

Shelf life of dried products from small indigenous fish species under various packing and storage conditions

M. Nurullah*, M. Kamal, MN. Islam, C.T. Ahasan, Shakuntala H. Thilsted¹

Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

¹Research Department of Human Nutrition, The Royal veterinary and Agricultural University

Rolighedsvæl 30, 1958 Frederiksberg C, Denmark

* Present and corresponding author: Bangladesh Fisheries Research Institute, Mymensingh 2201, Bangladesh

Abstract

The overall quality of five SIS products was found in good condition up to 2 months storage on the basis of organoleptic, biochemical and bacteriological characteristics and all the products was excellent in sealed packed condition up to 45 days of storage. However, quality of the products stored in open air atmospheric temperature was found excellent for first 15 days.

In an average the initial moisture content was in the range of 13.5 to 15.0% with highest moisture content in puti and lowest in chapila. At the end of the 60 days the moisture content reached to the range of 18.5 to 19.0% which was more or less near the recommended limit of 16% for dried fishery products. The moisture content beyond the recommended limit as the storage period increased further and at the end of 90 days the moisture content increased to the range of 22.9 to 24% when organoleptically the product quality became very poor. The changes in the value of total volatile base nitrogen (TVB-N), peroxide value (PO), moisture and aerobic plate count (APC) of solar tunnel dried products in sealed polythene packages were investigated during 60 days of storage. There was little or no differences in TVB-N, PO and bacterial load of each species packed under various polythene density. The initial TVB-N values were in the range of 10.30 to 12.40 mg/100g of the samples. TVB-N value increased slowly up to the end of the storage period and was to in the range of 46.20 to 57.00 mg/100 g of sample. Initially the peroxide values (P.O.) were in the range of 6.54 to 8.40 m.eq./kg oil of the samples. During 60 days of storage, P.O. values increased slowly and at the end of the storage period these values reached to the range of 22.00 to 25.30meq./kg of sample. The initial APC was in the range 5.3×10^4 - 7.3×10^4 CFU/g. The bacterial load increased slowly and at the end of the 60 days storage period reached to the range 6.6×10^6 - 8.6×10^7 CFT/g.

Key words: Dried products, Shelf life, Packing, Storage

Introduction

It is important to see how long the products could be kept in good condition with proper packaging at ambient room temperature although high quality shelf-life of dried

products largely depends on a_w , air humidity, temperature, exposure to oxygen, the presence of preservatives and infestation by insects. Such information was not available in the past for the dried fish products particularly in a tropical country like Bangladesh.

The quality of dried fish is related to the final water activity (a_w). Most bacteria do not grow nor do they multiply at a_w values below 0.95. At low a_w values uptake of water proceeds more quickly. In tropical climates, under humid conditions, heavy infestation of unsalted dried fish by blow flies may cause up to 30% loss of the product (Wood 1981). Generally, two major infestation damage the products, i. larvae (maggots) of several species of fly (*Diptera*) infestation during the early stage of drying; and ii. beetle (both larvae and adults) and mite infestation during storage and distribution (FAO 2005). The dried food consumption patterns in Bangladesh like many other countries are changing. The consumers now a day insist that the product should be acceptable in respect of both quality and safety, particularly free from contaminants, spoilage and infestation by insects. It is well known that without proper packaging the high water activity in tropical climate, denaturation of protein, oxidation of lipids and browning reaction are likely to ensue and cause loss of sensory properties and other qualities of dried products.

The quality of the dried fish produced by the *Hohenheim* type dryer was good in view of reducing infestations and contaminations, as it has been reported earlier by many authors (Ahmed *et al.* 1979, Islam 1982, Nowsad 2003). This section reports the quality changes of some dried products obtained from low cost solar dryer kept in various densities of sealed polythene bags and plastic jar by determining organoleptic, biochemical and bacteriological aspects.

Materials and methods

Dried samples of five species of SIS such as mola (*Amblypharyngodon mola*), dhela (*Osteobrama cotio cotio*), chapila (*Gudusia chapra*), puti (*Barbodes sarana*) and chela (*Chela phulo*) were used for the investigation. Fresh dried samples produced in the solar dryer were packed in the sealed plastic packet in various density of polythene bags and stored at ambient atmospheric temperature for 60 days. Different densities of polythene packaging materials such as transparent 120 μm , 80 μm , laminated pouch (120 μm) and aluminum foil (80 μm) were used. Required quantity of samples were examined with time interval for the determination of organoleptic, biochemical and bacteriological aspects of quality. For the preparation of samples, whole dried fish samples were comminuted in a meat grinder and ground in a Waring blender to produce a homogenous one before being sampled for analysis. Samples of each species were kept in a separate airtight container during study period.

Organoleptic quality assessment of packaged fish

The evaluation method used in the study was based on the method currently used by Fish Inspection and Quality Control (FIQC) of DoF with slight modification. The

organoleptic and physical characteristics such as odour, colour, texture, broken pieces and insect infestation were evaluated by four panel experts constituted in the Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh. The quality of the dried products was evaluated by determining organoleptic, and biochemical and bacteriological aspects. The samples were examined with 15 days time interval.

Biochemical analysis

Moisture: Moisture content of the samples was determined by drying a given sample in a thermostat oven at 105°C for 24 hours until reaching constant weight.

Total volatile base nitrogen (TVB-N): Exactly 10 g of the ground sample were weighed in to a suitable container and mixed with 90 ml of 6% perchloric acid. This was done under cooled condition (2-6°C).

Peroxide value (PO): The method used for the determination of peroxide value was described by Egan *et. al.* (1981) and adopted from wood and Aurand (1977).

Standard plate count: First 0.1 ml of diluted sample was transferred to prepare agar plates using micropipette. Samples were pipetted and transferred aseptically to the plates by raising the upper lids sufficiently enough to admit the tip of the pipette. The aliquot of the samples was then spreading over the whole surface of the media by using L-shaped glass rods until the samples were dried completely. Then the plates were incubated at 30°C in an inverted position. After 48 hrs of incubation, colonies developed were counted.

Results and discussion

Organoleptic characteristics

Organoleptic and physical characteristics of the dried products produced in the solar tunnel driers such as colour, texture, insect infestation, presence of broken pieces and overall quality were examined. Freshly caught mola, dhela, chapila, puti and chela were used as raw material. All the five tunnel dried products showed to emit their characteristic odour, assume whitish to slightly brown colour, process firm and flexible texture without manifestation of infestation or broken pieces and appeared to be of excellent quality. The organoleptic characteristics of the dried mola, dhela, puti, chela and chapila are more or less similar to that of solar dried silver Jew fish (*Johnius argentatus*), Bombay duck (*Harpodon nehereus*) and ribbon fish (*Trichiurus haumela*) as reported by Mehbub (2004), that the excellent products were produced without any infestation with firm and flexible texture and natural odours.

The storage life of the products was investigated under different density of polythene packaging materials as shown the Table 1. The density were 1. Transparent 120 μ m polythene 2. Transparen 80 μ m polythene 3. Laminated pouch (120 μ m) 4. Aluminium foil (80 μ m). The overall quality of these five SIS products were found to be in good condition for storage up to 2 months as determined by organoleptic, biochemical and bacteriological method irrespective of materials used for packaging. The present result is in agreement with those reported for marine dried fish products of Silver Jew fish (*Johnius argentatus*), Bombay duck (*Harpodon nehereus*) and ribbon fish (*Trichiurus haumela*) under different density of polythene packaging materials during 90 days of storage (Reza 2002 and Mehbub 2004).

Table 1. Quality retention of dried SIS products stored/under different packaging conditions for two months

Packaging materials	Name of SIS	Storage period (Month)	Overall quality
Transparent 120 μ m (Polythene)	Mola, Dhela, Chapila, Puti, Chela	2	Quality of fishes was good
Transparent 80 μ m. (Polythene)	Mola, Dhela, Chapila, Puti, Chela	2	Good
Laminated pouch (120 μ m)	Mola, Dhela, Chapila, Puti, Chela	2	Good
Aluminium foil (80 μ m).	Mola, Dhela, Chapila, Puti, Chela	2	Good

Changes in organoleptic characteristics

Studies were conducted to evaluate the quality changes in solar dried products up to 60 days of storage in two conditions: one stored in sealed package and the other in open air atmospheric temperature. Organoleptic and physical characteristics such as colour, texture, insect infestation, presence of broken pieces and overall quality were examined (Table 2).

The overall quality of all the products was excellent in sealed packed condition during 45 days of storage where the colour of dried mola, dhela, puti, and chapila became whitish to light brown with little difference among five fish species. Texture was firm and flexible and odour was very natural in all samples. No insect infestation was found around the products. Also no broken pieces were found during storage. After 60 days of storage the color of the products changed from light brown to brown and exhibited with slight rancid odour, fibrous and soft texture, although the overall quality of all the products was considered good by the panel of expert.

Table 2. Organoleptic quality assessment for solar tunnel dried mola, dhela, puti and chapila products in different storage conditions

Stored in sealed packed condition				Kept open at air atmospheric temperature		
Storage period (days)	Characteristics (color, odor, texture, broken pieces)	Infestation	Overall quality	Characteristics (color, odor, texture, broken pieces)	Infestation	Overall quality
0	With characteristic whitish, like fresh fish; good fishy odor; tough & firm; no broken pieces	No	Excellent	With characteristic whitish like fresh fish; good fishy odor; tough & firm; no broken pieces	No	Excellent
15	Like fresh fish; good fishy odor; tough & firm; no broken pieces	No	Excellent	Browning; good fishy odor; tough & firm; no broken pieces	No	Excellent
30	Light browning; slightly rancid; tough & firm; no broken pieces	No	Excellent	Dark browning; rancid; tough & firm; no broken pieces	No	Acceptable
45	Slightly browning; slight rancid; tough & firm; no broken pieces	No	Excellent	Dark browning; rancid; soft texture; broken pieces	Presence of fungus	Poor
60	Browning; slight rancid; tough & firm; no broken pieces	No	Good	Dark browning; rancid; soft texture; broken pieces	Infestation by insects	Poor

The quality of the products stored in open air atmospheric temperature was found excellent for 15 days. After 15 days, the colour became slightly dark brownish with little fishy odour although the texture was firm and there was neither broken pieces nor any infestation. The products were considered still acceptable for consumption. There were rapid changes in colour, odour, texture and broken pieces in products stored up to 45 days in open air atmospheric temperature. The products became dark browning with rancid odour and fragile texture. There was a lot of dust on the products due to oxidation and broken pieces. The growth of fungus was evident in some products and the overall quality of the products stored in air atmospheric temperature without packaging was poor.

The changes of the colour from light whitish to brownish and darkness was probably due to lipid oxidation and high fungal growth during the storage period. Some changes in colour, texture and odour were also observed in products packed in different polythene package after 60 days of storage. Since the polythene pack was sealed without vacuum in presence of oxygen inside the package, some oxidation might take place during storage. The result obtained in the present study is more or less similar to those reported for marine dried fish products of Silver Jew fish (*Johnius argentatus*), Bombay

duck (*Harpodon nehereus*) and ribbon fish (*Trichiurus haumela*) under different density of polythene packaging materials during 90 days of storage (Reza 2002, Mehbub 2004 and Ismail 2004). They observed that the colour of solar tunnel dried Bombay duck, Silver Jew fish and Ribbon fish became whitish to light brown colour with little difference among three fish species. Texture was firm and flexible and odour was very natural in all samples. No insect infestation was found on the products. Broken pieces were found after 60 days of storage. Infestation was found around the products. Broken pieces were found after 60 days of storage.

Changes in moisture, TVB-N, PO value, and APC of solar tunnel dried products in packaging condition

The changes in moisture content of the solar dried product in packaging condition during 90 days of storage are also shown in Fig. 1. In an average the initial moisture content was in the range of 13.5 to 15.0 % with high moisture content in puti and low in chapila. The moisture content slightly increased with the lapse of storage period. At the end of the 60 days the moisture content reached to the range of 18.5 to 19.0% which was slightly higher than the recommended limit of 16 % for dried fishery products. The moisture content increased well beyond the recommended limit as the storage period increased further and at the end of 90 days the moisture content increased to in the range of 22.9 to 24% when organoleptically the product quality became very poor.

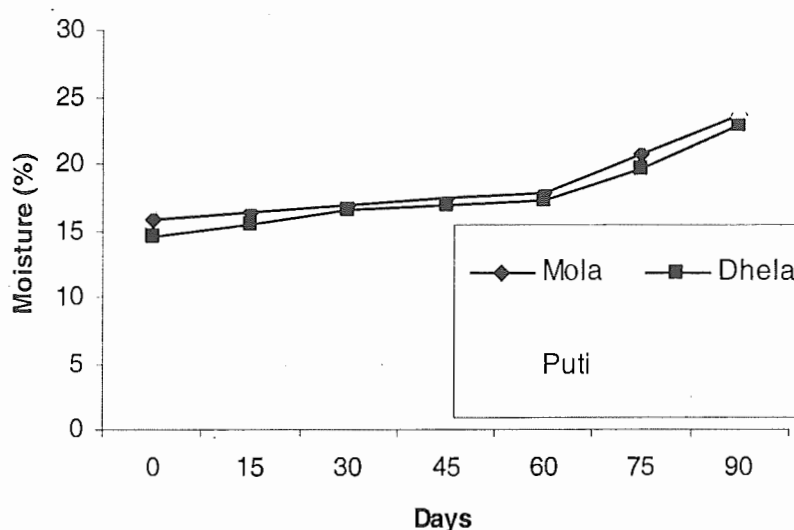


Fig 1. Changes in moisture content of solar dried SIS stored in packaging condition for 90 days.

According to Bhattacharyya *et al.* (1985), the market samples of sun-dried chapila (*Gadusia chapra*) had moisture ranging from 9.61% to 18.64% and storage life ranged from 15 to 35 days as judged by sensory evaluation. The result obtained from the present study is more or less similar to those reported for some marine solar tunnel

dried fish products where the initial moisture content of 11.4 to 15.8 % increased to 12.6 to 16.2 % during 60 days of storage under various polythene package conditions (Mehbub 2004).

The changes in values of total volatile base nitrogen (TVB-N), peroxide value (PO), moisture and aerobic plate count (APC) of solar tunnel dried products in sealed polythene packages during 60 days of storage are shown in Table 3. There was little or no differences in TVB-N, PO and bacterial load within each species packed under various polythene density. There was, however, variations among the species packed under various storage conditions. The initial TVB-N values were in the range of 10.30 to 12.40 mg/100g of the samples. TVB-N value increased slowly up to the end of the storage period and was to in the range of 46.20 to 57.00 mg/100 g of sample. These values were much lower than the recommended value 100-200mg/100g for variety of salted and dried fish products. (Connell 1995).

Initially the peroxide values (PO) were in the range of 6.54 to 8.40 m.eq./kg oil of the samples. During 60 days of storage, PO values increased slowly and at the end of the storage period these values reached to the range of 22.00 to 25.30meq./kg of sample. These values were slightly above the range of suggested value of 10-20 meq/kg oil by Connell (1957). It is well known that peroxide value gives a measure of first stage of oxidative rancidity that does not necessarily correlate well with the sensory assessment of rancidity. The dried products may deteriorate during storage due to oxidation of lipid. Fish oil as well as other edible oil unexpectedly oxidizes in presence of atmospheric oxygen, at or near the ordinary temperature. One of the most common factors influencing oxidation of lipid is degree of un-saturation. Temperature is another factor enhancing the rate of lipid oxidation. Rate of oxidation is increased with the increasing temperature. The rise of temperature activates the reacting molecules accelerating the process of oxidation (Tsuchiya 1961).

Table 3. Total volatile base nitrogen (TVB-N), peroxide value (PO), aerobic plate count (APC) and moisture of solar tunnel dried mola products in packaging condition

Dried sample	Storage duration	Moisture (%)	TVB-N value (mg/100 g)	Peroxide (P.O.) value meq./kg oil	APC (CFU/g)
Mola	0 day	13.5 -15.0	10.30 -12.40	06.54 -08.40	5.3×10^4 - 7.3×10^4
	15 days	15.0 - 16.3	26.00 - 29.50	12.82 - 15.57	6.0×10^4 - 8.6×10^4
	30 days	16.3 - 16.8	32.30 - 37.50	17.30 - 20.70	6.6×10^5 - 8.6×10^5
	45 days	17.0 - 18.2	38.45 - 40.00	19.40 - 23.55	6.6×10^5 - 8.6×10^5
	60 days	18.5 - 19.0	46.20 - 57.00	22.00 - 25.30	6.6×10^6 - 8.6×10^7

Studies were conducted on the bacterial load of the dried products during 60 days of storage in various polythene packages and the results are presented in Table 3. The initial APC was in the range 5.3×10^4 - 7.3×10^4 CFU/g. The bacterial load increased slowly and at the end of the 60 days storage reached to the range 6.6×10^6 - 8.6×10^7 CFT/g. In some cases the results was similar to that for solar tunnel dried ribbon fish, Bombay duck, big-eye tuna, silver jew fish and Chinese pomfret which were in the range

of 1.88×10^3 to 3.06×10^4 CFU/g stored up to 90 days. Frazier and Westhoff (1978) reported that, generally no microbe (yeast, mold and bacteria) can grow in a product with moisture content below 15%. The results obtained from the present study indicates that there was little action of bacterial activity due to low moisture content and the quality of the dried fish products did not appreciably change during 60 days of storage in sealed condition.

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