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A COMPARATIVE STUDY ON QUALITY ASSESSMENT OF TRADITIONAL AND CONVENTIONAL DRIED FISHES OF CHAPILA (*Gudusia chapra*) AND PUNTI (*Puntius sarana)*

*M.A. ZAHID[1], N. AKHTER[2], N. JAHAN[3], M.N.K. AZAM[4] AND N. NAHAR[5]

[1]Department of Nutrition and Food Technology, Jessore Science and Technology University, Jessore-7408, Bangladesh; [2]Collegiate Girls School and KCC Women's College, Khulna, Bangladesh; [3&4]Biotechnology and Genetic Engineering Department, University of Development Alternative, Dhanmondi, Dhaka-1205, Bangladesh; [5]Department of Environmental Science and Health Management, Jessore Science and Technology University, Jessore-7408, Bangladesh.

*Corresponding author: Md. Ashrafuzzaman Zahid, E-mail: zahid_24jstu @yahoo.com
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ABSTRACT

Zahid MA, Akhter N, Jahan N, Azam MNK, Nahar N (2011) A comparative study on quality assessment of traditional and conventional dried fishes of chapila (*Gudusia chapra*) and punti (*Puntius sarana). J. Innov. Dev. Strategy* 5(3), 47-56.

This study was conducted to investigate the proximate composition of raw, curry and fried fishes of locally available Chapila (*Gudusia chapra*) and Punti (*Puntius sarana*). Different parameters such as proximate composition (protein, fat, ash, moisture, carbohydrate), per-oxide value, TVB-N (Total Volatile Basis Nitrogen), bacteriological and fungal study. Studies were also conducted on the organoleptic and physical characteristics of the raw, curry and fried fish sample (prepared by heating fish in a fry pan with spices) determining color, odor, texture, insect infestation and presence of broken pieces. Here, though in some cases color and odour of fried item is attractive. Moreover, the organoleptic quality of curry fish is better compared to that of fried fish. Studies were also conducted to determine the nutrient loss of curry and fried sample. In the fried sample of all fishes lost more nutrient than curry fish sample. The moisture content of raw, curry and fried Chapila (*Gudusia chapra*) were 55.6%, 51.5% and 42.9% respectively, ash contents of raw, curry and fried ilish were 2.85%, 2.59% and 3.90% respectively. The protein content of raw, curry and fried Chapila (*Gudusia chapra*) were 20.09%, 21.0% and 24.35% respectively, lipid contents were 19.40%, 23.75% and 26.36% respectively, and carbohydrates contents were 2.06%, 1.61% and 2.48% respectively. Following the same way the moisture content of the other variety punti were74.0%, 66.83% and 50.24% respectively, ash contents were 1.97%, 1.40% and 3.98% respectively, protein contents were 15.98%, 18.37% and 24.47% respectively; lipid contents were 6.4%, 11.91% and 17.38% respectively; and carbohydrate contents were 1.65%, 1.44% and 3.93% respectively. The TVB-N content of conventional dried fish (normal punti, salted punti, normal chapila and salted chapila contained 28.56mg/100gm, 32.76mg/100gm, 30.94mg/100gm and 35.84mg/100gm respectively) was low compared with traditional dried fish (normal punti, salted punti, normal chapila and salted chapila contained 31.08mg/100gm, 38.22mg/100gm, 33.46mg/100gm and 39.06mg/100gm respectively). The per-oxide value of traditionally dried normal punti, salted punti, normal chapila and salted chapila were found 17.38 m.eq./kg of oil, 15.45 m.eq./kg of oil, 18.6 m.eq./kg of oil and 16.98m.eq./kg of oil but in conventional dried fish, these values were found15.49m.eq./kg of oil, 14.06m.eq./kg of oil, 16.51 m.eq./kg of oil and 14.95 m.eq./kg of oil respectively. The standard plate count of traditional dried fishes (normal punti, salted punti, normal chapila, salted chapila contained $3.95x10^4$ CFU/gm, $3.28x10^4$ CFU/gm, $4.3x10^4$ CFU/gm, $3.67x10^4$ CFU/gm) were higher than the conventional dried fishes (normal punti, salted punti, normal chapila, salted chapila contained $2.75x10^4$ CFU/gm, $2.02x10^4$ CFU/gm, $3.19x10^4$ CFU/gm, $2.85x10^4$ CFU/gm). The maximum count was found in traditional dried normal chapila and minimum in conventional dried salted punti. No *coliform* & *Salmonella* were found in both dried fishes. The shelf life and over all quality of studied samples obtained from conventional dryer was excellent compared to traditional drying though color, texture & odor were better in traditional drying process.

Key words: *dried fish, chapila, punti, quality assessment, food technology*

INTRODUCTION

Fish makes a vital contribution to the survival and health of a significant portion of the world's population. Fish is especially important in the developing world. In some countries of Asia (Bangladesh and Cambodia) obtained as much as 75% of their daily protein from fish. Often fish provides essential nourishment, especially high quality proteins and fats (omega 3 and 6 fatty acids), vitamins and minerals. Fish is a source of incomes which can be used to purchase other additional food items. In the economy of Bangladesh fishery products play a vital role. But most of the products are preserved for future uses since fish is an extremely perishable food item. Several preservation methods are followed over the world for preserving fish. Moulds cannot grow when the water content is below 15% (Frazier and Westhof, 1978). Pathogen growth in the finished product as a result of inadequate drying of fishery products can cause consumer illness. Examples of dried fish products are: salmon jerky; octopus chips; dried shrimp; and, stock fish (FDA 2001). The aim of all these methods is same to extend the shelf-life of fish so that the fish can be used in future properly.

There are frequent complains from the consumers about the quality of the products and the major problems associated with sun drying of fish are the infestations of the products by house fly and insect larvae, poor handling and sanitation and improper processing that often lead to contamination and spoilage. One of the problems markedly evident is indiscriminate use of various types of insecticides such as DDT, Nogos, Rubral etc. in the raw material or products to prevent infestations. Sun dried fish treated with insecticides may create wide spectrum of health hazards in this country. At present, consumers have become more health conscious and interested in convenient food. The changing pattern of the life style and increasing number of households in the rural area have an impact on market demand since consumers now a days insist that the products should be acceptable in terms of both quality and safety. The production of good quality dried products largely depends on

the appropriate temperature during drying and moisture content of the final product (Mukherjee *et al*. 1990). Temperature is an effective method of preservation especially during glut season (peak season). In Bangladesh, chances of contamination and uncertainly in weather conditions affect the quality of dried fish products and thereby marketing. To enhance market acceptability & awareness about hygienic practices, conventional drying is essential. Though it is expensive method but more controlled & a quicker process. Besides, in this process contamination is less and moisture content can be lowered up to 10-15%.

A comparative study on quality assessment of traditional and conventional dried fish is necessary to find out the good on. Fish is an important component of the daily diet and the dried fish is an important source of protein in Bangladesh. Drying of fish is mainly carried out by traditional method of sun drying. The drying procedure is not hygienic and the fish is vulnerable to infestation with insects and larvae attack. To avoid this infestation and for safe storage, dried fish producers often apply insecticides including DDT in fish. The fish is highly contaminated and creates broad spectrum of environmental and health hazards. Traditional sun drying is absolutely dependent on nature. Inadequate sunlight and excessive humidity in summer months keep the product un-dried for long days. On the other hand, frequent cyclone, tidal boar, rain, fog and other natural calamities seriously hamper the drying process. So for, maximum production rate and profit we have to consider this. To overcome the problems of drying depending on the sunlight we have to proceed for other process like conventional one. Actually it's a process of drying foodstuff not depending upon sun light rather on mechanical process of drying (Rotary drum drier, Cabinet drier, Tunnel drier, electric oven etc). Moreover, being a controlled, quicker, predictable & hygienic it is also attractive one. Fishes are fermented inside the pot in about three or four months and *Chapa Shuntki* is produced. This *shuntki* can be kept for about a year (Reza 2001).

So, question arises whether we will keep on following the traditional one or look for a better one like conventional one. And therefore our aim is to carry on a comparative study on quality assessment of traditional & conventional dried fish so that we can come to the conclusion, which one will be suitable for drying fish as a means of preservation and also to create public awareness about the better process.

The objective of this work is to investigate the quality assessment of sun dried and conventional dried fish of Chapila (*Gadusia chapra*) and Punti (*Puntious sarana*) and compare the quality. This research work carried out some objects:

1. To improve the traditional method by apply the new food technology. The application of new food technology is significant in order to improve the conventional method so that the equipment will be easily use by the worker;
2. To reduce drying time hence reducing the production time. When the drying time is reduce, simultaneously it increased drying rate which will reduce the production time and labor;
3. To minimize the labor needed to produce dried fish;
4. To provide high quality product, which will assure a good sell, more loyal customer, higher income and wide marketing;
5. To increase productivity of the dried fish;
6. To fulfill nutritional and national goals of developments and eradication of unemployment and poverty.

MATERIALS AND METHODS

The experiment was conducted from June, 2010 to June 2011, at Food Microbiology Laboratory of the Department of Applied Nutrition and food Technology, Islamic University, Kushtia, Bangladesh to compare the quality assessment of Traditional and Conventional dried Fishes of Chapila (*Gudusia chapra*) and Punti (*Puntius sarana*). As essential prerequisite for designing the infrastructure for fish handling, storage, transport, and marketing is to know how long each particular species in the catch will keep for edible condition (Khan *et al.* 1992). Such information on keeping qualities of most species from the colder waters has been accumulated over many years by experience in fish trade and by scientific investigations carried out in technological institutes, however very little is known on the fish species of tropical or subtropical areas.

Collection and sample preparation

The fishes were collected from the inland water bodies like the ponds; rivers, hours. The fisherman catches up using their nets and brings them to sell in the market or use them to dry up in traditional ways. To make our study easier two varieties of fishes (Punti and chapila) were taken which are very common in the southern region of Bangladesh. These two species are generally found in the fish markets throughout the year.

For the purpose of the comparative study, I personally went to the nearest Khoksha raw fish market to find out the fish and lively one, slight bigger in size and bought a favorable amount to carry out the research work. In the next, gutting is done in conjugation with the descaling of fish. The descaled fish then split or filleted, then brushed and cleaned with fresh water. Then the two varieties each were divided into four groups in equal amounts. The two groups from each variety were taken and salted properly. After that one part salt free and a part salted from each variety was taken and by making water free were fixed with a string and kept in contact

with the direct sunlight and dried (for about 5 days). The remaining part was then taken to the laboratory for the conventional drying and using the oven. The oven was carried out. The drying parameters in that case were temperature 45^0C, relative humidity 60% and process time 16 hours.

Organoleptic quality assessment of dried fish products

A large number of schemes have been proposed for sensory evaluation and many are currently in use in various institutes and industries. Sensory methods were used to assess the degree of freshness based on organoleptic characteristics such as odor, colour, general appearance, eyes, slime and consistency of flesh (Kamal 2000). These characteristics judged by panel members and the changes in quality of chilled fish during storage were assessed very alternative. The grading of fish using score on the characteristics has been followed by EC freshness grade for fishery products with slight modification (Howgate *et al.* 1992) to judge the quality of the fish.

Chemicals

Table 1. The chemicals used in this study and their manufacturers

No	Reagents
1	Chloroform
2	Methanol
3	Acetic anhydride
4	Sulfuric acid
5	Sodium hydroxide
6	Absolute alcohol
7	Hydrochloric acid
8	Ammonia
9	Potassium hydroxide
10	Sodium carbonate
11	Phenolphthalein
12	Potassium iodide
13	Sodium thiosulfate
14	Starch
15	Sodium bicarbonate
16	Acetic acid
17	Percholoric acid
18	Acetone
19	Ammonium sulfate
20	Copper sulfate
21	Boric acid

Preparation of reagents

- Preparation of potassium hydroxide solution (0.5 N): 28 gm of potassium hydroxide was first dissolved volume of distilled water and alcohol was then added to make 1-L solution.
- Preparation of phenolphthalein solution (1%): 1 gm crystalline phenolphthalein 100 ml absolute alcohol.
- Preparation of hydrochloric acid (0.1 N): 8.3 ml hydrochloric acid solution was dissolved in 1000 ml distilled water.
- Preparation of ammonium hydroxide solution: prepare 5 N, 3 N and 0. 2 N NH_4OH solutions by dilution 333 ml, 200 ml, and 13 ml respectively of the concentrated reagents (sp gr 0.90, 29%, 15 N) to1000 ml with distilled water.
- Preparation of NaOH solution: prepare 10 N, 5 N, 0.1 N solutions by diluting 400, 200, and 4 ml respectively to 1000 ml with distilled water.
- Preparation of potassium iodide solution (15%): 15 gm of potassium iodide was dissolved in 100 ml distilled water.
- Preparation of sodium thiosulfate solution (0.1 N): About 12.5 gm sodium thiosulfate (crystal) was dissolved in boiled out distilled water in a 500 ml volumetric flask and was made up to the mark with boiled out distilled water. To use this solution for few days three drops of chloroform was added.
- Preparation of Henus solution: Exactly 13.2 gm of iodine was dissolved in 1 liter of glacial acetic acid. It was warmed to dissolve the iodine completely. The mixture was cooled to room temperature. Then enough bromine was added to double the halogen content (usually about 3ml was sufficient).
- Preparation of starch solution (1%): A pest of 1gm starch in minimum quantity of distilled water was prepared in a beaker and in another beaker of distilled water was boiled. Then the boiling water was added to the pest and the volume was made 100 ml in total. This solution was prepared fresh before use.

- Preparation of alcoholic solution of potassium hydroxide (5.6%): 14 gm of potassium hydroxide was dissolved in 250 ml absolute alcohol.
- Preparation of sulfuric acid solution (0.1 N): 28ml sulfuric acid was added to 100ml distilled water.

***Physical Study* (*Water reconstitution behavior*)**

Percentage of water absorbed by dried fish at a certain temperature and time is called water reconstitution. It is one of the most important physical parameters to assess the quality of the dried products.

Procedure: Five gram of fish sample was kept soaked in one liter of water at temperature 40^0C, 60^0C and 80^0C respectively 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 weight 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.

Calculation: We know,

$$\text{Water reconstitution (\%)} = \frac{\text{Sample weight after soaking} - \text{Initial sample weight}}{\text{Initial sample weight}} \times 100$$

Table 2. Variations of sample weight by soaking water at 40^0, 60^0, 80^0C respectively for 60 minutes

Sample	Initial weight	40^0C	60^0C	80^0C
		Final weight	Final weight	Final weight
F_1	5.03	8.22	8.27	8.37
F_2	5.03	8.30	8.42	8.51
F_3	5.02	7.92	7.99	8.11
F_4	5.02	7.97	8.05	8.18
F_5	5.01	8.37	8.44	8.53
F_6	5.02	8.41	8.47	8.61
F_7	5.03	8.20	8.28	8.37
F_8	5.01	8.27	8.35	8.47

Here, F_1, F_2, F_3, F_4 indicate Traditional dried normal punti, salted punti, normal chapila, salted chapila and F_5, F_6, F_7, F_8 indicates Conventional dried normal punti, salted punti, normal chapila, salted chapila respectively

RESULTS AND DISCUSSION

Analysis of physical and organoleptic characteristics of dried fishes

Organoleptic and physical characteristics of the dried fish products produced from both sun drying and conventional drying were investigated by determining color, odor, texture, insects infestation and presence of broken pieces. The color of traditional dried fish was natural and attractive but the color of conventional dried fish became whitish to yellowish. In case of odor, little variation was found for conventional drying (slight abnormal) but traditional dried fish showed characteristic odor. Firm and flexible texture was found in traditional dried fish as compared to conventional dried fish. No broken pieces were present in conventional & traditional dried fishes. Infestation was common in traditional dried fish, but not in conventional dried fish. The over all organoleptic quality of traditional dried fish were good than conventional dried fish.

Table 3. Organoleptic quality of traditional and conventional dried fishes

Dried sample	Used chemicals	Color	Odor	Texture	Infestation	Broken pieces	Over all quality
F_1	Not used	Whitish	Normal	Firm & flexible	Present	Nil	Excellent
F_2	Salt	Yellowish	Normal	Slight soft	Present	Nil	Not so good
F_3	Not used	Whitish	Normal	Firm & flexible	Present	Nil	Excellent
F_4	Salt	Yellowish	Normal	Slight soft	Present	Nil	Good
F_5	Not used	Brown	Slight abnormal	Less firm & flexible	Nil	Nil	Good
F_6	Salt	Yellowish	Bad odor	Soft	Nil	Nil	Not good
F_7	Not used	Brown	Slight abnormal	Less firm, soft	Nil	Nil	Good
F_8	Salt	Slight redish	Bad odor	Damp	Nil	Nil	Bad

Here, F_1, F_2, F_3, F_4 indicate Traditional dried normal punti, salted punti, normal chapila, salted chapila and F_5, F_6, F_7, F_8 indicates Conventional dried normal punti, salted punti, normal chapila, salted chapila respectively

Analysis of Proximate Composition

The proximate composition of fishes of same species is variable and is dependent upon various factors like age, sex, size, season of year, habits and water status etc. The results of proximate analysis of traditional and conventional dried fish products indicate some variations in their compositions.

Moisture content analysis:

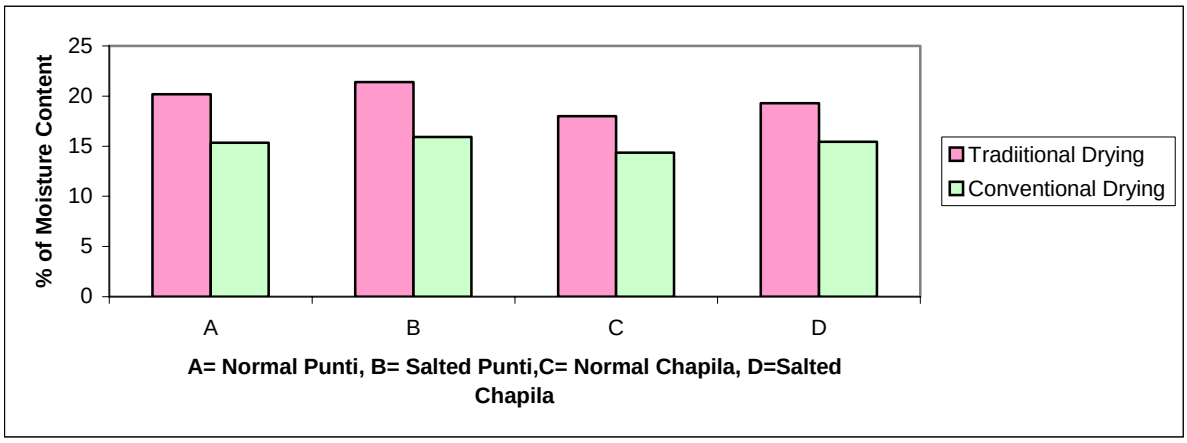

Fig. 1. Comparison of moisture content (%) of traditional & conventional dried fish

The moisture content of traditional dried normal punti and salted punti were 20.19% and 21.39%, respectively. On the other hand, these values were 15.35% and 15.92% in conventional drying. Again, 18% and 19.3% moisture were found in traditional dried normal chapila and salted chapila, respectively. But in conventional dried fish, these values were 14.36% and 15.42%, respectively. From this study on dried fish product we can see that especially conventional drying process supports the study of quality dried products (Frazier and Westhoff, 1978). According to them, in general no microbe could grow in dried products with moisture content below 15%. This actually happens in conventional drying since the products get heat in a proper way & at a preferable temperature. So the product becomes of better quality & chance of spoilage is very low.

Another important observation was that the salted product percentage of moisture is little higher than normal product.

Ash content analysis:

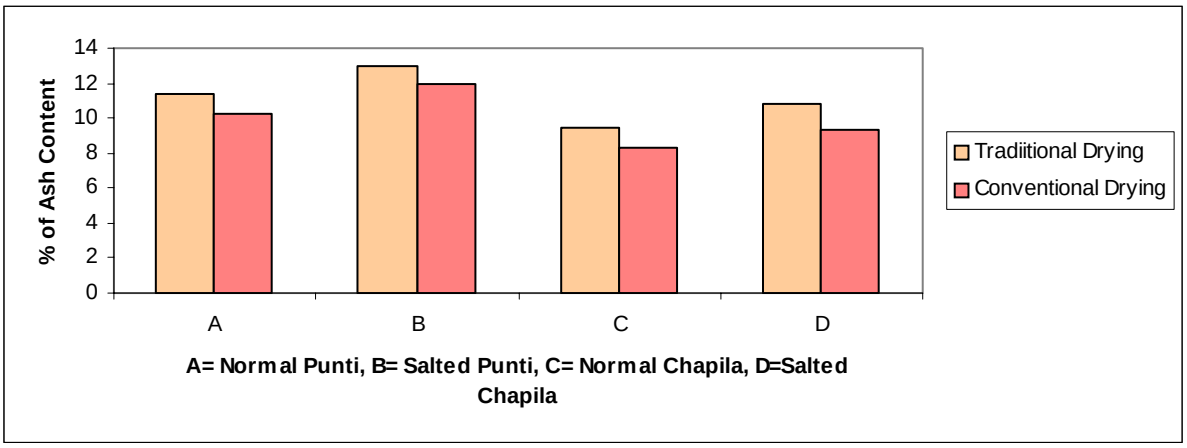

Fig. 2. Comparison of ash content (%) of traditional & conventional dried fish

The ash content of traditional dried normal Punti and salted Punti were 11.33% and 12.93%, respectively. On the other hand, these values were 10.29% and 11.94% in conventional drying. 9.45% and 10.83% ash were found in traditional dried normal Chapila and salted Chapila respectively. But in conventional dried fishes, these values were 8.29% and 9.31%. Ash content is higher in traditional sun dried products as compared to that of the conventional dried products. This perhaps due to the improper washing or washing with filthy water of raw fishes during processing and long time exposure in open air that facilitating the accumulation of dusts from external origin.

Protein content analysis:

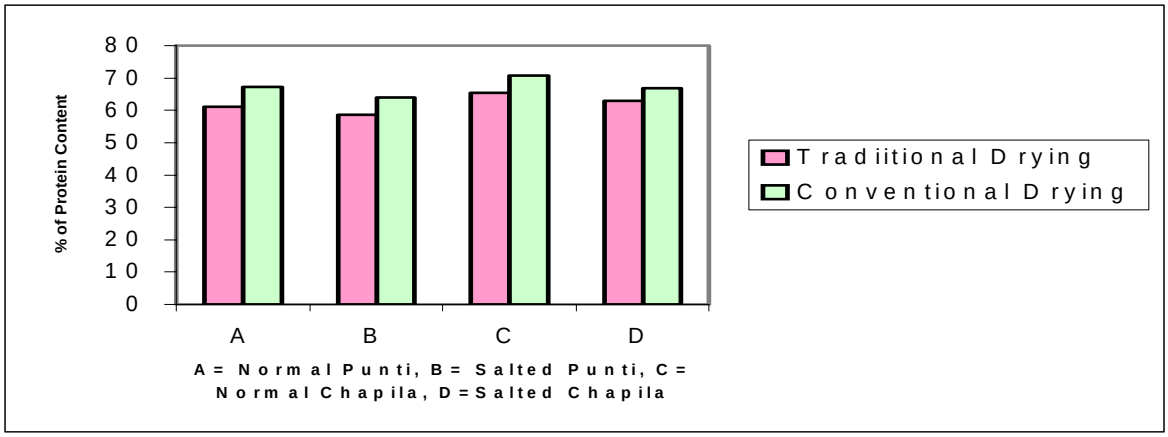

Fig. 3. Comparison of Protein content (%) of traditional & conventional dried fishes

The protein content of traditional dried normal Punti and salted Punti were 61.12% and 58.61%, respectively. On the other hand, these values were 67.29% and 63.95% in conventional drying. 65.46% and 62.93% protein were found in traditional dried normal Chapila and salted Chapila, respectively. But in conventional dried fish, these values were 70.78% and 66.83%.

Lipid content analysis:

Table 4. Lipid content (%) of Traditional & Conventional dried fishes

Type of fish	Traditional Drying (% of lipid)	Conventional Drying (% of lipid)
Normal Punti	5.3	5.95
Salted Punti	4.9	5.10
Normal Chapila	5.8	6.34
Salted Chapila	5.1	5.26

The lipid content of traditional dried normal Punti and salted Punti were 5.3% and 4.9% respectively. On the other hand, these values were 5.95% and 5.10% in conventional drying. Again, 5.8% and 5.1% lipid were found in traditional dried normal Chapila and salted Chapila, respectively. But in conventional dried fish, these values were 6.34% and 5.26%. Ahmed *el al.* (1979) reported that fishes dried by a conventional drier (solar) contained an increased percentage of protein and fat over the traditional sun dried products. The most important and significant variation was observed in moisture and ash content of traditional dried fish were much higher than that of the conventional dried fish.

Table 5. Proximate composition of traditional & conventional dried fish sample

Fish sample	Moisture (%)		Ash (%)		Protein (%)		Lipid (%)	
	TD	CD	TD	CD	TD	CD	TD	CD
Normal punti	20.19	15.35	11.33	10.29	61.12	67.29	5.3	5.95
Salted punti	21.39	15.92	12.93	11.94	58.61	63.95	439	5.10
Normal chapila	18	14.36	9.45	8.29	65.46	70.78	5.8	6.34
Salted chapila	19.3	15.42	10.83	9.31	62.93	66.83	5.1	5.26

Here, TD = Traditional Drying, CD = Conventional Drying

***Physical Study* (*Water reconstitution behavior*)**

The reconstitution properties of the dried fish muscles at 40^0C, 60^0C and 80^0C were investigated for the products obtained from both traditional and conventional dryer the results are presented in the following table:

Table 6. Reconstitution percentage of traditional & conventional dried fish at different temperature

Sample	Reconstitution Percentage					
	Soaking tem. 40^0C		Soaking tem. 60^0C		Soaking tem. 80^0C	
	Traditional drying	Conventional drying	Traditional drying	Conventional drying	Traditional drying	Conventional drying
Normal Punti	63.42	67.07	64.41	68.46	66.40	70.26
Salted punti	65.04	67.86	67.42	68.73	69.25	71.51
Normal Chapila	57.77	63.02	59.16	64.61	61.55	66.40
Salted Chapila	58.76	65.07	60.36	66.67	62.95	69.06

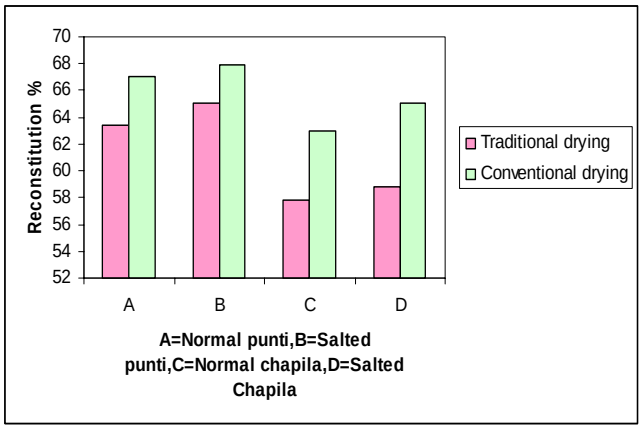

Fig. 4. Comparison of reconstitution (%) of traditional and conventional dried fishes soaked at 40^0C

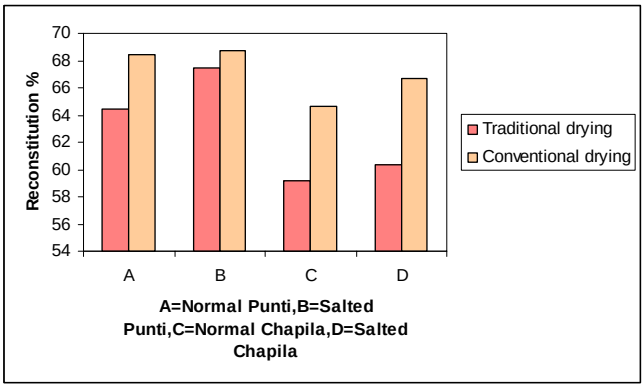

Fig. 5. Comparison of reconstitution (%) of traditional and conventional dried fishes soaked at 60^0C

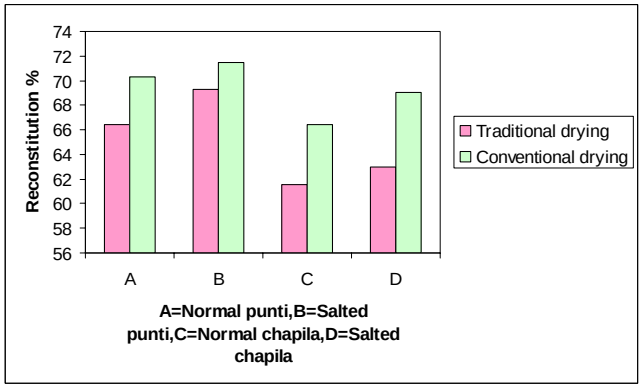

Fig. 6. Comparison of reconstitution (%) of traditional and conventional dried fishes soaked at 80^0C

A close relationship was observed between the reconstitution power and physical properties of the samples. The quality of dried fish is also related to final water activity. At low water activity values, water uptake proceeds more quickly. Denaturation of protein may cause decreased ability of rehydration. The reconstitution behavior of conventional and traditional dried normal punti and salted punti were 67.07%, 63.42% and 67.86%, 65.04% at soaking temperature 40^0C, 68.46%, 64.41% and 68.73%, 67.42% at soaking temperature 60^0C, 70.26%, 66.40% and 71.51%, 69.25% at soaking temperature 80^0C. We also found that the reconstitution behavior of conventional and traditional dried normal chapila and salted chapila were 63.02%, 57.77% and 65.07%, 58.76% at soaking temperature 40^0C, 64.61%, 59.16% and 66.67%, 60.36% at soaking temperature 60^0C, 66.40%, 61.55% and 69.06%, 62.95% at soaking temperature 80^0C. The studies on the reconstitution behavior of the dried samples soaked in hot water at temperature 40^0C, 60^0C and 80^0C determined that reconstitution rate was comparatively faster in conventional dried fishes than traditional dried fishes. The maximum value observed in conventional dried salted punti at 80^0C and minimum in traditional dried normal chapila at 40^0C.

According to Reza (2001) reconstitution rate of the dried products produced from solar tunnel dried at 45^0-50^0C and 50^0-55^0C temperature range. A close relationship was observed between the reconstitution power and physical properties of the sample. Reconstitution power was found to be slow with the poor texture such as tough, rubbery and compact structures with few inter fibriler spaces. This was especially true for Bombay duck

fish produced at 40-45^{0}C. The reasons for the failure of these dried products to reach perfection are not hard to find. In the first, for irreversible change (denaturation) that takes place during drying and severe damage suffered by cellular structure, the real reconstitution is impossible. The best way of reconstitution is to conserve a porous structure by a suitable method which absorbs and retains sufficient water by capillary. Compressed products absorb slowly and less completely (Jason 1965). The fibers of these samples appeared to be cemented together and suffered hardly any of the separation induced by shrinkage. The very large differences in dehydration rates, which existed between different products, can be explained by their micro structural differences. The dried fish at 45^0-50^{0}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). However, the toughness and fibrousness between dehydrated products may be ascribed to the cross-linking process between previously denatured protein molecules. Changes from the elastic characteristics of the tougher dry texture of any dehydrated products are very noticeable. According to Schewan *et al*. (1950), the most important requirements of a satisfactory dried fish product are: (i) resemble to fresh fish in flavor and texture and free from ripened flavors caused by prolonged bacterial, enzymatic, oxidative and chemical changes, (ii) compactness, (iii) ready and rapid reconstitution, and (iv) retention of good palatability for between six months to one year.

Total Volatile Base Nitrogen (TVB-N) analysis

Table 7. TVB-N (mg /100gm) content of traditional & conventional dried fishes

Type of fish	Traditional drying TVB-N (mg/100gm)	Conventional drying TVB-N (mg/100gm)
Normal Punti	31.08	28.56
Salted Punti	38.22	32.76
Normal Chapila	33.46	30.94
Salted Chapila	39.06	35.84

The determination of TVB-N content is one method that is used to determine freshness of fish applied in determine of freshness of fish and fish products. In traditional drying, TVB-N content of normal punti, salted punti, normal chapila and salted chapila were 31.08 mg/ 100 g, 38.22 mg/ 100 g, 33.46 mg/ 100 g and 39.06 mg/ 100 g. But in case of conventional drying, these values were 28.56 mg/ 100 g, 32.76 mg/ 100 g, 30.94 mg/ 100 g and 35.84 mg/ 100 g respectively. Sen *et al.* (1961) reported that TVB-N value of sun-dried product varied from 32.5 to 41.0 mg/100gm. While Ludorf and Meyer reported that the TVB-N content at 40 mg/ 100 g level is edible limit value, some investigators reported that the TVB-N value at 35-40 mg/ 100 g level is accepted as limit of spoiling. It is clearly evident that all of the experimental values are not exceed the limit. Patir *et al*. (2001) reported that 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. Also, the findings are higher than findings of Gun et al. who reported that TVB-N content in trout fillets preserved in salt was 1.5mg/ 100g in beginning, however, reached to 45.1 mg/100g at the end of storage period. The differences of findings may be attributed to different fish species, different technologic procedures, and different environmental conditions.

The anaerobic conditions of bulk storage of whole fish create a complex medium for microbes with formation of a variety of chemical spoilage products. One predominant end product is ammonia, which is generally used as a measure of deterioration. Ammonia is formed by bacterial breakdown of amino acids and protein and the heavy production of ammonia in a load of deteriorating fish may result in significant loss of protein (FAO 1971). The volatile bases (TVN) analysis is traditionally used in the fish meal industry to evaluate the freshness of raw material (Olafsdottir *et al.* 2000). Premium quality fish meal requires raw material less than 40 mg TVN per 100 g (Keller 1990b). In some countries fisherman are paid for their catch on a scale relating to TVN content (Pike 1989).

Per-Oxide Value (P.O.Value) analysis

Table 8. P.O.Value (m.eq./kg of oil) content of traditional & conventional dried fishes

Type of fish	Traditional drying P.O.Value (m.eq./kg of oil)	Conventional drying P.O.Value (m.eq/kg of oil)
Normal Punti	17.38	15.49
Salted Punti	15.45	14.06
Normal Chapila	18.6	16.51
Salted Chapila	16.98	14.95

The per-oxide value of traditional dried normal Punti and salted Punti were 17.38 (m. eq./kg of oil) and 15.45(m. eq./kg of oil) respectively. On the other hand, these values were 15.49 (m. eq./kg of oil) and 14.06 (m. eq./kg of oil) in conventional drying.

18.6 (m. eq./kg of oil) and 16.98 (m. eq./kg of oil) were found in traditional dried normal Chapila and salted Chapila respectively. But in conventional dried fish, these values were 16.51(m. eq./kg of oil) and 14.95 (m. eq. /kg of oil). Handling of raw material is a very important step in preserving freshness. Cooling and icing of raw material will normally slow down the biological decomposition. Handling of fish and fish offal with seawater and refrigerated sea water storage will increase the salt content in the raw material going to the fish meal plants (FAO 1971). In a number of fish species used for fish meal production particularly small pelagic fish species such as sardines, anchovies, herring etc. the digestive enzymes may cause heavy autolysis leading to softening of the meat, rupture of the belly wall and formation of considerable amounts of blood water containing both protein and oil. This causes difficulties in handling and processing and may lead to serious losses of both protein and oil (FAO 1971). Fat deterioration (lipolysis) caused by different fat splitting enzymes (lipases) is a general feature in fatty fish. Fish oils are largely composed of glycerol combined with fatty acids to form glycerides. Splitting of the glycerides of the oil and formation of free fatty acids (FFA) result in reduced quality of the oil with economic consequences.

Bacteriological study analysis

Table 9. Standard Plate Count (SPC), *Coliform* and *Salmonella* test of traditional & conventional dried fishes

Type of fish	Traditional drying SPC(CFU/g)	Conventional drying SPC(CFU/g)	*Coliform*	*Salmonella*
Normal punti	3.95×10^4	2.75×10^4	Nill	Nill
Salted punti	3.28×10^4	2.02×10^4	Nill	Nill
Normal chapila	4.3×10^4	3.19×10^4	Nill	Nill
Salted chapila	3.67×10^4	2.85×10^4	Nill	Nill

From the above table we see the standard plate count of traditional dried fishes were higher than the conventional dried fishes and the maximum count was found in traditional dried normal chapila, 4.3×10^4 and minimum in conventional dried normal punti, 2.02×10^4. No *Coliform* and *Salmonella* were found in both dried fish. There was a close relationship between the moisture content and bacterial load in food products. Bacteria, yeast and mold did not grow with moisture content below 18, 20, 16% respectively. 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 Westhoff (1978) reported that generally no microbe (Yeast, mold and bacteria) can grow in a product with moisture content below 15%. Moisture content in most of the conventional dried products was low enough for the growth and multiplication of micro-organisms. Besides, strict hygienic condition was maintained during various steps of drying. As a result the total bacterial count was within the acceptable limit and the products were safe from microbiological point of view. On the other hand, most of the traditionally sun dried product samples collected from retail market was stored for 6-7 months in abuse condition. Enough moisture was absorbed from the air especially during the rainy season. Thus a suitable environment was created and total bacterial content exceeded the limit of acceptability.

CONCLUSION

From the different observation we have come to know that curry fish is more preferable than fried fish in many ways. May be in some cases color and odors are found little better in fried fishes but the significant qualities like the nutritive values are not much more than curry fishes. Another important observation we got that during frying, fish losses significant weight as a result the percentage of ash content in fried fish is significantly increased. In our country, fish is the main source of protein of most of the people. Due to increase of coronary heart disease people are being encouraged to take more fish to fulfill their protein demand. The people of Bangladesh consume fish by cooking mainly curry fish and fried fish, but they were confused which one is helpful for health. So now it can be said that curry is more helpful for health and there is no doubt consuming the curry fish will being a good result for this purpose to meet up our demand of nutrition and also strengthen our national economy.

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