# EFFECT OF DELAYED ICING ON THE QUALITY CHARACTERISTICS OF BAGDA (*PENAEUS MONODON* FABRICIUS, 1798)

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**ABSTRACT**

**Mahmud, M. M., Hossain, M. A., Jahan, I., Banerjee, P. and Rahaman, M. A. 2007.** *Effect of Delayed Icing on the Quality Characteristics of Bagda (Penaeus monodon fabricius, 1798).* **Int. J. Sustain. Crop Prod. 2(5): 24-30**

The effect of delayed icing on the quality characteristics of Bagda (*Penaeus monodon* Fabricius, 1798) iced after three hours of harvest was studied. From the ninth hour and after iced condition quality of shrimp is acceptable score range 6.8-8.4 in the bamboo basket whereas in the plastic basket the quality moderately acceptable score range6.4-8.2. Till the end point of the experiment the quality of shrimp was acceptable and the TVB-N content was 2.56 ± 0.32 mg-N/100g to 5.21 ± 0.61mg-N/100g in the bamboo basket whereas in the plastic basket it was 2.58 ± 0.36 mg-N/100g to 5.37 ± 0.37 mg-N/100g. TMA-N was 2.68 ± 0.21 mg-N/100g to 5.02 ± 0.41 mg-N/100g and 2.72 ± 0.23 mg-N/100g to 5.16 ± 0.47 mg-N/100g in the bamboo and plastic basket respectively. SPC of microbiological analysis was $\log_{10}$ 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.

**Keywords:** Icing, quality of bagda, bamboo and plastic basket

## INTRODUCTION

The fishery product contributes 5.45% of the national income and export earning out of which 86% coming from shrimp. About 2-2.5 million people are engaged in shrimp culture, fry collection, transportation, and processing and other related activities (DoF, 2003).

Fishermen not get proper return of their catch, for qualitative and quantitative losses include fish's low commercial value, spoilage, insect attack, etc. The two largest sources of quantitative losses accounted to 6% of the total marine catch and 2% of the inland catch. Qualitative losses consist of losses in commercial value, but not in physical biomass, through losses of quality (Coulter and Disney, 1988).

At a temperature of $0^0$C merely slows down microbiological activity. An increase in temperature of 1-$2^0$C will markedly increase the rate of bacterial growth (Matches, 1982). Various studied have been carried out on the shelf life of shrimp hold in ice (Yamagata and Low, 1995).

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 (Farooqui, 1978). Similar work was done by Reilly *et al.* (1985).

TVB-N of *Gher* shrimp varied between 7 and 28mgN/100g (Putro *et al.,* 1980). 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.

Reilly *et al.* (1985) stated that TVB-N 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.

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). The use of TMA-N, as an index of fish freshness, was first proposed by Gibbons and Labire, (1937).

Connell (1975) recommended 10–15 mg/100g 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).

Bacterial counts were valuable as a measure of degree of freshness of fish. For the bacterial spoilage the most common used method is the total viable count or standard plate count (Rahman, 1980). Khalil (1964) has found SPC was also detected three times in the experiment like as TVB-N and TMA-N. $0^{th}$ hour, $9^{th}$ hour and $24^{th}$ hour of the experiment.

For Standard Plate Count (SPC) shrimp collected from all the three districts and from all the points (Gher, Depot, Agent, and P. Plant) indicated value within $10^5$cfu/g, is acceptable limit even when being practiced normally (Azam, 2004).

SPC of freshly harvested shrimp ranged from $6.8\times10^4$ to $1.5\times10^5$ as observed by Lillard (1984). 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.

## MATERIALS AND METHODS

### *Collection of shrimp*

The study period was May and June, 2006. Name of the *gher* is four stars, near Shoalmari river at Koia, Khulna. After harvesting bagda (*Penaeus monodon* Fabricius, 1798*)* from *gher* totally 28 shrimps were collected, average weight 25-30 gm, preserved in a plastic and bamboo baskets, using ice. The temperature of water $28^0$C. Immediately brought to the Quality Control Laboratory of Fisheries and Marine Resource Technology Discipline of Khulna University.

### *Technique for analysis of sample*

***Organoleptic analysis:*** Organoleptic score sheet (Shewan and Ehenberg, 1957) (Table 1) and an overall acceptability ranking was done (Table 2). The organoleptic characteristics emphasized on odor, carapace color, carapace texture, eyes and shell color characteristics.

Table 1. Organoleptic score sheet for shrimp.

| Odor | Score. | Carapace color | Score | Carapace texture | Score. |
|---|---|---|---|---|---|
| Fresh odor | 10 | Greenish (fresh) | 10 | Hard | 10 |
| Slightly fresh odor | 9 | Moderately greenish | 9 | Slightly hard | 9 |
| Sweetly odor | 8 | Slightly greenish | 7 | Moderately hard | 8 |
| Slightly spoilage odor | 7 | Slightly darken | 5 | Slightly soft | 7 |
| Moderately spoilage odor | 6 | Moderately darken | 3 | Moderately soft | 5 |
| Spoilage odor | 5 | Darken | 0 | Soft | 3 |
| Slightly off odor | 4 | | | Very soft | 0 |
| Moderately off odor | 3 | | | | |
| Off odor | 2 | | | | |
| Extremely off odor | 0 | | | | |

| Eye Characteristics | Score. | Shell color | Score |
|---|---|---|---|
| Bright and transparent | 10 | Bluish white | 10 |
| Moderately transparent | 9 | Moderately bluish | 9 |
| Slightly transparent | 8 | Slightly bluish | 8 |
| Slightly dull | 7 | Slight loss of brightness | 7 |
| Moderately dull | 5 | Loss of brightness and opaque | 5 |
| Dull and opaque | 3 | Slightly reddish | 3 |
| Fully dull and opaque | 0 | 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) | 6.5-08.4 |
| Moderately acceptable (MA) | 4.5-06.4 |
| Just acceptable (JA) | 3.6-04.4 |
| Just unacceptable (JU) | 2.6-03.5 |
| Unacceptable (U) | 1.5-02.5 |
| More unacceptable (MU) | 0-01.4 |

**Biochemical analysis**

TVB-N and TMA-N were determined (Fig. 1) according to the procedure of Siang and Kim (1992) as given below:

***Solution and reagents:***

- Inner ring solution: 1% boric acid solution containing indicator.
- Mixed indicator solution: Bomocresol green (BCG) 0.01g and methyl red (MR) 0.02g were dissolved in to 10 ml of ethanol.
- 0.02 Hydrochloric acid, HCl.
- Standard potassium carbonate solution ($K_2CO_3$) solution.
- 50% Potassium carbonate ($K_2CO_3$) solution.
- 4% Trichloroacetic acid (TCA, $CCl_3COOH$) solution.
- Neutralized 10% formaldehyde solution.

***TVB-N determination***

$$\text{TMA-N or TVB-N} = (V_S - V_B) \times (N_{HCL} \times A_N) \times \frac{[(W_S \times \frac{M}{100}) + V_E] \times 100}{W_S}$$

Where, $V_S$ = Titration volume of 0.02N HCl for sample extract (ml.); $V_B$ =Titration volume of 0.02N HCl for blank (ml.); $N_{HCl}$ =Normality of HCl (= 0.02N × f, factor of HCl); $A_N$ =Atomic weigh of Nitrogen (14.00); $W_S$ =Weigh of muscle sample (gm); M = Percentage moisture of muscle sample; $V_E$ = Volume of 4% TCA used in extraction.

***Microbiological analysis:*** Microbial analyses followed the procedures of Siang and Kim, (1992) (Figure 2).

*Standard Plate Count* (SPC)**:** The procedure provides a standardized mean of determining the density of heterotrophic bacteria in samples. This is an empirical measurement because organisms occur singly, in pairs, clusters, or packets, and no single growth medium or set of physical and chemical conditions can satisfy the physiological requirements of all organisms in a sample.

***Culture Media:***

*Plate Count Agar* (PCA): 23.5 grams of plate count agar (PCA) was first added in 1000 ml of distilled water and boiled to dissolve the medium completely. The medium was then sterilized by autoclaving at 15 lbs pressure (121°C) for 15 minutes.

***Peptone water (0.1%)****:* 1.0 g of peptone powder was added in 1000 ml of distilled water. The medium was sterilised by the same way.

**RESULTS AND DISCUSSIONS**

***Organoleptic changes of Bagda (P. monodon) at delayed icing three hours after harvest stored at bamboo and plastic basket:***

The quality of shrimp was under highly acceptable (HA) limit till $10^{th}$ hour of observation and the quality was drastically changed soon after the $10^{th}$ hour. It was 8.4 in the bamboo basket (BB) and 8.2 in the plastic basket (PB) (Figure 3). The difference of score was little but the quality attribute changed into another state. Then the score was gradually changed with time.

***Bio-chemical Changes of Bagda at delayed icing one hour after the harvest stored at plastic and bamboo basket:***

The amount of TVB–N was obtained over 24 hours storage of Bagda in ice ranged between 2.56 ± 0.32 mg-N/100g to 5.21 ± 0.61 mg-N/100g whereas in the plastic basket was 2.58 ± 0.36 mgN/100g to 5.37 ± 0.37 mgN/100g. In the $12^{th}$ hour the value was 3.64 ± 0.66 mgN/100g and 3.73 ± 0.58 mgN/100g in the bamboo and plastic basket respectively (Figure 4). TNB-N value proportionately related to time.

***Trimethylamine Nitrogen (TMA - N) at bamboo and plastic basket:***

TMA-N was also detected three times in the experiment. In the $0^{th}$ hour the value was 2.68 ± 0.21 mgN/100g, in the $12^{th}$ hour it was 3.56 ± 0.53 mgN/100g and $24^{th}$ hour of the experiment TMA-N content was 5.02 ± 0.41 mgN/100g for the bamboo basket whereas 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 in $0^{th}$, $12^{th}$ and $24^{th}$ hour (Figure 5).

***Microbiological analysis for plastic and bamboo basket****:*

SPC was also detected three times in the experiment like as TVB-N and TMA-N. In the 0th hour, $12^{th}$ hour and $24^{th}$ hour of the experiment. The average results obtained in this experiment were $\log_{10}3.93 \pm 0.12$ cfu/g, $\log_{10}4.22 \pm 0.53$ cfu/g and $\log_{10}4.33 \pm 0.21$ cfu/g respectively in the bamboo basket and in the plastic basket it was $\log_{10}4.01 \pm 0.12$ cfu/g, $\log_{10}4.36 \pm 0.04$ cfu/g and $\log_{10}4.83 \pm 0.19$ cfu/g respectively (Figure 6).

***Relationship among the parameters within the bamboo and plastic basket:***

*Bamboo basket*: TVB-N, TMA-N and SPC were gradually increased but organoleptic score (OLS) was decreased with increasing storage time. In the $0^{th}$ hour TVB-N, TMA-N and SPC were 2.56mgN/100g, 2.68mgN/100g and $\log_{10}$3.93 cfu/g and at that same time the organoleptic score was 10 (highly acceptable range). In $12^{th}$ hour of storage time the value was 3.64mgN/100g, 3.56 mgN/100g and $\log_{10}$4.22 cfu/g respectively and the organoleptic score was 8.2 (acceptable range). In the $24^{th}$ hour of storage time the TVB-N was 5.21mgN/100g, TMA-N was 5.02 mgN/100g and SPC was $\log_{10}$4.33 cfu/g and the organoleptic score was 6.8 (acceptable) (Figure 7).

*Plastic basket*: same results which found in the bamboo baskets. In the $0^{th}$ hour the TVB-N, TMA-N and SPC were 2.58mgN/100g, 2.72mgN/100g and $\log_{10}$4.01 cfu/g and at that time the organoleptic score was 10 (highly acceptable range), which was similar to the bamboo basket. In $12^{th}$ hour storage time the value was 3.73 mgN/100g, 3.63mgN/100g and $\log_{10}$4.36cfu/g respectively and the organoleptic score was 8.2 (acceptable range). In the $24^{th}$ hour of storage time the TVB-N was 5.37mgN/100g, the TMA-N was 5.16mgN/100g and SPC was $\log_{10}$4.83 cfu/g and the organoleptic score was 6.4 (moderately acceptable region) (Figure 8).

***Correlation among the parameters for shrimp within the bamboo and plastic basket:***

*Bamboo basket*: organoleptic score of shrimps TVB-N, TMA-N and SPC, individually are negatively (-0.98413, -0.97715, -0.98346) correlated. Whereas TVB-N with TMA-N and SPC shows positive (0.99936 and 0.93570) correlation. Again TMA-N with TVB-N and SPC shows positive (0.99936 and 0.92248) correlation (Table 3).

*Plastic basket*: Organoleptic score of shrimps TVB-N, TMA-N and SPC, individually are negatively (-0.9864, -0.97809, -0.98902) correlated. Whereas TVB-N with TMA-N and SPC shows positive (0.99905, 0.99986) correlation. Again TMA-N with TVB-N and SPC shows positive (0.99905 and 0.92248) correlation (Table 4).

Table 3. Correlation among the parameters for shrimp within bamboo basket.

| | OLS BB | TVB-N | TMA-N | SPC |
|---|---|---|---|---|
| OLS | * | -0.98413 | -0.97715 | -0.98346 |
| TVB-N | -0.98413 | * | 0.99936 | 0.93570 |
| TMA-N | -0.97715 | 0.99936 | * | 0.92248 |
| SPC | -0.98346 | 0.93570 | 0.92248 | * |

Table 4. Correlation among the parameters for shrimp within plastic basket.

| | OLS PB | TVB-N | TMA-N | SPC |
|---|---|---|---|---|
| OLS | * | -0.9864 | -0.97809 | -0.98902 |
| TVB-N | -0.9864 | * | 0.99905 | 0.99986 |
| TMA-N | -0.97809 | 0.99905 | * | 0.99811 |
| SPC | -0.98902 | 0.99986 | 0.998117 | * |

The bamboo and plastic basket provided almost same 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. As three hours delayed icing provided acceptable result for both plastic and bamboo basket.

Therefore, it is necessary to mention that the determination of organoleptic, biochemical and microbiological assessment could provide an adequate result for the freshness and quality of *Penaeus monodon* stored delayed icing one hour after the harvest and perhaps for all the fish species.

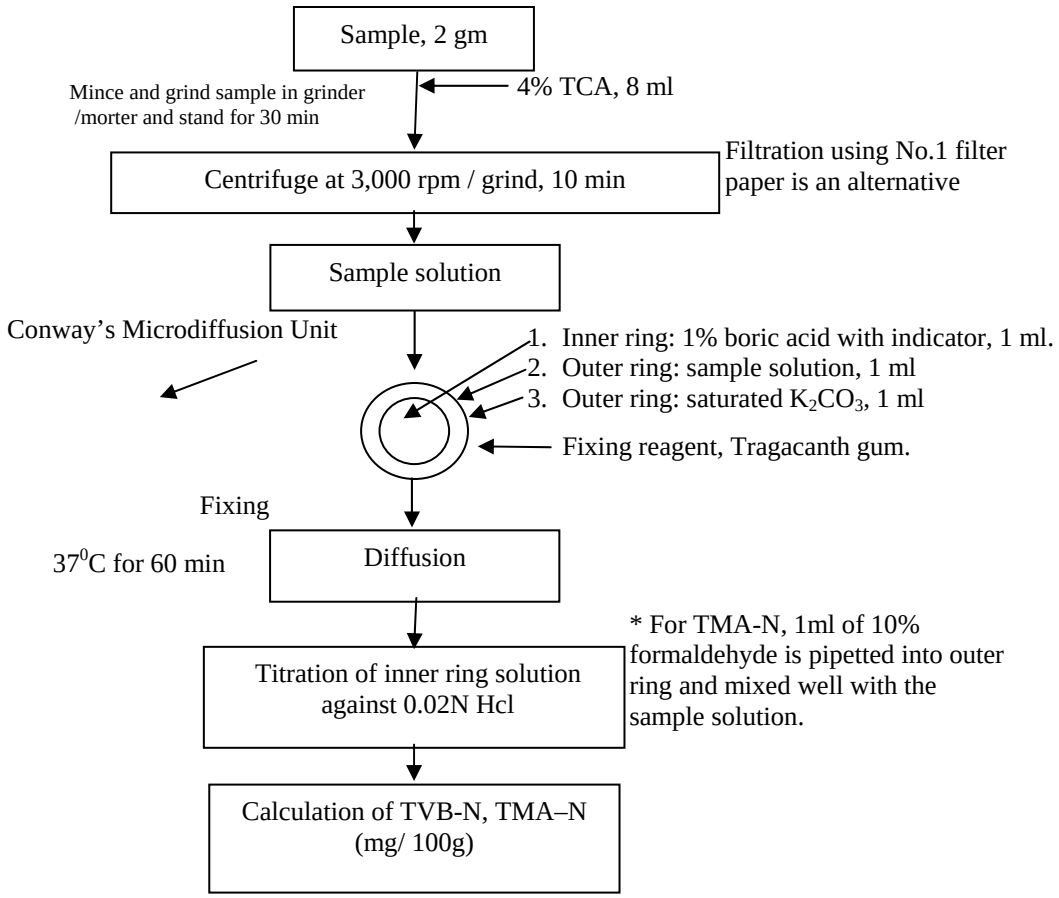


Figure 1. Flow chart for TVB-N and TMA-N determination

20.0 gm of pooled sample is added in 180 ml. of 0.1 % peptone water and blended for 2 minutes

↓

Ten fold serial dilutions are made ($10^{-1}$, $10^{-2}$, $10^{-3}$, $10^{-4}$).

↓

1.0 ml. of each dilution is transferred into sterile petridishes.

↓

20.0 ml. of autoclaved and molten plate count agar is poured.

↓

Petridishes are incubated at 37ºC for 48 hours.

↓

Plates with 30-300 colonies are counted.

↓

Calculation is done as cfu/gm.

Figure 2. Enumeration of standard plate count (SPC)

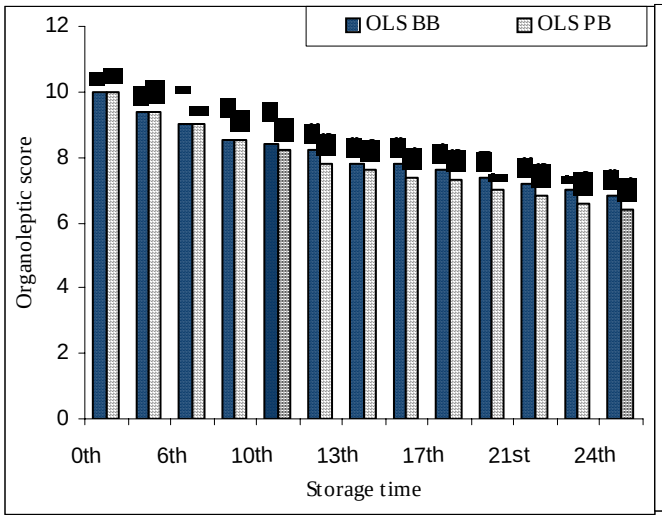


Figure 3. Relationship of organoleptic score between bamboo and plastic basket with storage time period.

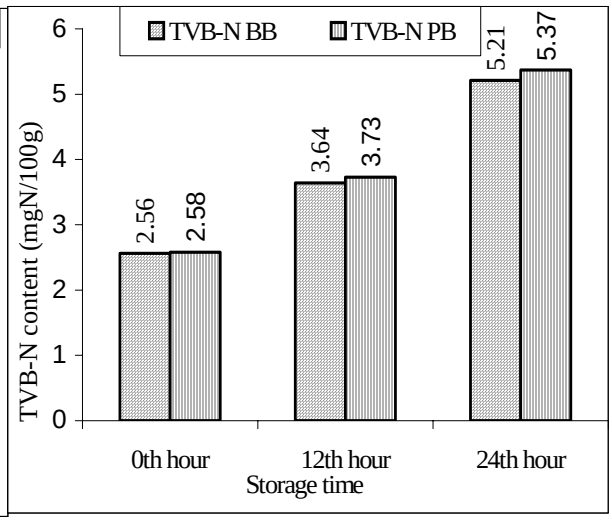


Figure 4. *Comparison of TVB-N in plastic and bamboo basket with storage time.*

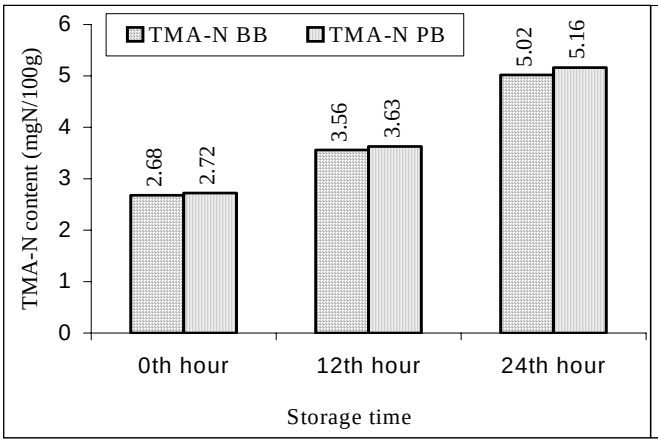


Figure 5. *Comparison of TMA-N in plastic and bamboo basket with storage time.*

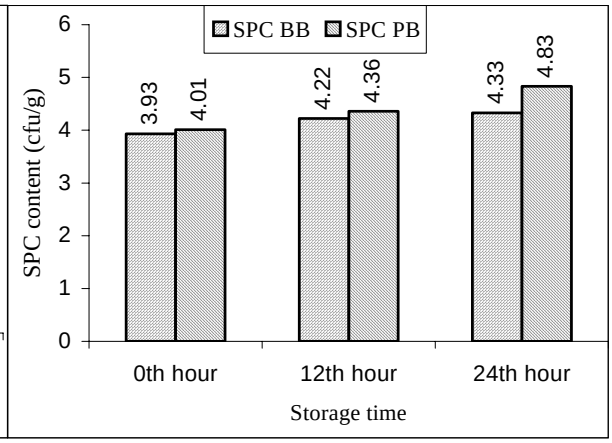


Figure 6. Comparison of SPC in plastic and bamboo basket with storage time.

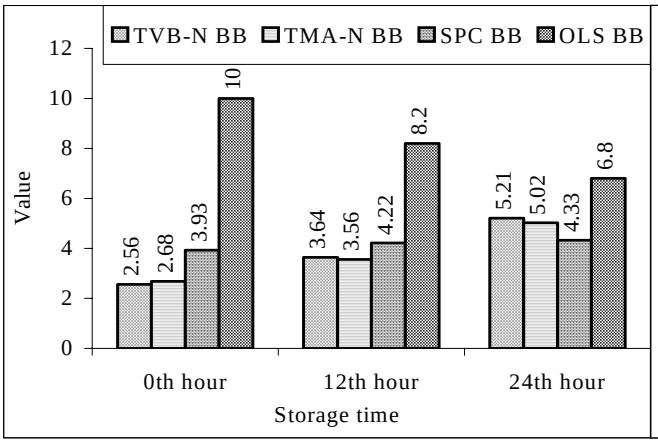


Figure7. Relationship of the parameters with storage time in the bamboo basket.

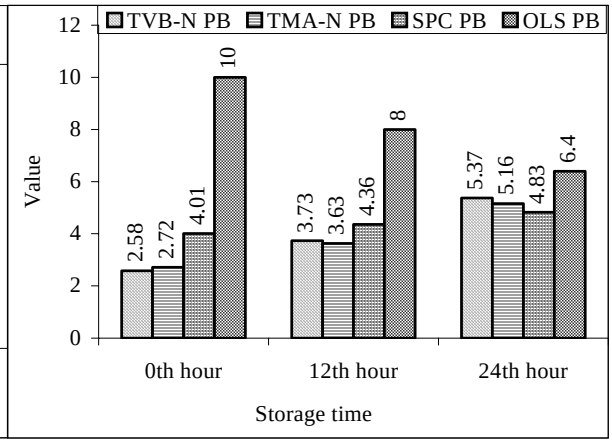


Figure 8. Relationship of the parameters with storage time in the plastic basket.

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