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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

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Abstract. Studies have been carried out on chemical and microbiological changes that occur during ice storage of shrimps, under commercial conditions. These changes are compared as indices of quality in relation to organoleptic changes.

Significant correlation coefficients (*r*) are obtained between the mean organoleptic response (MOR) and the various objectively measured changes during the storage period. The merits of some of these changes as objective indices of quality particularly in relation to taste panel assessment are discussed.

Introduction

The shrimp industry is the principal segment of our fish industry and the exports from shell fisheries alone have been contributing about 85% of the total foreign exchange earnings from fisheries sector. Shrimps are exported from Pakistan in frozen, canned and dried froms.

Objective tests which are useful for assessing the number of days elapsed in ice storage or which reflect the early changes occurring in shrimp before the onset of spoilage are essential for quality control in the processing industry. Various tests have been proposed by Bailey *et al.* [1] which when used in conjunction with organoleptic evaluation, would enable the processor to determine the suitability of the product for processing. The present study was under taken to collect some basic data for the benefit of local fish industry as very little is known about the preprocessing state of shrimps brought to the harbour by commercial trawlers.

Material and Methods

This study was carried out from November 1975 to December 1976. Shrimps were collected from the local fish harbour, packed in ice and transported to the laboratory within 2 hr. They were deheaded and washed in tap water. A portion of the lot was analysed for various parameters and this was taken as the zero hour study. Remaining shrimps were placed in crushed ice and stored in refrigerator maintained at $5\pm1°C$ during the experimental period. Melted ice water was drained every day and ice was continually replenished.

No identification studies were performed on the samples as the local fishermen divide the shrimps into categories according to their sizes e. g. (a) Kalri and Kiddi measuring 3–4 in and (b) Jiara measuring 4–9 in [2,3]. *Penaeus merguiensis* is the predominant species and forms about 80% of the total catch of Jiara. Similary *Metapenaeus monoceros* is the predominant species of Kalri. Therefore the samples were marked large and small. The results are given only for the large (Jiara) shrimps as this variety is mostly frozen for export purposes.

Organoleptic Analysis. The method used was based on scoring difference test described by Larmond [4]. A scale was worked out between 11 (excellent) to 1 (very poor) each for odour, texture and colour. The score of each parmeter was calculated in terms of average score points awarded by a panel of judges to each sample.

Microbiological Analysis. Total aerobic plate counts were determined by the spread plate method by placing 0.1 ml of appropriate dilution in peptone –water on nutrient agar. The plates were incubated in duplicates at 37°C for 48 hr.

Chemical and Biochemical Analysis. All chemical analyses were performed on 5% trichloroacetic acid extract of shrimp tails by blending for 2 min in a sample to solvent ratio of 1:3.

Nonprotein nitrogen (NPN) was determined by microkjeldhal's method by direct Nesslerization [5].

Amino acid nitrogen (AAN) was determined by the method of Spies and Chambers [6], as modified by Cobb *et al.* [7]. Cupric phoshate suspension was made by adding 1 volume of 0.16M cupric chloride to 2 volumes of 0.36M trisodium phosphate followed by 2 volumes of borate buffer (57.21 g Na_3BO_3 + 100 ml NH_4Cl made to 2 litre). 7.5 ml freshly stirred cupric phoshate suspension was added to 5 ml 5% TCA extract and carefully mixed, allowed to stand for 5–10 min and centrifuged. The supernatant was removed and absorbance read at 630 nm.

Total volatile nitrogen (TVN) was determined according to Cobb *et al* [7] and trimethylmine (TMA) was estimated according to the modified [8] picrate method of Dyer's.

For ribose and orthophosphate the methods of Dische[9] and Tarr[14] respectivley were used.

pH of flesh was determined after blending it with distilled water for 1 min.

Results and Discussion

Restuls of organoleptic analysis during ice storage

of shrimps is shown in Fig. 1 On the basis of average score three phases of changes can be recognized. During the first phase (0–2 days) the quality of the product was very good; during the second phase (2–7 days) the samples were acceptable–there being no marked change in average score in the three characteristics. Between 7 and 9 days of storage the condition of the product showed definite decline in quality and after 9 days almost all the sample were rejected.

Figure 2 shows the changes in bacterial count and pH during ice storage. Log bacterial count increases from 7.6 to 9.3 from the 1st to 4th day of storage and then shows a decrease from 9.3 to 8.5 on the 7th day, it then continues to increase on further storage and goes upto a maximum of 10 in 13 days. The reduction in counts after 7 days of ice storage. probably results by the washing effect of the melting ice and inability of some of the species to survive at low temperatures. These results are in agreement with those reported by Campbell and Williams [10], Carroll *et al.* [11] and Vanderzant *et al* [12].

There appears to be a close relationship between pH and orgnaoleptic properties of ice stored shrimps. Below pH 7.7 the product was acceptable but as soon as pH increases shrimps were rated as of poor quality.

From Fig. 3 it is evident that trimethylamine nitrogen starts increasing after 4 days of storage in ice. The increase is rather slow as compared with the increase in bacterial counts. The slow production of trimethylamine may probably be due to either the absence of bacteria responsible for converting trimethylamine oxide into triemethylamine, or to losses of triemethylamine due to leaching in the early stages of ice storage on the fishing vessel.

Acid-soluble orthophosphate and ribose show a gradual and less rapid decrease during ice storage (Fig. 4). This is somewhat contradictory to the findings of Bailey *et al.* [1] who observed rapid decrease in orthophosphate during the first few days of ice storage. They attributed it to the leaching of in-

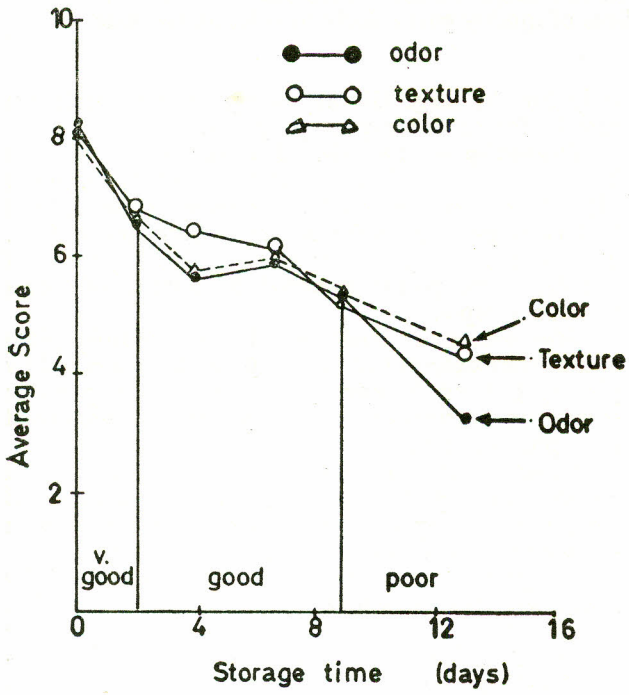

Fig. 1. Organoleptic analysis of shrimps stored in ice. Each point represents an average of 15 experiments.

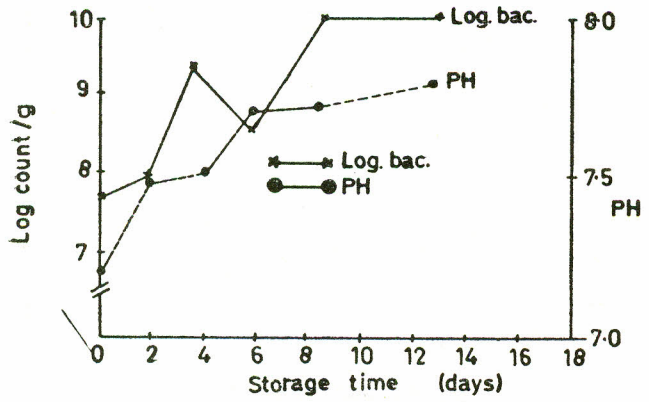

Fig. 2. Agar-plate count and pH of shrimps stored in ice. Each point represents an average of 15 experiments.

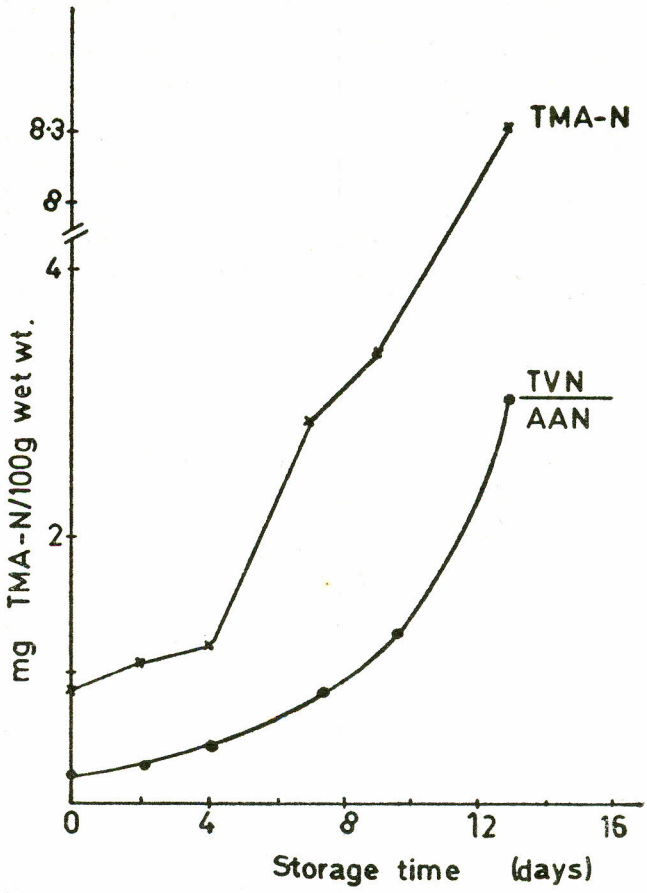

Fig. 3. Effect of ice storage on TMA-N and TVN/AAN of shrimps. Each point represents an average of 15 experiments.

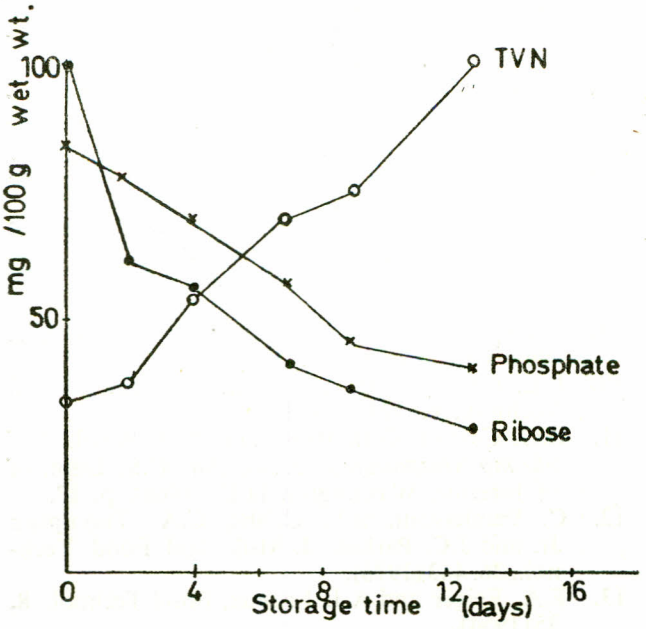

Fig. 4. Effect of ice storage on ribose, phosphate and TVN contents of shrimps. Each point represents an average of 15 experiments.

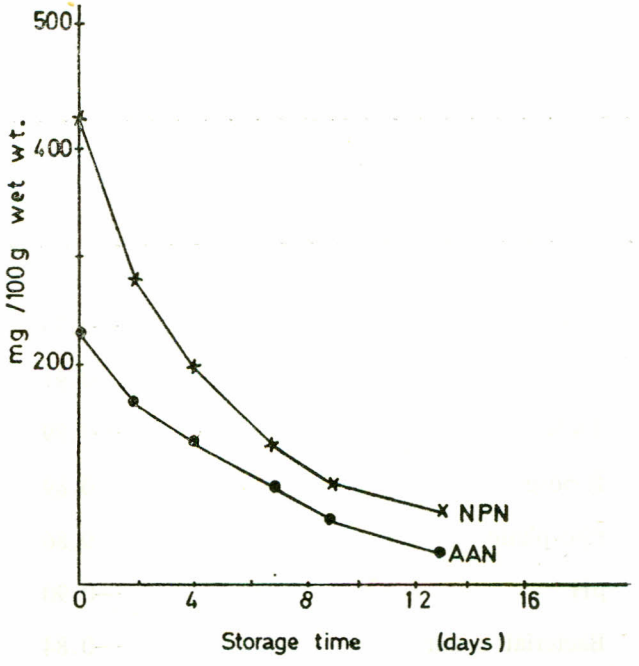

Fig. 5. Effect of ice storage on NPN and AAN contents of shrimps. Each point represents an average of 15 experiments.

organic phosphate from ice stored shrimps during the first few days of storage. In the present study also, it is possible that during ice storage in the trawlers, orthophosphate could have leached out and a further leaching occurred on washing the shrimps in the laboratory. Hence the less rapid decrease in orthophate observed by the present authors.

Total volatile nitrogen (TVN) was observed to increase gradually during storage from 34 to 97 mg/100 g of shrimp after 13 days (Fig 4). Thevalue of TVN obtained after 7 days of storage was 69 mg and can be regarded as the limit of acceptability for Pakistani shrimps as against a value of approximately 30 mg reported by Cobb and Vanderzant [12] as the limit of acceptability for shrimps caught in the Northwestern Gulf of Mexico.

Free aminonitrogen (AAN) of the sample at zero hour was noted as 222 mg/100 g and is almost 52% of the total nonprotein nitrogen (NPN) (Fig 5). Such high proportions of AAN have been reported for crustaceans by Velankar and Govindan[16,17]. Both NPN and AAN decreased on ice storage of shrimps. A decrease in AAN has also been reported by Velankar and Govindan [16]. They suggested that at least for the initial stages the loss is mainly due to leaching action of ice-melt water. Unpublished work in the authors laboratory also has shown that the decrease of AAN was much less in shrimps when they were not stored in direct contact with ice.

TVN/AAN ratio has been reported by Cobb *et al.* [19] to be a measure of shrimp quality. In Fig. 3 this ratio has been plotted against storage time of Jiara shrimps. It is evident that after a lag period the value of this ratio gradually increases until spoilage could be detected.

Correlation coefficients (*r*) were also calculated between mean organoleptic response (MOR) and chemical parameters. The results are given in Table 1. It is clear from the table that significant correlation exists between the various parameters tested and the organoleptic response, thus suggesting that all these changes contribute to subjective changes in quality. Correlation is low for TMA-N as is evident from Fig. 3, significant changes occur only at a later stage.

Results have shown that all the parameters change when shrimps are stored in ice. No one parameters could however be regarded specific either for the assessment of prime quality or spoilage, although, to a certain extent, they could be used as simple screening test to evaluate the degree of freshness or spoilage of shrimps.

From numerous tests and data presented in this study the following guidelines are suggested:

If the pH of the shrimp tissue is >7.7, bacterial count $>1\times10^9$/100 g, TVN >69 mg/100 g, TMA> 2.5 mg/100, TVN/AAN ratio>1 and acid soluble orthophosphate, ribose, AAN$\angle$65 mg/100 g, 40m g/100 g, 76 mg/100 respectivley the sample was considered to be of poor quality or spoiled.

On the bais of the results obtained so far, it can be concluded that the majority of the samples examined were acceptable upto 7 days under the experimental conditions of storage and it is after this stage that spoilage becomes evident. It must be emphasized that this has been the study on the shrimps which have been collected from the fish harbour. The shrimps after catch are normally stored in ice on the fishing vessel for a period of 4 to 8 days before being brought to the fish harbour. Therefore, it can be assumed that the potential shelf life of these ice-stored shrimps is approxmately 11 to 15 days.

Although the shelf life of ice-stored shrimps may

TABLE 1. CORRELATION COEFFICIENTS BETWEEN MEAN ORGANOLEPTIC SCORE AND OTHER PARAMETERS DURING ICE STORAGE OF SHRIMPS.

Mean organoleptic response (MOR) vs	Correlation coefficients (*r*)
NPN	0.90
TMA	—0.73
AAN	0.91
TVN	—0.89
Ribose	0.89
Phosphate	0.86
pH	—0.90
Bacterial count	—0.84
TVN/AAN	—0.85

be as long as 15 days, changes occurring during early stages of handling and storage may affect their prime quality and the shrimps may lose flavour that is both subtle and attractive.

References

1. M.E. Bailey, E.A. Fieger and A.F. Novak, Food Res., **21**, 611 (1956).
2. N. Tirmizi, FAO Fisheries Reports, No. 57, Vol. 3, pp. 1 (1967).
3. S.A. Haq, Iqbal H. Siddiqui and Shamsuddin Qureshi, Pakistan J.Sci. Ind. Res., **15**, 61 (1972).
4. E. Larmond, *Methods for Sensory Evaluation of Foods*, (Canada Department of Agriculture Publication No. 1284, 1967).
5. P.R. Hawke, B.L. Oser and H.W. Summerson. *Practical Physiological Chemistry* (McGraw, Hill, New York, 1954), p. 568.
6. J.R. Spies and D.C. Chamber, J. Biol. Chem. **191**, 787 (1951).
7. B.F. Cobb III, I. Alaniz and C.A. Thompson Jr., J. Food Sci. **38**, 431 (1973).
8. C.K. Murray and D.M. Gibson, J. Food Tech. **7**, 35 (1972).
9. Z. Dische, in *Methods in Enzymology* (Academic, New York, 1957), Vol. III, p. 87.
10. L.L. Cambpell Jr. and O.B. Williams, Food Technol., **6**, 125 (1952).
11. B.G. Carroll, G.B. Reese and B.Q. Ward, *Iced Shrimp Symposium*,circ. no. 284 (U.S. Dept. of of Interior, Washington D.C., 1968), p. 17.
12. C. Vanderzant, B.F. Cobbs, C.A. Thompson Jr. and J.C. Parker, J. Milk and Food Technol., **36**, 443 (1973).
13. E.A. Feiger and A.J. Friloux, Food Technol., **8**, 35 (1954).
14. H.L.A. Tarr, Bact. Revs., **18**, 1, (1954).
15. W.A. Montgomery, G.S. Sidhu and G.L. Vale, CSIRO Food Preservation Quart., **3**, 21 (1970)
16. N.K. Velankar and T.K. Govindan, Current Sci., **27**, 451 (1958).
17. N.K. Velankar and T.K. Govindan, Proc. Ind. Acad. Sci., **47B**, 202 (1958).
18. Simidu and M. Hujita, Bull, Japanese Soc. Sci. Fisheries, **20**, 720 (1954).
19. B.F. Cobb III and C. Vanderzant, J. Food Sci., **40**, 121 (1975).
20. M. Rajindranathan Nair and A.N. Bose in *Technology of Fish Utilization FAO Symposium* (Fishing News Books, England, 1965) p. 68.
21. B.F. Cobb III and C. Vanderzant, J. Milk and Food Technol., **32**, 533 (1971).