Quality Comparison of Ambient (22-28^{0}C) and Refrigeration (4^{0}C) Storage Salt-smoke-dried Shoal (*Ophiocephalus striatus*)

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Abstract— *The research was investigated to compare the organoleptic quality and physical properties of salt-smoke-dried Shoal (Ophiocephalus striatus) stored at ambient (22-28^{0}C) and Refrigeration (4^{0}C) temperature. The fish were divided into three treatments where T_1, T_2 and T_3 were indicated controlled, ambient (22-28^{0}C) and refrigeration (4^{0}C) condition respectively. The fillets only sun-dried without salting and smoking and stored at ambient temperature were controlled fillets whereas, T_2 and T_3 denoted the fish kept at ambient and refrigeration condition respectively. The sensory analysis showed that the shelf-life of T_1 treated dried fillet was only 5 days after preparation whereas T_2 treated fillet was 30 days and T_3 treated products was still excellent up to 45 days. It was found that the initial(day1) and final(30 day) water rehydration(%) of fish in T_2 treated Shoal at soaking time 60 minutes ranged from 58.5-54.5%, 68-62%, 75.5-66.5% at soaking temperature 22-28^{0}C, 40^{0}C, 60^{0}C whereas the initial(day1) and final(45 day) water rehydrating(%) for T_3 treated Shoal at soaking time 60 minutes ranged from 58.5-56% 68-63% 75.5-71% at soaking temperature 22-28^{0}C, 40^{0}C, 60^{0}C. The water reconstitution behavior gradually decreased with the increasing of storage in both treatment .The water rehydration rate in T_2 treatment decreased more in comparison to T3 treatment during storage period. Analyzing the organoleptic and physical properties of the salt-smoke-dried Shoal it was found that the samples kept at refrigeration temperature (treatment T_3) was still excellent during 45 days of storage.*

Keywords— Ambient temperature, Quality, Refrigeration temperature, Salt-smoke-dried, Shoal.

I. INTRODUCTION

To extend the shelf life of fish different fish processing and preservation methods have been practiced in Bangladesh for a long time, simplest method employed are refrigeration, freezing, icing, salting, drying, smoking etc. (Chakroborty and Chakraborty, 2017). Traditionally, salting and drying are the most popular methods of fish preservation in Bangladesh. But Under warm and humid condition, sun-dried fish rapidly become infested by blowfly larvae (Kordyl, 1976). The presence of fungi in salted and sun dried cured fishes are also serious problem in view of the safety and quality of the dried products. (Valsan *et al.*, 1985, Chakrabarti and Varma 1999). On the other hand, among the traditional techniques smoke curing is one of the best preservation techniques because it does not depend on climatic condition and in peak season the amount of catch is not a matter of tension to the fish processor. At present, in combination of salting smoking and sun drying not only increase the shelf life of products but also give a suitable color, texture flavor, odor which increase the palatability of fish products. For this reason, salt-smoke-drying may be considered another important aspect of fish preservation (Chakroborty and Chakraborty, 2017).

Salt-smoked-dried fish is a recent addition to the fishery products of Bangladesh. For salt-smoke-dried products medium fatty fish or lean fish is most suitable. (Chakroborty and Chakraborty, 2016 and Chakroborty and Chakraborty, 2017). In Bangladesh lean fish like Shoal is a most popular smoke-dried fish due to its high palatability and marketability. Limited work has been conducted on salt-smoke-dried products of shoal no significant work has been done on salt-smoke-dried Shoal. Developing of salt-smoke-dried products from Shoal not only enhances the shelf life of product but also imparts attractive smoky flavor, odor, and appearance to make them a value added new product. Therefore, the purpose of the present research is to provide a clear idea on the organoleptic quality and physical properties (water rehydration behavior) of the salt-smoke-dried Shoal during storage the products at ambient and refrigeration condition.

II. MATERIALS & METHODS

For preparation of salt-smoke-dried products fresh Shoal (*Ophiocephalus striatus*) were collected from the local K.R. market. Then the fishes were divided into three treatments viz. T_1, T_2 and T_3 for salt-smoke- drying. The fillets where no salt-smoke was treated only sun dried and

kept at ambient temperature considered as controlled fillet (T_1). For studying shelf-life of the salt-smoke-dried fish at varying length of times the treatment T_2 and T_3 was kept at ambient and refrigeration temperature. The fresh fish were weighed, dressed, filleted followed by washing before salting. The T_2, T_3 fillets were brined (≈25% brine) for 10 minutes followed by air drying. After air drying partial smoking was done for 30 minutes at 53^0C, and then sun drying was done for 21hrs. in the ring tunnel. After sun drying the products were packaged for shelf-life study. In controlled condition (T_1) two fishes were kept. For treatments T_2 and T_3 a total of 6 fishes were selected randomly for salt-smoke-drying.

2.1 Assessment of Organoleptic Quality

The changes in organoleptic characteristics during storage of salt-smoke-dried shoal were assed. Sensory methods were used to assess the degree of freshness based on organoleptic characteristics such as color, odor, texture and flavor of salt –smoke-dried Shoal. This evaluation methods used in this study were based on one that is currently in use in various institution of world (larmond, 1977). Representative samples were taken on a tray to assess the characteristics such as color, odor, and texture by organoleptic method.

2.2 Assessment of physical properties (Water rehydration behavior)

Percentage of water absorbed by dried fish at a certain temperature and time is called water rehydration. It is one of the most important physical parameter to assess the quality of the dried products. About 5-10 g of smoke-dried fish samples was soaked in one liter of water at different temperatures up to 60 minutes with occasional stirring. Water was drained off through a coarse nylon net. All the flesh was then transferred to the strainer and extraneous water was wiped off by a piece of blotting paper and flesh was weighed again. By the given soaking time, flesh could reabsorb maximum amount of water. Results in this respect have been expressed in terms of weight of water absorbed by the sample. The rehydration behavior was measured at room temperature, 22-28°C, 40°C and 60°C temperature. Rehydration percentage was measured at 15 minutes intervals for each temperature The percentage of water uptake in rehydrated fish sample was calculated using the following formula:

$$\text{Water rehydration (\%)} = \frac{W_r - W_i}{W_i} \times 100$$

Where,

W_i = Initial weight of the dry fish

W_r = Weight of the dry fish after water absorption.

III. RESULTS AND DISCUSSIONS

3.1 Organoleptic Quality analysis

Observation were made on the changes took place on different samples of salt-smoke-dried Shoal kept under different treatments where T_1 denotes the fish products where no salt and smoke was done only sun drying product kept at ambient temperature whereas T_2 and T_3 denote the salt-smoke-dried products kept at ambient and refrigeration temperature.

The shelf life of the salt-smoke-dried products was found to be related to the temperature and length of storage. The sensory evaluation scores of Shoal are summarized in Figure 3.1 Overall general acceptability scores of nine point hedonic scales (According to Larmond, 1977) are given in Figure 3.1. At the beginning of two storage treatment all the organoleptic parameters of the samples were rated as good based on the grading scale, the highest mean acceptability score for Shoal was 8.56 and whereas the controlled fillet score (only sun drying fillet) was 5.58 uring 1st day before storage (Fig. 3.1).

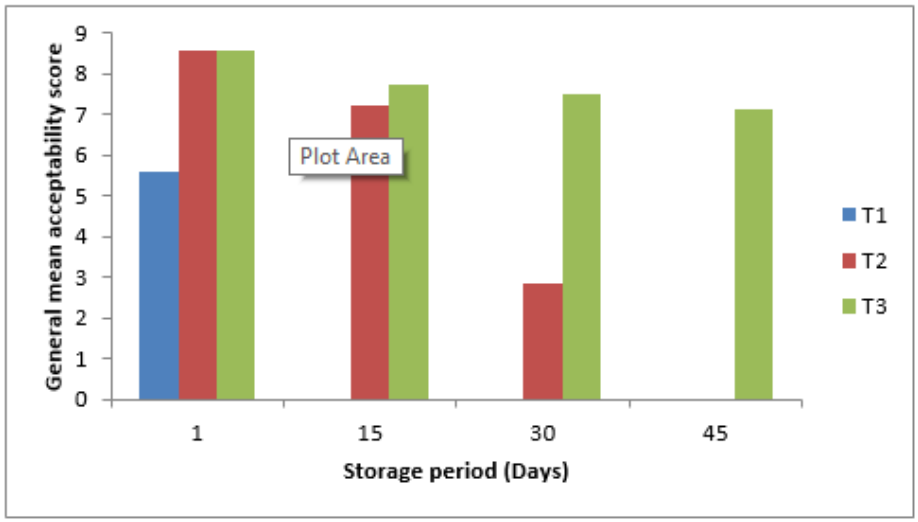

Fig 3.1: Changes in sensory evaluation score (general mean acceptability) of the salt-smoke-dried products of Shoal with different treatments during different days of storage (T_1, T_2 rejected on day after 5 and 30 respectively).

The product kept at controlled condition was found acceptable up to a period of four days and thus rejected from 5th day of observation (Fig 3.1) and during this time fungal growth occur in product (Fig. 3.3). However, the fish in treatment T_2 showed the sensory evaluation to be acceptable for 29 days (Fig. 3.1). and on the 30th day fungal growth on the fish tissue confirmed its quality as to be rejected (Fig. 3.3). The treatment was found T_3 continue its quality as accepted at very good condition with general mean acceptability score 7.21 (Fig. 3.1) even up to the period 45 days storage and more.

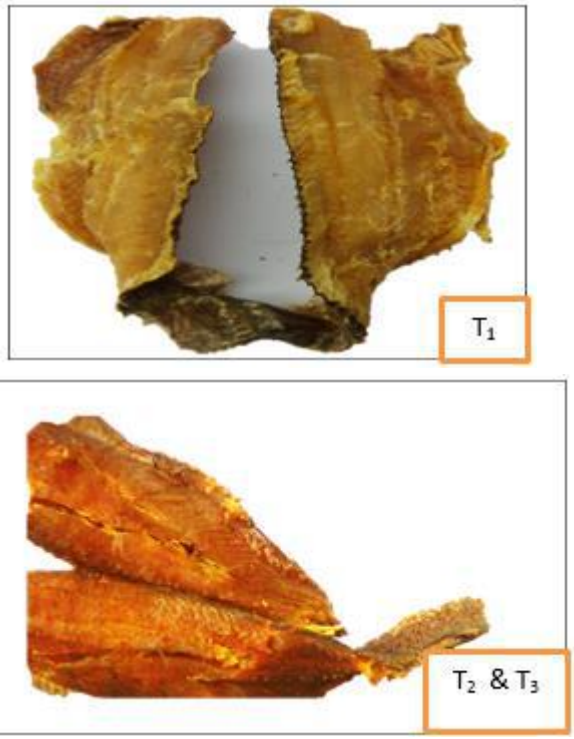

Fig.3.2: Samples of controlled product (T_1) and salt-smoke-dried (T_2 & T_3) product of Shoal during 1st day before any treatment.

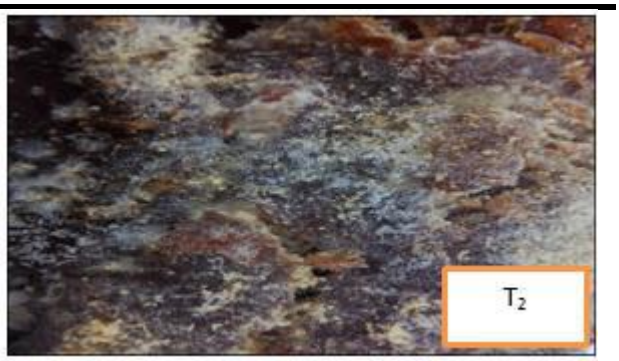

Fig. 3.3: Appearance of fungus in Shoal samples of T1 & T2 treated on 5th and 30th day respectively.

Fig.3.4: Shoal (Ophiocephalus striatis) samples of T3 treated on 45th day

The heat and air associated with smoking reduced the water activity of foods, thereby depriving the organisms for growth (Daun, 1979). Also the chemical constituents of smoked itself provided bactericidal action inhibiting some spoilage bacteria (Draudt, 1963; Daun 1979). Debnath et al., (2009) reported that smoking fish are generally perishable commodities and may be kept under refrigerator for better shelf life. Their shelf-life depends on man factors, mainly the initial quality of the raw material, the temperature regime during smoking, the content of smoke components, and the type of packaging, the hygienic standard of the premises and the temperature. The relationship between smoking parameters and odor characteristics of smoked fishes was evaluated in this experiment by experienced sensor panel numbers.

3.2 Physical properties (water rehydration behavior) analysis:

From the Fig 3.5 it is observed that the rehydration (%) of fish products kept at T_1, T_2 and T_3 increased directly with dip time whereas, with storage in different length of time (days) it decreased in all treatments at 22-28^0 C. In treatment T_1, the rehydration (%) at 15 minutes dip time in water was 29.5% which increased to 48.5% when it was dipped for 60 minutes. Similarly, T_2 had rehydration (%) of 31% in 15 minutes dip time which increased to up to 58.5% when the dip time was 60 minutes. Same thing

happened in case of T_3. In the contrary, the products in T_2 and T_3 showed a rehydration of 31% each at 15 minutes dip on 1st day of observation was found to have a slight lower value of 25.5% and 28.5% on 30 days. This type of decreasing trend with storage period at different dip time was revealed in treatment T_2 and T_3 also.

Similarly, Fig. 3.6 represents that the rehydration (%) of fish products kept under different treatments increased with dip time and decreased with the length of storage days in all treatments at 40^0C. In treatment T_1, the rehydration (%) at 15 minutes dip time in water was 32.5% which increased to 53% when it was dipped for 60 minutes. Similarly, T_2 had rehydration (%) of 37.5% in 15 minutes dip time which increased to up to 68% when the dip time was 60 minutes. Same thing happened in case of T_3. In the contrary, the products in T_2 and T_3 showed a rehydration of 37.5% each at 15 minutes dip on 1st day of observation was found to have a slight lower value of 32.5% and 36% on 30 days. This type of decreasing trend with storage period at different dip time was revealed in treatment T_2 and T_3 also.

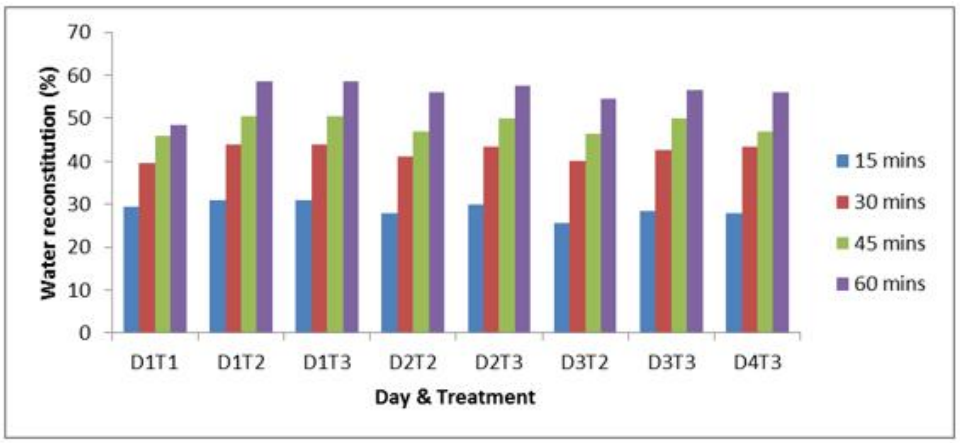

Fig.3.5: Water rehydration (%) pattern of Shoal at 22-28^{0}C with different soaking period during different days of storage (T_1 ,T_2 rejected on day after 5 and 30 respectively; D1T1, D1T2, D1T3, D2T2, D2T3, D3T2, D3T3, D4T3 denotes day 1 treatment T_1, day 1 treatment T_2, day 1 treatment T_3, day 15 treatment T_2, day 15 treatment T_3, day 30 treatment T_2, day 30 treatment T_3, day 45 treatment T_3 respectively)

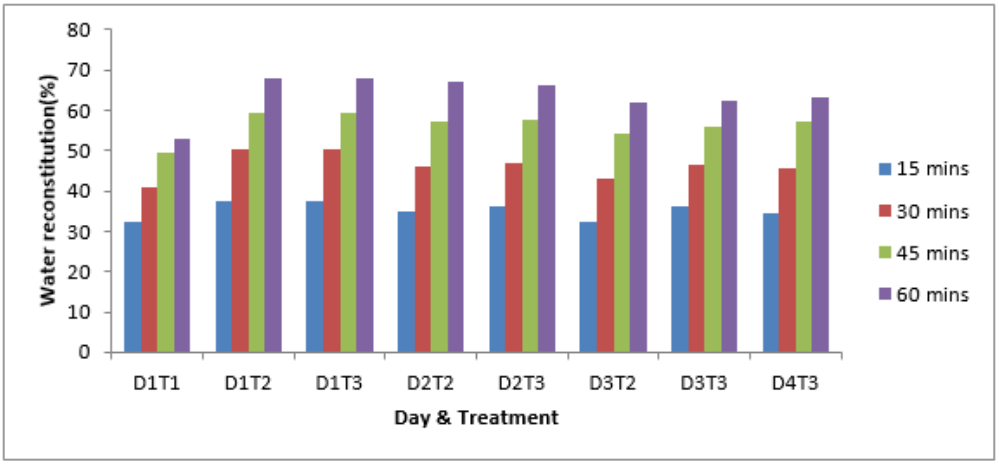

Fig 3.6: Water rehydration (%) pattern of Shoal at 400C with different soaking period during different days of storage (T1 ,T2 rejected on day after 5 and 30 respectively; D1T1, D1T2, D1T3, D2T2, D2T3, D3T2, D3T3, D4T3 denotes day 1 treatment T1, day 1 treatment T2, day 1 treatment T3, day 15 treatment T2, day 15 treatment T3, day 30 treatment T2, day 30 treatment T3, day 45 treatment T3 respectively) .

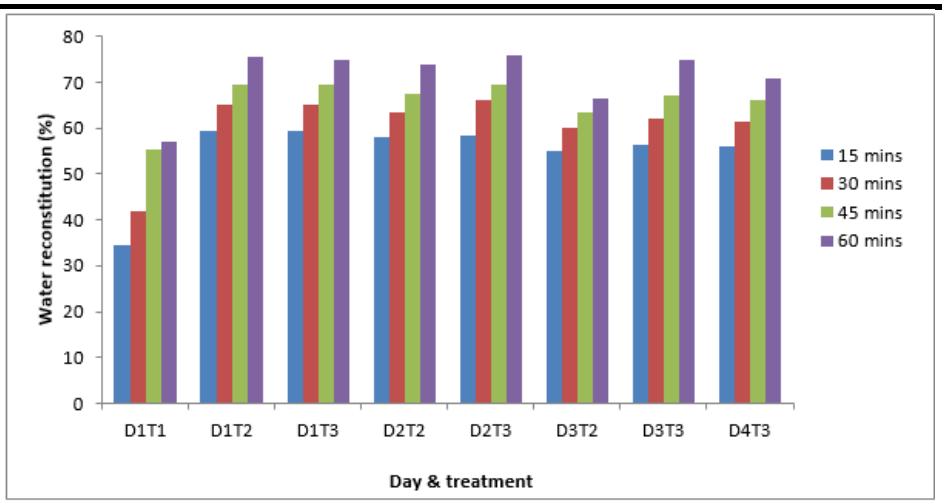

Fig 3.7: Water rehydration (%) pattern of Shoal at 600C with different soaking period during different days of storage (T1 ,T2 rejected on day after 5 and 30 respectively; D1T1, D1T2, D1T3, D2T2, D2T3, D3T2, D3T3, D4T3 denotes day 1 treatment T1, day 1 treatment T2, day 1 treatment T3, day 15 treatment T2, day 15 treatment T3, day 30 treatment T2, day 30 treatment T3, day 45 treatment T3 respectively).

Similarly, Fig. 3.7 expresses the same thing at 60^0C like Fig 3.5 and 3.6. In treatment T_1, the rehydration (%) at 15 minutes dip time in water was 34.5% which increase to 57.0% when it was dipped for 60 minutes. Similarly T_2 had rehydration (%) of 59.5% in 15 minutes dip time which increased to up to 75.5% when the dip time was 60 minutes. Same thing happened in case of T_3. In the contrary, the products in T_2 and T_3 showed a rehydration of 59.5% each at 15 minutes dip on 1st day of observation was found to have a slight lower value of 55% and 56.5% on 30 days. This type of decreasing trend with storage period at different dip time was revealed in treatment T_2 and T_3 also.

Experimentally it has been proved that rehydration increased with the increase of time and temperature. The rehydration decreased with increase of storage period due to absorbance of moisture from the media.

Jason, (1965) reported that the samples of solar dried products exhibited an enormously rapid initial rate of rehydration which was no doubt due to water being carried deep into the pieces by a porous structure which absorbed and retained sufficient water by capillary. Experiment conducted by Reza (2002) found that the maximum reconstitution of solar dried fish was ranged from 62.72 to 78.09% obtained in different species after one hour of soaking and the reconstitution of the samples increased as the temperature of the soaking water increased. Similarly, Nurullah *et al*., (2006) showed that the water reconstitution of solar dried products was in the range of 65.26 to 70.51 % where the percentage of reconstitution increases with the increase of soaking time and reaches maximum at the end of up to 60 min. And the maximum reconstitution was from 22.58 to 48.93% in solar dried products was achieved during 15 minutes of soaking at 60°C.

Therefore, this experiment of reconstitution behavior with Shoal (*Ophiocephalus striatus*) provided more or less similar result with the findings of above study.

IV. CONCLUSION

On the basis of sensory evaluation the result of the present research revealed that the refrigeration storage (4^0C) of salt-smoke-dried Shoal (*Ophiocephalus striatus*) had longer period of shelf-life and good color, texture and flavor than the products kept at ambient temperature (22-28^0C) and controlled (T_1) products which was prepared only by sun drying without salting and smoking and also kept in ambient condition. The reason of fungal attack of T_1 and T_2 treated salt-smoke-dried fish was due to absorbance of moisture from surrounding condition. At lower temperatures in refrigeration temperature there was a longer shelf-life, whereas at ambient temperature there was rapid fungal attack observed. On the other hand the rehydration (%) increased with the increase of time and temperature. The rehydration decreased with increase of storage period due to absorbance of moisture from the media. In comparison to the different storage treated samples in T_3 showed longer shelf-life and good water rehydration (%).

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