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Original Article

Biochemical and Bacteriological Changes in Salt-Dried Bujuri Tengra (*Mystus tengara*) During Storage in Different Packaging Conditions

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A B S T R A C T

The study was conducted to prepare good quality salt-dried bujuritengra (*Mystus tengara*) in a solar tunnel dryer. Changes in the quality parameters of salt-dried bujuritengra during 180 days of storage were examined under different packaging conditions. In the solar tunnel dryer, it took 42-46 hrs to complete the drying process where the percent moisture value in the fish decreased to a level of 18.65±0. Moisture content (%) of fresh fish was found 75.87±0.19% which fell to 18.65±0.05% after drying then raised again in the range of 28.22±0.23 to 29.91±0.25%. Protein content (%) for fresh fish was obtained 13.86±0.06 after drying which increased to 51.56±0.12. While stored the product in different packets this value decreased to the range of 40.06±0.17 to 43.53±0.25%. Lipid content (%) was found 7.21±0.09 in the fresh fish which increased to 16.27±0.12 after drying. During storage the lipid content also decreased. The percent ash content was found 2.75±0.11 in fresh fish which increased to 13.36±0.05% after drying though it decreased during storage. The TVB-N value of fresh fish was 2.90 (mg/100g) after drying this value reached to 3.96 (mg/100g). With the lapse in storage time TVB-N value increased. For fresh fish pH value was obtained 6.80 which decreased to 6.10 after drying. On "0" day of drying the aerobic plate count of bacteria was found 1.87×10^4 (CFU/g, after 180 days of storage the value reached to 6.9×10^5, 6.2×10^5 and 5.8×10^5 (CFU/g), in tied, sealed and vacuum sealed packets, respectively. Results of the study indicated that- if drying is properly done and salt-dried bujuritengra are kept in vacuum sealed packets it can be stored at room temperature (26 to 28°C) for about 6 months without any major deterioration in the quality.

Introduction

On an average fish contains 15-20% protein and hence it is the single highest human protein source (animal source) especially in developing countries all over the world (Nowsad, 2011). In Bangladesh, about 63% animal protein of meal comes from fish resources (Ahmed, 2005) which is composed of 260 freshwater native species, 12 species of exotic fish, 24 species of freshwater prawn, 475 marine fish species and 36 species of marine shrimp (Haque, 2005).Abdullahi*et al* (2001) reported that, for supplementation of essential nutrients of both infant and adult diets fish is rich source which also contains many vitamins and minerals. After catch of fish, quality loss can occur very rapidly (Zakhia, 2002). In other words, during post harvest period proper handling, processing and preservation are the prerequisites for minimizing the spoilage loss. To preserve fish scientifically or to maintain its flavor, nutritional quality as like as the fresh one is not easy task. Curing of fish is an age old system of fish preservation for increasing its shelf life and this method is used by the consumers at different levels. In curing (methods like, salting, smoking and drying) the moisture is reduced in fish muscle by decreasing the water activity (a_w). There are number of advantages and disadvantages for each of the type of preservation. In recent years, among all food preservation methods, drying has received the most widespread and enthusiastic publicity (Calicioglu *et al*., 2002). Drying is used as a means of prolonging the shelf life of fish after

capture. Sun drying is one of the most important low cost methods of fish preservation and the products provide nutrients to all categories of people throughout the world including Bangladesh. Doe *et al*. (1977) observed the spoilage of dried fish and the effect of water activity and temperature on spoilage organisms. He reported that spoilage of dried fish might be due to bacteria, fungi, brining and others, all of which are temperature and water activity dependent. For improving the quality of dried fish several methods of drying have been developed and practiced especially in Bangladesh, and the feasibility of their application was also studied. Doe *et al*. (1977) worked with the polythene tent drier for getting improved quality of sun dried fish.

Salting is another oldest method of curing which has been practiced for fish preservation. Dry-salting process is still been used in different countries around the world. Dry-salting is generally aimed in reducing water activity (a_w) at the same time to prevent the growth of the microorganism and to inactive autolytic enzymes (Horner, 1997). Several scientists (Ahmed et. al., 1981; Andres et. al., 2005) have stated that, dry-salting does not prolong the shell life of fish product but provide desirable sensorial changes. Salt plays highly significant role to guarantee the quality and stability of the finished products. The preservative action of salt lies in the reduction of water activity of a system thus renders a condition less favorable for the microbial life (Barbut et. al., 1986).

According to Rahman (1989), there are 260 species of freshwater indigenous fishes in Bangladesh. Felts *et al*. (1996) have included 45 fish species on the list of SIS including carps and minnows (18 species), catfishes (9 species), perches (9 species). Bujuritengra (*Mystus tengra*) is one of the most common catfish of the commercial catches of Bangladesh.

People of the country are being acquainted with different fish products with time. Testing of some smoke cured, salt smoke cured, salt dried fish with native species prepared experimentally showed the consumer's preference for this tasty product as encouraging (Salim *et al*., 2007). For developing different fish products of having better quality in comparison to the fish products available in the markets, attempts need to be taken to utilize the available fish species in preparation of the products. To observe the changes in their nutritive value in different storage conditions, quality parameters of the products should be tested so that consumers can get the products of prime quality round the year. Therefore, considering the possible health benefit or risk and the nutritional benefits associated with fish consumption; this study was carried out for ascertaining the effect of salt-drying on the biochemical and microbiological parameters of bujuritengra (*Mystus tengara*) during storage at room temperature (26 to 28°C) in three packaging condition,

Materials and Methods

For conducting the present experiment, salt-dried product was prepared using high quality salt in a solar tunnel dryer. Prepared products were stored in different packets for a certain time and during the storage changes in quality of the products were evaluated by examining their biochemical and microbiological parameters.

Experimental design

For the experiment fresh bujuritengra (*Mystus tengara*) fishes were collected from a nearby market (K.R. market) located in the campus of Bangladesh Agricultural University (BAU), Mymensingh. Salting and drying processes were performed in the Department of Fisheries technology. Faculty of Fisheries of the university.

Description of Solar Tunnel Dryer

A Hohenheim-type solar tunnel dryer was used for drying fish which was constructed using locally available materials and the size of the dryer was 20m×2m with 20 m^2 drying area. The dryer had a flat plate/platform, air-heating collector, a drying unit and a small fan to provide the required airflow over the fish to be dried. Both the collector and the drying unit were covered with transparent polythene sheet. Black paint was used as heat absorber in the collector. The fishes were spread on polyethylene sheet set on plate/platform (in some cases hanged from the rod of the top by hook) in the tunnel dryer. The air at required rate was provided inside the dryer by fan and passed over the products. The black painted collector absorbed heat through transparent polythene from sunlight. Solar radiation also passed through the transparent polythene cover of the dryer and heated the products. It enhanced the drying rate and raised the temperature inside the dryer to the range of 36°to 60°C.

(a) **(b)**

Plate 1. (a) Model of Solar Tunnel Dryer; (b) Solar Tunnel Dryer used for fish drying

The experimental process

The collected fish samples were carried to the laboratory of Department of Fisheries technology, BAU in an icebox. The procedure followed for the preparation of salt-dried fish is presented in Figure 1.

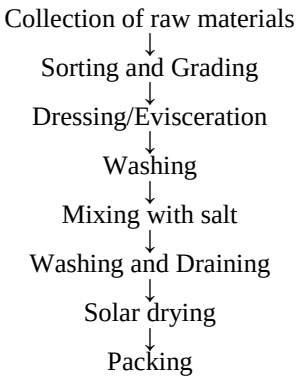

Figure 1. Processing steps of salt-dried tengra preparation.

(a) **(b)**

(c) (d)

Plate 2. (a) washed and salted tengra; (b) closed view of solar tunnel dryer; (c) inside view of the dryer and (d) salt-dried tengra in tied, sealed and vacuum sealed packets.

Quality assessments of salt-dried bujuritengra

For chemical analysis, whole salt-dried fish samples were ground in an electric blender to produce a homogenous one before being sampled for analysis. Samples of each treatment were packed in polythene packets tightly by using a sealer and kept for further analysis.

Proximate composition

Analysis of proximate composition of salt-dried tengra were done according to the methods as given in AOAC (2000) with certain modification.

Total Volatile Base Nitrogen (TVB-N)

TVB-N value was determined according to the methods given in AOAC (2000).

Determination of pH value

pH was measured following the method described in AOAC (2005) using an electronic pH meter (HANNA pH 211 Microprocessor pH Meter) with a glass electrode using expandable scale.

Aerobic plate count (APC)

Aerobic plate count of the samples was done by spread laboratory as per direction of Cowan and Steel's Manual for the Identification of Medical Bacteria (edited by Barrow and Felthham, 1993) and with the help of DIFCO, Manual of Dehydrated Culture Media and Reagents, 9th edition, 1964. Number of bacteria per gram of the fish sample (CFU/g) was calculated by using the following formula:

$$\text{APC(CFU/g)} = \frac{\text{No. of colonies on Petridish} \times 10 \times \text{dillusion factor} \times \text{volume of total samplesol}^{n}}{\text{wt. of fish sample(gm)}}$$

Data analysis

For analyzing the data obtained from the study, one-way analysis of variance and the general linear model (using Windows for SPSS) 9.0 were used. The significant differences between data of storage periods were calculated by the Duncan's New Multiple Range Test (DMRT).

Results and Discussion

Proximate composition, TVB-N and pH value of fresh bujuritengra

Proximate composition of fish indicates the nutrient value of that fish which helps to make the decision regarding the necessity and technique of processing or preservation of the fish. There is a inverse relationship between moisture and lipid content of fish. In fresh fish moisture content is always high. TVB-N and pH are the indicator of freshness of fish. TVB-N indicates the presence of total volatile base nitrogen as mg/100g where, pH indicates the alkaline or acidic condition of muscle. pH of fresh fish is around neutral. The chemical composition of fresh tengra is shown in Table 1.

For fresh tengra. Latifa *et al*. (2014) found moisture, protein, fat, ash 74.27%, 13.43% 9.04% and 2.67%, respectively. In the case of TVB-N and pH value they obtained 4.27mg/100g and 7, respectively for the same fish. In the present study the values of moisture, protein, lipid and ash contents in fresh fish were 75.87%, 13.86%, 7.21% and 2.75% and values for TVB-N and pH were 2.90mg/100g and 6.80, respectively which were quite nearer to the previous study.

Table 1. Proximate composition, TVB-N and pH values of fresh bujuritengra.

Parameters	Values
Moisture (%)	75.87±0.19
Protein (%)	13.86±0.06
Lipid (%)	7.21±0.09
Ash (%)	2.75±0.11
TVB-N (mg/100g)	2.90±0.09
pH	6.80±0.14

Changes in the Proximate composition, TVB-N and pH values in salt--dried bujuritengra stored in different packets

Proper packaging is very important to extend the shelf-life of the products. Packaging protects the product from contamination and prevent it from spoilage, and at the same time it facilitates distribution and display, give the product greater consumer appeal. In this experiment three types of packets (tied, sealed and vacuum sealed) were used to store salted-dried tengra.

Changes in moisture content (%)

In fresh tengra, moisture was found 75.87±0.19% (Table1). Salt-dried curing process reduced the moisture level in the final product. In salt-dried tengra the moisture content was found 18.65±0.05% on "0" day. The changes in moisture content of salt-dried tengra in different packets stored at room temperature (26 to 28°C) are presented in Table 2. The table shows that-moisture level gradually increased in the product irrespective of packets during storage of 180 days. Though an increasing trend in percent moisture content in all three types of packets were observed but moisture intake was slightly higher in tied packet than the others. After 60 days of storage of salt-dried tengra the percent moisture were found 20.20±0.30, 20.25±0.14 and 20.12±0.04 in tied, sealed and vacuum sealed packets, respectively which increased to 24.10±0.20, 23.15±0.06 and 23.02±0.12 after 120 days storage and finally reached to 29.91±0.25, 29.20±0.08 and 28.22±0.23 after 180 days of storage. Flowra *et al.* (2012) carried out biochemical analysis of five dried fish species of Bangladesh and found moisture content for dried *Mystus vittatus* around 18%. Rana and Chakraborty (2016) reported moisture value 76.06% for fresh tengra (*Mystus tengra*) and 18.36% for sun dried sample. During 60 days of storage they observed the increment in moisture level from 18.36±0.25 % to 25.86±0.16%. Antony and Govindan (1983) conducted study on packaging and storage of salted and dried lizard fish (*Saurida* sp.) using different synthetic films like, low density polyethylene (LDPE) of different gauges, high density polyethylene (HDPE) of 200 gauge, polyvinylidene chloride (PVDC) coated 400 MXXT cellophane, 100 gauge polypropylene (PP) and paper laminate of 100 gauge polythene. They found a continuous increase in moisture content during storage. In 700 gauge LDPE they found

29.30% moisture content on 30th day of storage which reached to 29.52% after storage of 150 days whereas in 100 gauge PP they observed moisture content 27.80% after 30 days of storage which increased to 31.57% on 120th days. All these results are similar to the findings of the present study. Antony and Govindan (1983) stated that- dried fishery products are very sensitive to humidity changes and absorb or lose moisture depending on the prevailing atmospheric conditions. Initial moisture content and quality of the common salt used for curing are important factors affecting the ultimate quality and storage life of dried fish.

Changes in protein content (%)

The percent protein was found 13.86±0.06 in fresh fish, after salting and drying which reached to 51.56±0.12. The changes in protein content (%) of salt-dried tengra in different packets stored at room temperature is presented in Table 2. Table shows that- percent protein content of salt-dried tengra decrease with the increase of storage period in all types of packets After 60 days of storage the values decreased to 48.15±0.13%, 48.45±0.04% and 47.73±0.08% in tied, sealed and vacuum sealed packets, respectively. While the salt-dried tengra stored for 120 days the values were found 44.75±0.17%, 44.34±0.21% and 45.79±0.21% and at the end of experiment of 180 days the values reduced to 40.06±0.17%, 42.79±0.09% and 43.53±0.25%, respectively.

A study carried out by Flowra *et al.* (2012) showed that, the protein content varied between 44.08% to 65.65% in dried *Mystus vittatus*, *Channa punctatus*, *Chanda nama*, *Coricaso borna* and *Trichuiru haumela*. The other study reported that, the protein content varied from 42.06% to 65.78% in ten indigenous dried fishes (Rana*et al*., 2019). Islam *et al* (2013) found the protein content in the range of 32.02% to 41.38% in dried *Puntius sp*. (puti), *Amblypharyngodon mola* (mola), *Channa punctatus* (taki) and *Glossogobius giuris* (bele). Majumder *et al*. (2018) observed that, the crude protein content of *M. vittatus* varied between 69.08% and 70.03% on a dry matter basis during the storage period of 90 days. The highest crude protein content was obtained for fish with the 0-day storage period. Results obtained in the present study are quite nearer to the studies mentioned above.

Table 2. Changes in proximate composition (%) of salt-dried tengra (*Mystus tengara)* in different packets stored at room temperature (26 to 28°C).

Days	Moisture content (%) in salt-dried tengra			Protein content (%) in salt-dried tengra			Lipid content (%) in salt-dried tengra			Ash content (%) in salt-dried tengra		
	Tied packet	Sealed packet	Vacuum sealed packet	Tied packet	Sealed packet	Vacuum sealed packet	Tied packet	Sealed packet	Vacuum sealed packet	Tied packet	Sealed packet	Vacuum sealed packet
0	18.65±0.05	18.65±0.05	18.65±0.05	51.56±0.12.	51.56±0.12.	51.56±0.12.	16.27±0.12	16.27±0.12	16.27±0.12	13.36±0.05	13.36±0.05	13.36±0.05
15	18.90±0.05	-	-	51.18±0.23	-	-	16.08±0.16	-	-	13.12±0.06	-	-
30	19.10±0.10	19.25±0.11	-	50.80±0.05	51.10±0.05	-	15.82±0.13	15.74±0.14	-	13.02±0.08	13.04±0.06	-
45	19.80±0.11	-	-	49.70±0.07	-	-	15.21±0.08	-	-	12.40±0.20	-	-
60	20.20±0.30	20.25±0.14	20.12±0.04	48.15±0.13	48.45±0.04	47.73±0.08	14.55±0.15	14.48±0.20	14.65±0.11	12.16±0.17	12.16±0.14	12.25±0.12
75	21.53±0.27	-	-	47.46±0.05		-	13.75±0.12	-	-	11.73±0.06	-	-
90	22.25±0.16	23.05±0.13	-	46.53±0.07	45.70±0.16	-	12.90±0.06	13.52±0.05	-	11.27±0.19	11.06±0.04	-
105	23.60±0.15	-	-	45.72±0.14		-	11.45±0.26	-	-	10.91±0.13	-	-
120	24.10±0.20	23.15±0.06	23.02±0.12	44.75±0.17	44.34±0.21	45.79±0.21	10.98±0.14	12.49±0.11	12.54±0.05	10.53±0.08	10.75±0.07	11.17±0.11
135	25.90±0.12	-	-	43.35±0.23	-	-	10.58±0.06	-	-	10.08±0.16	-	-
150	26.35±0.18	26.30±0.05	-	42.92±0.19	43.51±0.26	-	10.08±0.03	11.29±0.20	-	9.14±0.05	10.20±0.17	-
165	28.10±0.25	-	-	41.40±0.13	-	-	9.38±0.22	-	-	8.57±0.03	-	-
180	29.91±0.25	29.20±0.08	28.22±0.23	40.06±0.17	42.79±0.09	43.53±0.25	9.06±0.07	10.56±0.24	10.89±0.23	8.20±0.24	9.45±0.08	10.18±0.02

Changes in Lipid Content (%)

In fresh tengra, percent lipid was found 7.21±0.09 which increased to 16.27±0.12 (Table-2) after salt-drying. The changes in lipid content of salt-dried tengra in different packets stored at room temperature are presented in Table 2. The table (2) shows that- percent lipid content decreased gradually in the products irrespective of packets throughout the storage of 180 days. Though a decreasing trend in lipid value was found in all types of packets but the values were comparatively lower in tied packet samples than the samples of other two packets. The lipid contents (%) were found 14.55±0.15, 14.48±0.20, 14.65±0.11 in tied, sealed and vacuum sealed packets, respectively on 60th days of storage which further declined to 10.98±0.14, 12.49±0.11, 12.54±0.05 after 120 days and finally reduced to 9.06±0.07, 10.56±0.24, 10.89±0.23 after storage of 180 days at room temperature.

Flowra *et al*. (2012) found highest lipid content 17.76% in *M. vittatus* based on wet matter basis and 21.54% on dry matter basis, which is more or less similar to the present study. Lipid content (%) varied greatly among the dried fish species, which was also reported by Stansby, (1962); Kalamani and Kamasastri (1998) (3.7-17.8%). Majumder*et al*. (2018) observed that, the crude lipid content of *M. vittatus* increased from 13.31% to 13.71% in 30 days of storage, while it decreased slightly to 12.42% after 90 days on a dry matter basis. Present study with tengra also provided more or less similar result with the findings of other researchers.

Changes in Ash Content (%)

Initially, the percent ash was found 2.75±0.11 (Table1) in fresh tengra which increased to 13.36±0.05 (Table-2) after salting and drying operation. The changes in percent ash content of salt-dried tengra in different packets stored at room temperature are presented in Table 2. From this table it is seen that-the ash content decreased in all the stored samples. After 60 days of storage the ash contents were found 12.16±0.17%, 12.16±0.14%, 12.25±0.12% in tied, sealed and vacuum sealed packets, respectively which decreased to 10.53±0.08%, 10.75±0.07%, 11.17±0.11% on 120th day and finally reduced to 8.20±0.24%, 9.45±0.08%, 10.18±0.02% at the end of 180 days of storage.

The mineral content of dried *Wallago attu*, *C. striatus* and *G. giuris* were found 6.79%, 6.49% and 7.83%, respectively in a study carried out by Majumdar *et al*. (2017) while, the mineral content ranged from 9.63% to 22.73% in five selected dried fishes observed by Flowra *et al* (2012), In another study Flowra and Tumpa (2012) found the ash

contents 10.78% in *Labeobata* and 15.67% in *Palaemon sp*. The percent ash value of *M. vittatus* varied between 16.61 and 17.08, and no significant difference could be observed by Majumder *et al*. (2018) during 90 days of storage. Ash contents obtained in the present study are near to the range of obtained values by the other researchers. A decreasing trend in ash content of the samples were found with the progress of storage time might be due to the absorbance of moisture and loss of protein in the samples (Hassan *et al*., 2013).

Changes in TVB-N Value

Total volatile base nitrogen (TVB-N) levels were mentioned as the main parameter of fish muscle freshness and widely used as an indicator of the degree of lipid oxidation (Daramola *et al*., 2013). The changes in TVB-N value (mg/100g) of salt-dried tengra in different packets stored at room temperature are presented in Table 3. The TVB-N value of fresh tengra was 2.90 mg/100g (Table 1), after salt-drying of tengra which increased to 3.96 mg/100g (Table-3). During180 days of storage of the products this increasing trend in TVB-N value continued. The result shows that-the TVB-N values increased in all the stored samples. In tied, sealed and vacuum sealed packets the values obtained 15.32, 15.27, 15.32 (mg/100g), respectively which increased to 22.65, 22.35, 22.39 (mg/100g) after 120 days and finally reached to 29.34, 28.20. 28.16 (mg/100 g) at the end of 180 days of storage.

Increase in final values of TVB-N in this study is similar to the result of Hasan *et al*. (2006) who reported the range of values from 10.64 mg/100g to 17.52 mg/100g with lowest in mola and highest in tengra fish, dried in rotary dryer under direct sunlight. Latifa *et al*. (2014) found TVB-N value in their experiment in the range of 3.9 (0 day) to 30.22 mg N/100 g (7 month) for dry-salted *M. tengara* and 4.92 (0 day) to 31.04 mg N/100 g (6 month) for pickle-salted *M tengra*. On the other hand, Rana and Charaborty (2016) reported TVB-N values 5.86 and 6.88 mg/100g for salt-smoke-dried and control dried tengra, respectively in fresh processed condition which raised later on with lapse of storage time. According to Darmola *et al*. (2007) this increase in TVB-N value might occurred due to gradual degradation of the initial protein to more volatile product such as volatile base nitrogen.

Table 3. Changes in TVB-N content ((mg/100g)) and pH of salt-dried (SD) tengra (*Mystus tengara)* in different packets stored at room temperature (26 to 28°C).

Days	TVB-N content ((mg/100g)) in salt-dried tengra			pH in salt-dried tengra		
	Tied packet	Sealed packet	Vacuum sealed packet	Tied packet	Sealed packet	Vacuum sealed packet
0	3.96	3.96	3.96	6.10	6.10	6.10
15	8.85	-	-	6.16	-	-
30	10.15	10.26	-	6.21	6.17	-
45	12.17	-	-	6.29	-	-
60	15.32	15.27	15.32	6.33	6.39	6.36
75	17.20	-	-	6.39	-	-
90	19.12	19.18	-	6.52	6.53	-
105	20.89	-	-	6.59	-	-
120	22.65	22.35	22.39	6.67	6.62	6.54
135	23.96	-	-	6.80	-	-
150	25.18	25.27	-	7.10	7.15	-
165	27.93	-	-	7.30	-	-
180	29.34	28.20	28.16	7.65	7.60	7.45

Changes in pH Value

pH is an indicator of the extent of microbial spoilage in fish. Some proteolytic microbes produce acid after decomposition of carbohydrate, thereby the acid level of the medium increase (Eyo, 1993). The changes in pH value of salt-dried tengra in different packets stored at room temperature are shown in Table 3. The pH value of fresh tengra was 6.80 (Table 1) which decreased to 6.10 (Table-3) after salt-drying. Here, pH value increased in all the salt-dried tengra samples stored in different types of packets during storage. In tied, sealed and vacuum sealed packets the pH value of the samples were found 6.33, 6.39 and 6.36, respectively on 60th day which finally reached to 7.65, 7.60 and 7.45 on 180th day of storage.

Latifa *et al*. (2014) reported that, the pH value of dry-salted (DS) and pickle-salted (PS) *M. tengra* increased significantly ($P<0.05$) with storage period. While salt was added with the fish, pH value decreased, might be due to increase of acidic compounds. Then afterward pH value increased with the progress of storage period which might be might be due to increase of basic compounds in the product. In their study, pH value varied from 6.0 (0 day) to 7.9 (7 month) in DS *M. tengra* and from 6.0 (0 day) to 8.0 (6 month) in PS *M. tengra*, which coincides with the findings of present study.

Changes in APC (Aerobic Plate Count) in Salt-Dried Product

The total bacterial load is expressed as colony forming unit in one gram sample (CFU/g) of the representative samples. Microbial load of salt-dried tengra samples stored at room temperature in different packets were determined randomly by plate count method on nutrient agar media. Changes in the aerobic plate count of the stored samples are presented in Table 4. The initial load of bacteria was found 1.87×10^4 CFU/g in the salt-dried samples on "0" day of storage (Table 4) which increased slowly with the progress of storage time and the value reached to 5.2×10^5 CFU/g for tied pack after 150 days of storage, Aerobic Plate Count (APC) for sealed packet reached to 2.3×10^5 CFU/g 120th day and in vacuum sealed packet it reached to 8.9 x 10^4CFU/g at the end of 180 days of storage (Table 4).

Table 4. Changes in Aerobic Plate Count (CFU/g) of salt-dried tengra (*Mystus tengara)* in different packet s stored at room temperature (26-28^0 C).

Days	Tied Packet (CFU/g)	Sealed Packet (CFU/g)	Vacuum Sealed Packet (CFU/g)
0	1.87×10^4	1.87×10^4	1.87×10^4
30	3.8×10^4	3.1×10^4	2.9×10^4
60	6.1×10^4	5.9×10^4	5.3×10^4
90	7.9×10^4	6.8×10^4	6.2×10^4
120	4.4×10^5	3.8×10^5	8.9×10^4
150	5.2×10^5	4.6×10^5	4.7×10^5
180	6.9×10^5	6.2×10^5	5.8×10^5

A similar finding has also been reported by Kamruzzaman (1992) where the bacterial count of commercially dried freshwater fish samples ranged from 1.84×10^4 to 5.3×10^6 CFU/g. Another study carried out by Hasan *et al*. (2006) on mola, tengra and katcki in traditional, rotary and solar tunnel dryer showed that, the bacterial load range between 1.43×10^8 to 2.89×10^8 CFU/g, 1.91×10^8 to 2.84×10^8 CFU/g and 1.95×10^8 to 2.59×10^8 CFU/g, respectively.

Conclusions

Therefore, on the basis of the obtained results the present study could be concluded as, salt-dried tengra can be stored at room temperature (26 to 28°C) until 180 days in tied, sealed and vacuum sealed packets without any major deterioration in the quality. Among the three different packets vacuum sealed packet might be most suitable one for storing the product like salt-dried tengra.

Conflict of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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