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Qualitative assessment of improved traditional fish drying practices in Cox's Bazar

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ABSTRACT

Studies were conducted to evaluate the quality of marine dried fish products produced in improved traditional fish dryer. Three marine fish species – Silver pompfret (*Pampus chinensis*), Bombay duck (*Harpodon nehereus*) and Ribbon fish (*Trichiurus haumela*) were used in the present study. This dryer is made of locally available materials mainly Bamboo pole, Bamboo stick and Nylon net of different mesh size. It can be operated in different fishing yard in Cox'sBazar. The drying performance of improved traditional fish dryer was three days and one day break for cleaning. The final moisture content of the dried fish sample reached below 20%. The overall organoleptic qualities of the dried fish products obtained from both type of dryers were excellent. Maximum reconstitution of 71.98% to 78.09% was obtained for dried products at 80°C. The percentage of reconstitution increased with the increase of soaking time and temperature. The moisture content of improved traditional dryer dried fish products ranged from 16.71% to 21.1%. Protein contents on wet weight ranged from 55.2% to 60.16%. The lipid contents on wet weight basis for the products 12.9% to 18.80%. On the other hand, ash contents of the dryer were 5.18% to 7.5%. Total bacterial load varied in the range of 1.78×10^3 to 9.54×10^3 CFU/g.

INTRODUCTION

Sun drying is a long run traditional practice in Bangladesh coastal fishing community people who are engaged in fishing and drying activities. It have been used as a low cost preservation technique in the production of dried fishery product. This technique has been practices by thousands of fisherman as they have no other assets for better living although dried fish products are important food in many Asian countries including Bangladesh. About 20% of the artisanal catch is sun dried and consumed in the internal domestic market (Coulter and Disney, 1987). Although those dried product have been used as a tasty food many more problem are associated with this industry such as insect infestation, betel infestation, quality deterioration and finally the use of Insecticides. The physical and organoleptic qualities of most of the traditional sun dried products available in the market are not satisfactory for human consumption (Kamruzzaman, 1992; Khan, 1992; Saha, 1999).

In the coastal region of Bangladesh, the traditional fish drying practice on the sand of the sea beach, in raised bamboo racks and on the bamboo made chatai are very common. The drying process in the sun takes about one week depending on the climatic conditions. The longer duration of drying causes considerable spoilage, blowfly infestation, broken, contamination with filth and soil particles and widespread use of different types insecticides to avoid insect infestation which make the product unattractive to the consumers. Besides, considerable post-harvest losses are reported to occur during processing, storage and during different stages of marketing channel. The quantitative losses through spoilage and inset attack on fish being dried fish has been estimated to 10-35% in the marine areas (Doe et al., 1977; Ahmed et al., 1978).Large group of consumers have become more health conscious and interested in convenience food. The consumers now a days insist that the product should be acceptable in terms of both quality and safety. To improve the situations some research works were conducted to

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develop different models of solar dryers (Ahmed et al., 1979; Islam, 1982, Bala and Hossain 1998, Bala and Mondol 2001). The solar dryer can ensure good hygienic quality of the product, but it is very much costly. It is, therefore, felt very significant to minimize the coast of solar drier by improving the designs so that the coastal fishing community can afford and implement the solar drying technique as a viable and sustainable means over traditional practices.

In order to improve the food quality of the traditional dried products, an improved traditional drier has been developed by BFRI for both small- and large-scale processors to avoid infestation and wide spread contamination. The design of this drier realizes the demand for higher drying capacity. The production of good quality dried products through this technique was recently field tested in Bangladesh in order to assess its suitability in drying fish.

The present paper reports the organoleptic, biochemical and bacteriological aspects of improved traditional dried products produced from some commercially important marine fish species.

MATERIALS AND METHODS

Construction of improved traditional fish dryer

A improved traditional fish dryer originally developed in marine fisheries and technology station, Bangladesh fisheries research institute, Cox'sbazer. This was a box type dryer medium in size. Fish dryer construction materials comprise Bamboo pole, Bamboo stick, Nylon net (mesh size- 0.8 cm), Fine mesh net, rope and Ladder having a length of 15 meter and wide 7 meter. The height of the dryer was 4 meter (2 meter from the land to the bottom drying surface and 2 meter for fish drying facilities). Total fish drying space was 210 m^3. Each of the bamboo poles was settled 2 meter interval. Dryer roof and peripheral fence covered with Nylon net (mesh size- 0.8 cm) and dryer bottom covered with fine meshed net. Fish drying facilities on bottom surface was 105 m^2 which is more suitable for Pomfret and small fishes. Bamboo Colum having a height of 2meter, Colum length- Peripheral (15+15+7+7) = 44 meter. Resulted Internal Colum was 3 having a Height of 2 meter and length 12 meter. Each Colum interval was 2 meter. There were 5 rows for Bombey Duck (Colum height 2 meter) and 3 rows for Ribbon fish (Colum height 2 meter) in Colum. Fish drying capacity was 3- 4 kg fresh fish per cubic meter space of improved fish dryer. About 225 kg hygienic dry fish can be produced per lot. Fish drying period depending on weather condition 3 days for one lot dry fishing and one day break for cleaning. Fish drying capacity per month was (225 kg × 7 lot) = 1575 kg hygienic dry fish per month and therefore per year (1,575 kg × 8 month) = 12,600 kg = 12.6 metric ton hygienic dry fish because drying activities are operated in this area 8 month per year due to bad weathered condition.

Figure1
Model of improved traditional dryer.

Figure 2
Operation of dryer by processors.

Standardization of organoleptic, nutritional and microbial aspects: Standardization of organoleptic, nutritional and microbial aspects especially bacterial load of the products produced by the Improved Traditional Fish Dryer will be assessed for different species separately. All organoleptic qualities, such as odour, colour, texture, appearance, etc will be assessed by a panel of consumers. Water reconstitution properties will also be assessed for every 15 minutes interval for different shelf-life. Proximate composition will be analyzed to assess the nutritional qualities in different shelf-life for every species separately. Finally, total microbial counts will be estimated in one month interval for different species separately.

Organoleptic quality assessment

For the sensory (organoleptic) evaluations, a representative whole sample of dried products produced by the Improved Traditional Fish Dryer will be taken on a tray and different organoleptic characteristics such as colour, odour, texture, broken pieces and insect infestation will be observed by a four member panels of scientists constituted in the marine fisheries and technology station, Bangladesh Fisheries Research Institute.

Water reconstitution property

Water reconstitution property, i.e. the percentage of water absorbed by the dried fish will be assessed for the product produced by the Improved Traditional Fish Dryer at normal temperature (30^0C) up to two hours with 15 minutes intervals. Results in this respect will be expressed in terms of percentage of weight of water absorbed by the sample.

Proximate composition analysis

Proximate composition analysis, i.e. moisture, ash, lipid and crude protein contents will be estimated on wet weight basis and expressed as percentage. The chemical analyses will be carried out according to the methods given in AOAC (1980).

Micro bacterial study

For the preparation of media ingredients of recommended quantities were weighted by electric balance and were dissolved in prescribed amount of distilled water. Then the mixture was boiled to mix the ingredients thoroughly and sterilized in a autoclave at 121^0C under 15 lb/inch^2 for 30 min. For the purpose of this study plate count agar (Hi Media) were used. At the end, it was cooled down and was poured into petridish.

For the preparation of sample dried fish sample were chopped at first using a sterile knife in order to make it into small pieces and then it was weighed. An accurate amount of 25g chopped sample was placed in a sterile blending jar and 225 ml of 0.2% peptone water was added to it. Then it was blended at a speed of 3000 rpm for two minutes. Thus a 1:10 dilution was obtained. One ml of diluted fish sample was transferred with a sterile pipette to a test tube containing 9.0 ml of sterile 0.2% peptone water and the tube was shaken thoroughly. Similarly several ten-fold dilutions were made to desired level.

For the standard plate counts first 0.1ml of diluted sample was transferred to prepare ager plate using micropipette. The pipetted samples were spreaded over the whole surface of the media by using L-shaped glass rods until the sample were dried completely. All the plates were inoculated duplicate. Then the plates were incubated at 30^0 in an invert positions for 48 hours. Colonies developed were counted by aerobic plate count (APC) which was expressed as colony forming unit in one gram of sample (CFU/g) of the representative samples.

RESULTS AND DISCUSSION

An improved traditional fish drier was an intermediate drying technique over traditional and modern solar drier approach made of locally available materials. Although many of our coastal community were engaged in drying activities very few studies were conducted for suitable production in terms of field operation. This drier was found suitable over a Hohenheim type or Emerging type which was previously developed and very much concerned about the quality of dried product particularly contamination, spoilage and infestation by blow flies and in use directly by farmer on fish drying yard without modern facilities such as electricity. Due to the availability

of construction materials such as bamboo, roof and mesh net it was easy to construct. Settlement at two feet height over the ground did not allow any sand or sand like particle to settle down which makes it more efficient for quality production. Moreover, during operation it was covered with a fine meshed net which did not allow any insects to settle down on row materials. Beside using as a production technique of three major species Loytta, Rupchada and Churi it's bottom surface also used as an efficient place for many other marine small species and by product. By techniques of its construction allows man to work vigorously through it during drying (See an overlook at picture in plate.1 and plate.2). It was operated in the Nazirer tak drying yard which is one of the largest fish drying yard in Bangladesh. Large group of producer has become more conscious and interested in improved traditional fish drying practices due to it's a simple but technical practice to provide safe product organically. After installation of drier, studies were conducted to evaluate the organoleptic and biochemical aspects of improved traditional fish drier.

Quality assessments

Food quality aspects represent the organoleptic evaluation, physical observation and biochemical parameters characteristics of any food. These parameters serve as important base to evaluate the food quality of any products under investigation.

Organoleptic characteristics

Three major types of dry fish species Bombey Duck, Silver Pomfret and Ribbon fish were tested for different periods of time and their suitability in all aspects were accessed separately for different periods of time in case of organoleptic quality. In case of improved practices there were found 120 days shelf life for Bombay duck and Chinese Pompfret except few changes in quality, Whereas Ribbon fish show 90 days acceptance in case of shelf life (Table 1).

Table 1
Organoleptic characteristics of improved traditional dried products.

Dried fish sample	Color	Odor	Texture	Infestation	Broken pieces	Overall quality
Ribbon fish	Silvery	Characteristics odor	Firm and flexible	Nil	Nil	Very good
Bombay duck	Whitish	Characteristics odor	Firm and flexible	Nil	Nil	Excellent
Silver pompfret	Raddish to yellowish	Characteristics odor	Firm and flexible	Nil	Nil	Excellent

Table 2
Reconstitution percentage of BFRI fish dryer products produced at different temperatures and time interval.

Dried Fish	Stocking time (m)	Soaking Temp 40°C	60°C	80°C
Bombay Duck	15	31.02	36.11	36.21
	30	53.31	48.69	49.88
	45	64.82	62.02	65.06
	60	70.24	73.62	75.50
Ribbon Fish	15	29.91	34.42	37.07
	30	44.08	49.90	48.12
	45	56.66	60.31	60.11
	60	62.72	69.00	71.98
Pomfret Fish	15	35.56	35.51	39.38
	30	52.04	54.52	56.21
	45	61.11	66.42	67.77
	60	73.92	74.92	78.09

Water reconstitution properties

The reconstitution properties of the dried fish muscles at a wide range of temperature were investigated and the result is presented in table. The samples were soaked in water at the temperature of 40^0 C, 60^0 C and 80^0 C for one hour and ability of the samples to absorb moisture was investigated every 15 minutes intervals. The

reconstitution of the samples increased as the temperature of the soaking water increased and at 80^0 C the maximum reconstitution of the range of 71.98% to 78.09% (Table 2).

A close relationship was observed between the reconstitution capacity and physical properties of the samples. The quality of the dried fish is also related to final $a_{w.}$ At low values, water uptake proceeds more quickly. In properly dried fish the water uptake is reported to complete in 3-15 minutes (Sikorski et.al., 1995). If it takes more than 15 min, the quality is considered to be questionable. Denaturation of protein may cause decreased ability of rehydration.

The very large differences in rehydration rates, which existed between different products, can be explained by their micro structural differences. The dried fish samples of Silver pompfret, Bombay duck and Ribbon fish produced at 45°C-50°C exhibited an enormously rapid 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 capillarity (Jason, 1965). With a tough and rubbery tissue, water penetrates mostly to the centre of large pieces by diffusion through the protein of the fibre itself and the process is very slow (Connell, 1957; Sen et. al., 1961; Lahiry et. al., 1961). Considering the reconstitution ability, it can be stated that dried fish products from improved traditional fish dryer were good quality.

Chemical composition:

Proximate composition was analyzed to assess the nutritional qualities in different shelf-life for Pomfret, Ribbon fish and Bombey Duck separately for every 3 months up to 60 days. For the Pomfret, Ribbon fish and Bombey Duck, the protein content was 59.04%, 57.39% and 60.16% at initial stage of packaging. The crude protein was increased after 30 and 60 days of drying with value of 59.70% and 59.3% respectively. After 30 and 60 days of drying fish the lipid and moisture content were decreased but ash content was increased (Table 4,5).

Table 3
Proximate composition of the improved traditional dried products at initial stage.

Species	Moisture (%)	Crude Protein (%)	Lipid (%)	Ash (%)
Silver pompfret	16.71	59.04	18.80	5.27
Ribbon fish	20.18	57.39	16.79	5.18
Bombay duck	19.29	60.16	13.36	6.84

Table 4
Proximate composition of the improved traditional dried products after 30 days.

Species	Moisture (%)	Crude Protein (%)	Lipid (%)	Ash (%)
Silver pompfret	17.36	58.40	18.31	5.93
Ribbon fish	20.87	56.44	16.20	6.49
Bombay duck	19.79	59.70	13.12	7.39

Table 5
Proximate composition of the improved traditional dried products after 60 days.

Species	Moisture (%)	Crude Protein (%)	Lipid (%)	Ash (%)
Silver pompfret	18.0	58.0	17.8	7.5
Ribbon fish	21.1	55.2	15.8	7.2
Bombay duck	20.4	59.3	12.9	7.5

**Values within parenthesis indicate the result on wet matter basis

Stansby (1962) reported an inverse relationship between the oil and moisture content of fish, the sum of the total approximates near about 80%. The summation of oil and water was not necessarily constant and it frequently ranges from 78 to 85%.The results obtained in this investigation is more or less in agreement with general rule suggested by Stansby (1962). An inverse relation also found between the protein and fat contents where the relationship was markedly evident by the data calculated on wet matter basis. Therefore, it may be concluded that proximate composition is

variable and is dependent upon various factors like size, age, sex, season of year etc.

Bacteriological aspects

The total aerobic plate count expressed as colony forming unit in one gram of sample (CFU/g) of the representative samples was determined by standard plate count (SPC) method plate count agar media. Coliform and salmonella tests were done according to the standard methods. Total bacterial load varied in the range of 1.78×10^3 to 9.54×10^3 CFU/g. (Table 6)

Table 6
Standard plate count (SPC) of improved traditional dried product.

Fish sample	SPC (CFU/g)
Ribbon fish	9.54×10^3
Bombay duck	3.96×10^3
Silver Jew fish	1.78×10^3

There is a close relationship between the moisture content and bacterial load in food products. Fish is an ideal substrate for the growth and multiplication of microorganism. Various factors are responsible for this. Suitable moisture content is one of them. The heat applied during drying cause considerable reduction of microorganisms of various types. Drying by heat usually destroys all yeasts and most of the bacteria, but spores of some bacteria and moulds usually survive. Bacteria, yeast and mold do not grow with moisture content below 18,20 and 16% respectively. So, if the drying process and storage conditions are adequate, there will be no growth of microorganism in dried fish. But in practical, it is about impossible to control moisture and growth of microbs during process and storage of dried fish. Especially during improper storage and exposed condition in the retail market, dried product absorbs a considerable amount of moisture. Even Coliform bacteria and other harmful bacteria may also be found in dried products. According to Sen et al. (1961), when water content of fish fell below 25% of wet weight, bacterial action stopped and when the water content further reduced to 15%, mold ceased to grow. Frazier and Westoff (1978) reported that, generally no microbe (yeast, mold and bacteria) could grow in a product with moisture content below 15%.

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