



## Protective effect of Salt (sodium chloride) and Turmeric (*Curcuma longa*) on Physicochemical attributes of sun-dried Tengra fish (*Mystus tengra*; Hamilton-Buchanan, 1822) at Laboratory condition

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Available online at: [www.isca.in](http://www.isca.in), [www.isca.me](http://www.isca.me)

Received 24<sup>th</sup> October 2014, revised 9<sup>th</sup> December 2014, accepted 11<sup>th</sup> January 2015

### Abstract

Sun-drying is one of the most important low cost methods of fish preservation and the products provide nutrients to all categories of people through the world including Bangladesh. The experiment was subjected to the difference between biochemical-composition and quality-analysis of sun-dried salted (SDS) and turmeric treated sun-dried salted (SDS+T) Tengra fish product for making a better flavored product with a view to preserve it in laboratory level for a long time. In fresh-process condition the values of total volatile base nitrogen, pH and free fatty acid were 1.9 mgN/100g, 6.3, 1.8% in case of SDS and 2.52 mgN/100g, 6.4 and 1.6% in case of SDS+T Tengra respectively. This value increased significantly ( $p < 0.05$ ) with the time of storage and between this two products, these values rapidly increased in SDS tengra than SDS+T Tengra fish-product and at the end of 12 months, the SDS Tengra fish-product became spoiled whereas SDS+T Tengra fish-product still in fresh condition. The TVB-N value had been found to have inverse relationship with the sensory score of both dried products. From the overall performance, it has been proved that this fish was highly acceptable level in salt-turmeric condition and also maintain best quality.

**Keywords:** Salt, turmeric, sun-drying, tengra, bio-chemical-composition, quality-analysis.

### Introduction

In Asia, Bangladesh is ranked as third largest aquaculture producing country after China and India<sup>1</sup>. Fisheries items are the major protein source of Bangladesh which contributing 58% of the nation's animal protein demands<sup>2</sup>. The current fish consumption rate is 17.52 kg/people/year whereas the demand is 20.44 kg/people/year and is 29.74 MT per year<sup>3,4</sup>.

The freshwater small indigenous fish species provide food and nutrition substance and supplemental income to great majority of people. The rural people have easy access to flood plain, reservoir and natural water bodies where small fishes are abundantly caught by traditional gear. It is well known that small fishes has high nutritional value in terms of both protein content and presence of micronutrients, vitamins and minerals for both young and old age consumers because these fishes can be consumed with their bones and heads<sup>5</sup>. These fishes are acceptable in all classes of peoples as fresh as well as dried products.

Catfish being one of the most valued and very diverse groups of bony fishes. Popular lean catfish tengra (*Mystus tengra*) is selected for the present study which is one of the sole species of family Bagridae. This species very widely distributed in rivers, canals, khals, beels, ditches, inundated fields and other freshwater areas and is one of the most common catfish of the

commercial catches of Bangladesh.

In our country, small indigenous fish in a fresh condition is not always available. Major fishing grounds are far away from the cities and the consuming centers which are not easily accessible. Fishing is also seasonal. Seasonal abundance in certain places and a dearth of fish in others stimulates fisherman to preserve their catch.

Fish is a low acid food and is therefore very susceptible to the growth of food spoilage bacteria. Fish begin to deteriorate as soon as they leave the water. The preservation of fish is therefore considered to be a major hindrance to its production and utilization especially in the tropical countries like Bangladesh where spoilage is rapid at ambient temperature. Due to perishable nature of fish, traditional methods of preservation have been developed over the years which including Salting, drying, smoking etc<sup>6</sup>. Preservation process starts when it is harvested and become complete when reaches the consumer's table<sup>7</sup>. Among the different fish products, dried fish is an important source of animal protein in Bangladesh. Sun drying is an important and low cost method of fish preservation. It is practiced in Bangladesh as well as throughout the world since the time of immemorial and regarded as a traditional and primitive means of fish preservation. Fishery industry of Bangladesh is mainly processing high value items such as frozen shrimps and dried products.

The main purpose in drying is to prolong the shelf life of the product. It is a slow process (usually it takes 5-7 days to dry) that makes the product spoiled and unhygienic due to partial destruction of protein content of the fish through hydrolysis oxidation. One of the major problems associated with the lengthy sun-drying of fish is the infestation of the products by the blowfly and beetle larvae. To avoid such infestations and microbial contaminations salt and salt-turmeric was used combined in order to achieve the desired product. Being a safe, antimicrobial and incidental food additive, toxic for some microorganisms, depressor of water activity ( $a_w$ ) of the food, sodium chloride has been used as a seasoning and flavor enhancer as well as a preservative or curing agent<sup>8,9</sup>. Brining reduces the microorganisms count on dry fish<sup>10</sup>. The active ingredient of turmeric (*Curcuma longa*) having pesticidal action is curcumin<sup>11</sup>. It is also known to have antibacterial properties and have a range of pharmacological activities<sup>12-14</sup>. It is used as a food additive, preservative and coloring agent in many other Asian countries, including China and South East Asia<sup>15</sup>. The suitability of herbal products like turmeric in repelling dry fish insect<sup>16</sup>.

In the traditional storage of dried fish in Bangladesh, no proper measures are normally taken to protect the fish against unfavorable environmental conditions. In order to ensure micronutrient supply for the growing population and to enable the poor fishermen and processors to produce high quality marketable products, the improvement of traditional fish drying is an urgent necessity.

In Bangladesh very little is known about the production and quality aspects of traditional dried fresh water fishery products. With this view in mind the present study was undertaken.

## Material and Methods

**Collection of the fishes and location of the experiment:** Fresh experimental Tengra Fish (*Mystus tengra*) had been collected from the river Meghna in the early hours of day and the fishes were brought to the Fish Technology Section, IFST, BCSIR, Dhaka for conducting the research activities, starts in the month of January, 2013. The whole experimental period covered 14 months of duration started from January, 2013 to March, 2014.

**Preparation of fish:** Fishes were carefully washed using cooled tap water. Fins, gills and viscera were removed and again washed with tap water to remove blood, slime and unnecessary flesh.

**Fresh sample:** Few fresh samples of experimental fish species was taken to the laboratory for quality analysis. Fishes were taken randomly and ground with an electric blender to make a homogenous-sample before being sampled for analysis.

Therefore, the total cleaned fishes were grouped into 2 batches.

**Sun-dried-salting (SDS) method:** During this experiment the

fresh tengra fishes were enrolled by dry commercial salt (NaCl) of about 30% by weight of the dressed fish (fish weight: salt weight 3 : 1). They were kept on a plastic bade basket in the sun. They were kept in sun regularly during day time (12 a.m. to 3 p.m.) for 2-7 days as sometimes the sky was cloudy and until the ripening period was over. At the same time, temperature and relative humidity were also recorded. During sun-drying, they were kept covered by dense meshed nylon or mosquito net to avoid outside contamination and prevent bird attack and fly infestation.

**Turmeric treated sun-dried-salt curing method:** During this method the fresh tengra fishes were enrolled by dry commercial salt (NaCl) of about 30% by weight of the dressed fish (fish weight: salt weight 3:1) and Turmeric powder of about 1% of dressed fish weight. They were kept on a plastic bade basket in the sun. They were kept in sun regularly during day time (12 a.m. to 3 p.m.) for 2-7 days until the ripening period was over. At the same time, temperature and relative humidity were also recorded. During sun-drying, they were kept covered by dense meshed nylon or mosquito net to avoid outside contamination and prevent bird attack and fly infestation.

**Storage of the product:** At the end of the drying period, sun-dried salted (SDS) and turmeric treated sun-dried-salted (SDS+T) tengra fish-products was packaging with plastic bag maintaining aseptic condition as far as possible and was stored at room temperature.

**Sampling procedures:** To determine the bio-chemical composition of fresh as well as dried fish and quality of dried fishes during storage period some parameters, viz. freshness test by sensory scores, TVB-N value, pH, FFA, etc. were analyzed 2 month interval until the fish become spoil or inedible condition. The experiment was done for second time at regular intervals during salting period. Salt crystal was removed from both salted-dried fish-products using dry tissue paper before being sampled for analysis.

**Biochemical analysis:** Analytical methods were applied for the determination of biochemical composition of the fresh fish and shelf-life quality of processed fish products on experimental basis. The analytical methods are: Moisture, fat and ash contents of the fish were determined by AOAC method<sup>17</sup>, The crude protein of the fish was determined by Micro-Kjeldal method<sup>18</sup>, Sensory score evaluation has been done by using 9-point hedonic scales as described by Peryan and Pilgrim (9. Like extremely; 8. Like very much; 7. Like moderately; 6. Like slightly < 5. Bad)<sup>19</sup>. TVB-N was determined by Conway modified micro-diffusion technique<sup>20</sup>. pH was used to measure quality deterioration of Tengra fish using a pH meter (Mettler Toledo 320-s, Shanghai, China)<sup>21</sup>, FFA of the fish was determined by AOAC method<sup>17</sup>.

Data were analyzed using SPSS for windows-20 statistical programme. Significance was established at  $p < 0.05$ .

## Results and Discussion

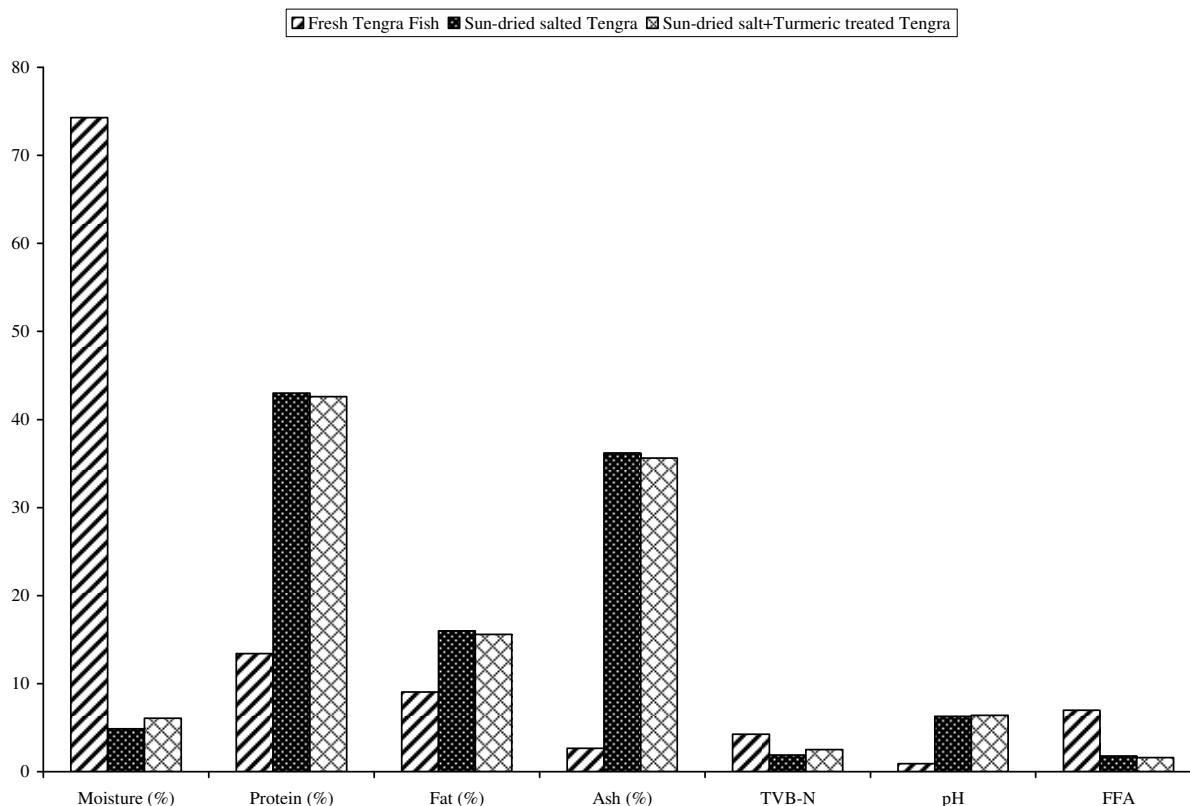
**Biochemical analysis:** The experimental fish tengra (*Mistus tengra*) is small in size and rich in nutrients. In case of fresh tengra fish the percentage of moisture, protein, fat, ash (Proximate composition) was 74.27%, 13.43%, 9.04% and 2.67% and chemical composition (TVB-N, pH, FFA) was 4.27 mgN/100g, 7 and 0.9% respectively (Fig.1). Generally, lipid content varies within species (1.46 to 5.77%) and is affected by the catching season (1.2 to 18.4%)<sup>22</sup>. In present experiment, fresh tengra fish recorded a high moisture and low protein content, similar to other report<sup>23</sup>. Ash content of fresh tengra fish was higher than those found in other species<sup>24</sup>. The higher ash content could be explained by the presence of the bones in the samples.

Values of Moisture, protein, fat, ash, TVB-N, pH and FFA was 4.9%, 43.00%, 15.99%, 36.20%, 1.9 mgN/100g, 6.3 and 1.8% in case of sun-dried salted (SDS) and 6.08%, 42.60%, 15.58%, 35.60%, 2.52 mgN/100g, 6.4 and 1.6% in case of turmeric treated sun-dried-salted (SDS+T) tengra respectively.

**Quality assessment and storage stability: Sensory evaluation (Score):** According to the panel's evaluation, the sensory properties of sun-dried salted (SDS) and turmeric treated sun-dried-salted (SDS+T) tengra fish-products were in acceptable

condition throughout storage period though, statistically there was significant difference ( $p < 0.05$ ) in the sensory evaluation during storage period based on the panel's score. The initial score of the sensory evaluation of SDS and SDS+T tengra was 9. But during storage period this score rapidly decreased and at the end of the storage period, the score was 5 in case of SDS (12 month) and SDS+T (14 month) Tengra. Figure-2, 3. This hedonic rating scale was applied by using 9- points for the sensory evaluation of the dried and dehydrated fish<sup>25</sup>. The sensory analysis of salted- sun dried (SDS) and turmeric treated salted sun- dried (SDS+T) fishes were done and reported that the quality of turmeric treated salted sun- dried product was much better.

**Changes in TVB-N (Total Volatile Base Nitrogen) value:** The TVB-N of fish is an indicator of the freshness of the raw material<sup>26</sup>. TVB-N values were found to vary from 1.9 (0 day) to 30.15 mgN/100g (12 month) for sun-dried salted (SDS) tengra and 2.52 (0 day) to 30.24 mgN/100g (14 month) for turmeric treated sun-dried-salted (SDS+T) tengra. TVB-N values of the products storage at room temperature showed linearly increasing pattern throughout storage period but neither of the value exceeded the recommended value set for fish regarded as acceptable condition. Significant statistical differences were found between the initial



**Figure-1**  
Biochemical composition of fresh, freshly processed sun-dried salted (SDS) and turmeric treated sun-dried salted (SDS+T) Tengra fish-products

product and end product ( $P < 0.05$ ) during storage period. Total volatile base nitrogen (TVB-N) is important compound provide a measure of the progress of spoilage that is dependent of sensory assessment. TVB-N contents of mirror carp fish fillets were found mean value 11.67 mg/100 g, and TVB-N contents in treated fillets did not show an important increase till days 14 of storage, on the following days, reached to 17.9-20.07 mg/ 100g levels on days 28, increasing rapidly<sup>27</sup>. The level of TVB-N in fish and fish products are mostly used as spoilage indicator through bacterial activity<sup>28</sup>. The same result has been evident in the present study. TVB-N is mainly contributed by ammonia in the muscle produced by determination of muscle proteins<sup>29</sup>. A value of 35 mg/100 g of TVB-N has been suggested as border line<sup>30</sup>. In present experiment, TVB-N values of all samples were lower than 35 mgN/100 g which was considered as the threshold for a good-quality fish product (figure-2, 3). In early storage, spoilage rate become slower than later storage time, it would appear from the Figure. TVB-N value increases when decrease of sensory score value with the increase of storage period.

**Changes in pH value:** pH value is a reliable indicator of the degree of freshness or spoilage. The pH in fresh condition fresh-water fish flesh is almost neutral<sup>31</sup>. Because of the decomposition of nitrogenous compounds, pH in the fish flesh increase in the post-mortem period. The increase in pH

indicates the loss of quality. The pH value of sun-dried salted (SDS) and turmeric treated sun-dried-salted (SDS+T) tengra fish-product was increased significantly ( $P < 0.05$ ) with storage period. pH value of fresh tengra fish was 7.0 in present study. But when salt is added with the fish, pH value decrease due to increase of acidic compound and after that among shelf life study pH value increases in the time interval due to increase of basic compounds. In the present study pH value were found to vary from 6.3 (0 day) to 7.1 (12 month) for SDS and 6.4 (0 day) to 7.2(14 month) for SDS+T tengra.

The limit of acceptability of fish products is usually 6.8 to 7.0<sup>32</sup>. While the initial pH values in the samples were similar to findings of other researchers; the increase in pH values during the storage of room temperature (30-34°C) was higher than others. The probable reason of these differences is differences in fish species and different methods of salting.

**Changes in FFA (Free Fatty Acid) value:** FFA value is a measure of the extent of oxidative deterioration in oily fish, but it can fall further at latter stages of fish spoilage<sup>33</sup>. The initial FFA values were 1.8% (oleic acid percentage) and 1.6% for sun-dried salted (SDS) and turmeric treated sun-dried-salted (SDS+T) tengra fish-products. FFA values increased with storage time.

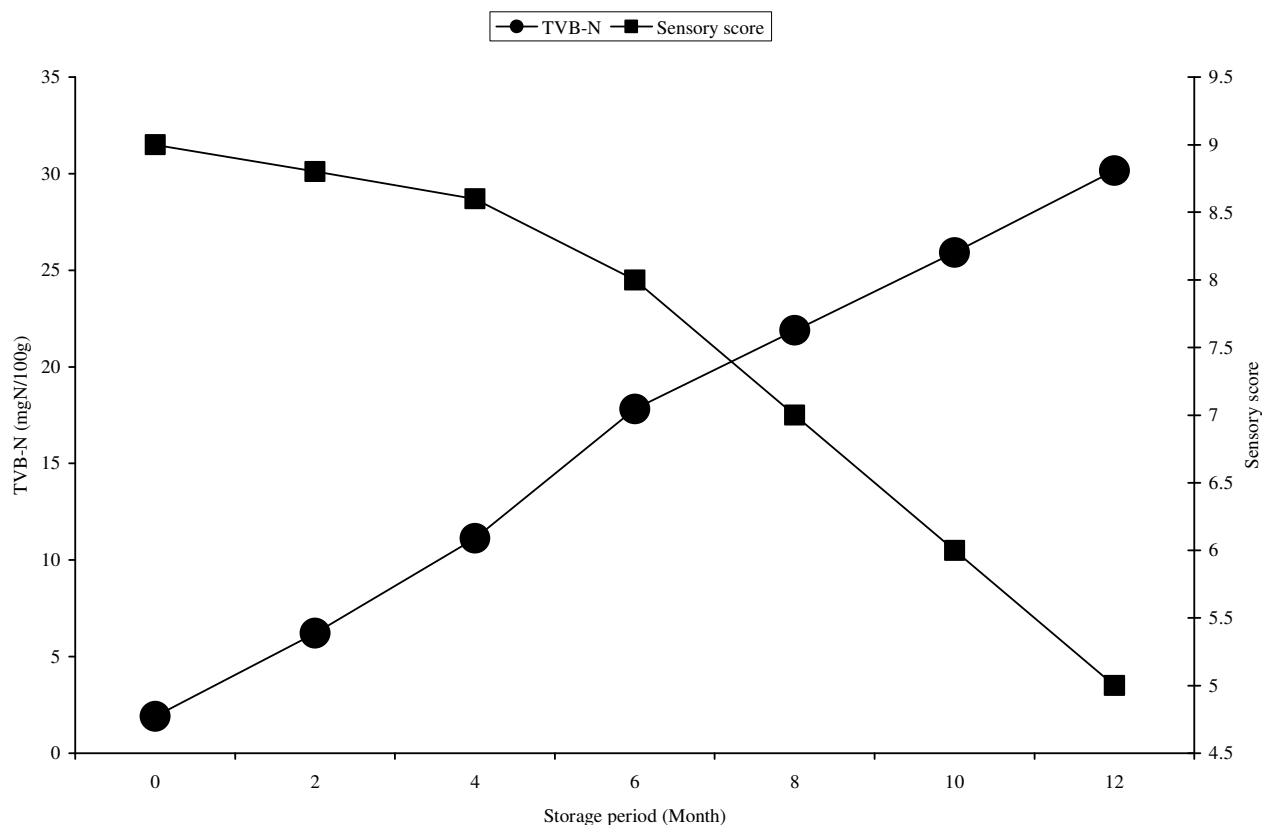
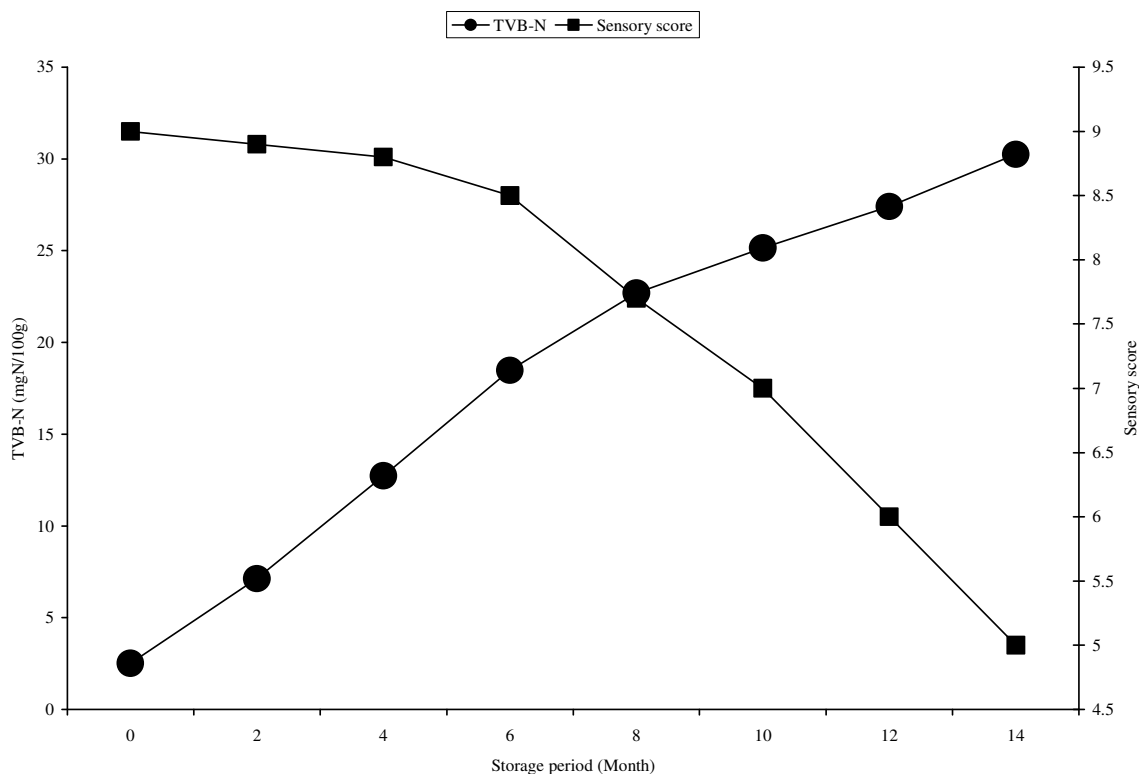


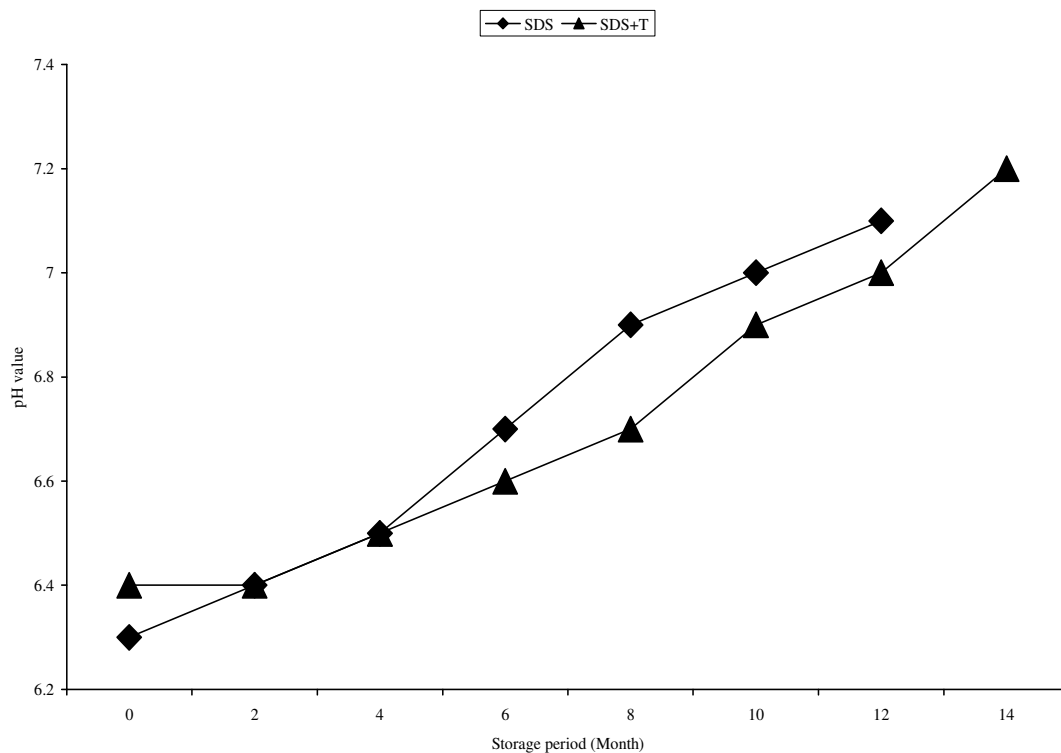
Figure-2

Inverse relationship between TVB-N and sensory score of sun-dried salted (SDS) Tengra fish-product during storage at room temperature



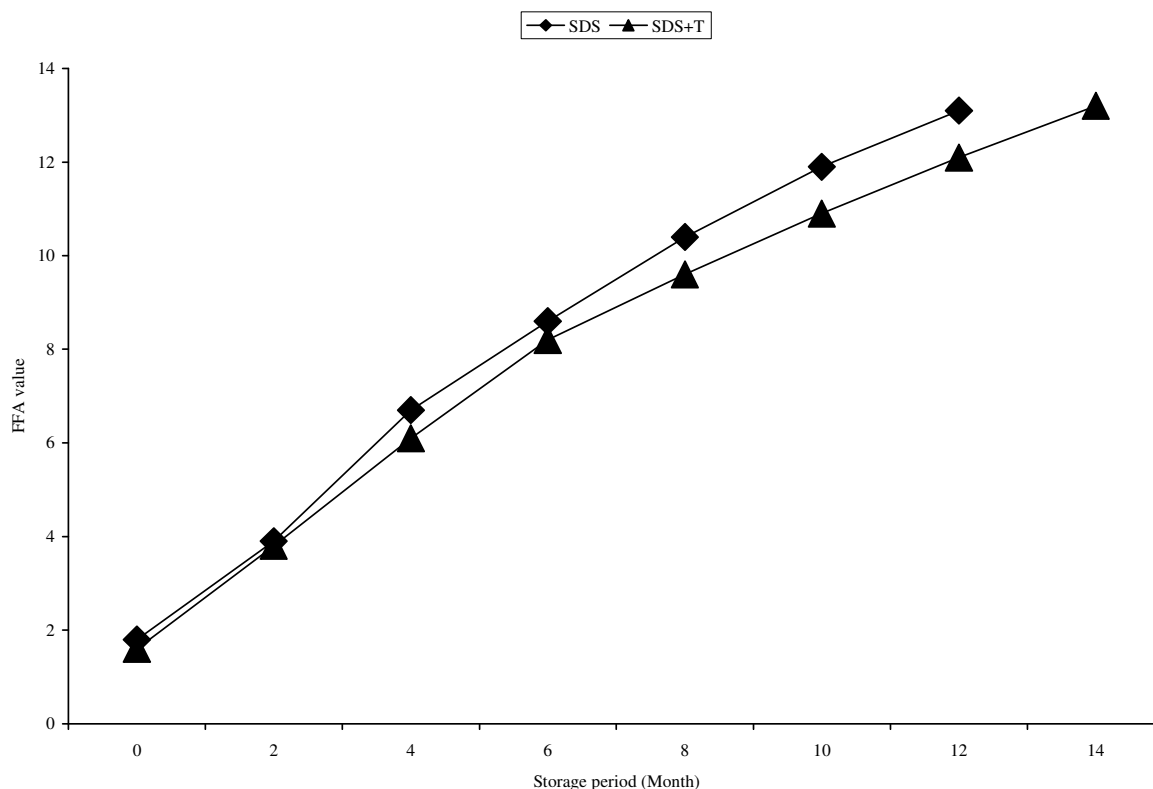
**Figure-3**

**Inverse relationship between TVB-N (mg N/100g) and sensory score of turmeric treated sun-dried salted (SDS+T) Tengra fish-product during storage at room temperature**



**Figure-4**

**Changes in pH value of sun-dried salted (SDS) and turmeric treated sun-dried salted (SDS+T) Tengra fish-products during storage at room temperature**



**Figure-5**

**Changes in FFA (%) value of sun-dried salted (SDS) and turmeric treated sun-dried salted (SDS+T) Tengra fish-products during storage at room temperature**

At the end of the storage period values of FFA were found to be 13.1% (12 month) for SDS tengra and 13.2% (14 month) for SDS+T tengra respectively. Significant statistical differences were found between the initial product and end product ( $P < 0.05$ ) during storage period. Lipid hydrolysis by itself has no nutritional significance but the accumulation of free fatty acids (FFA) in fish oils in undesirable amount due to secondary reaction catalyzed, such as increased susceptibility to oxidation and consequent development of off flavors<sup>34</sup>. The result of free fatty acids (FFA) (Figure 5) indicated that the salting and drying conditions accelerate lipid oxidation and this is in agreement with the results as shown by other researchers. A high level of FFA is characteristics of product that have undergone both microbial and biochemical spoilage<sup>35</sup>.

## Conclusion

In the present study, quality and shelf life of dried Tengra fish using two different treatments were analyzed and found organoleptically excellent quality. The main hypothesis of the present study is to understand the effect of different treatments used for drying and to find out the best method of drying for the consumer's safety and economic benefit of the coastal society who mainly depend on the dry fish for livelihood. Commercial traders those who produce market dry fish in our country may be asked to follow the suggestions made over here on the basis of the findings of the present study.

## Acknowledgement

The author acknowledges the scientists and technicians of BCSIR, Dhaka, Bangladesh for their technical supports and continuous assistance to carry out the present study.

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