**:162-165.

William C. F. and Dennis C. W. (2003). Food Microbiology, fourth edition, part-3, Contamination, Preservation and Spoilage of fish and other seafoods. pp 243-254.

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