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# Nutritive value of dried and heat processed mola fish (*Amblypharyngodon mola*) products

**Islam MJ [1*], Hossain MS[2] and Mian S[3]**

*[1]Department of Fisheries Technology and Resource Utilization, [2]Department of Aquaculture, [3]Department of Fisheries Biology and Genetics, Faculty of Fisheries, Sylhet Agricultural University, Sylhet-3100, Bangladesh.*

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## ABSTRACT

Sensory characteristics, nutritive and food qualities of traditional, rotary and solar tunnel dried mola (*Amblypharyngodon mola*) products were investigated. Nutritional analyses of fresh mola fish at various steps of heat processing (cooking) were also studied. Organoleptically, the colour of traditional dried mola products was slight brownish with emission of faint off odour. On the other hand, the colour of dried mola fish produced in rotary and solar tunnel dryer was showed characteristic shiny colour and whitish to slight brownish respectively. For traditional dried mola products texture was somewhat soft, whereas it was firm and flexible with characteristic fresh fishlike odour for rotary dryer and solar tunnel dryer. Traditionally dried products were not satisfactory and found to be infested. On the contrary, rotary and solar tunnel dried mola products were excellent having no insect infestation or broken pieces. The dried mola products showed different nutritional contents significantly ($p<0.05$) higher than others. The percent of moisture content of dried mola products obtained from different drying procedures was in the range of 12.80 to 26.60 %, protein content varied from 50.03 to 62.53%; lipid content also varied considerably from 12.16 to 18.36% and ash content varied from 5.93 to 12.19%. The Total Volatile Base Nitrogen (TVB-N) values varied from 10.64 to 20.36 mg/100g. Considerable loss of protein occurred during cooking of mola with or without vegetables compared to fresh mola. Considering the nutritional value, colour, odour and texture of the dried products rotary dryer gave good and significant ($p<0.05$) result.

**Key Words:** Drying, sensory, composition, mola and textures

## INTRODUCTION

In tropical countries like Bangladesh drying of the fish and fishery products is an important method of fish preservation for most traditional fishing communities. Traditionally sun drying is performed mainly by artisanal and local processors who have serious lack of knowledge on processing, sanitation and public health. The physical and organoleptic qualities of most of the traditional sun dried products available in the market are not satisfactory for human consumption [10, 11, 13, 14]. There are frequent complaints from the consumers about the quality of the products available in the market. The dry fishes are often infested by blow fly (*Chrysomya* sp.) and their larvae (maggot) during drying phase especially in the cloudy and rainy days; and by beetle (*Necrobia* sp.) and mites in the store causing considerable amount of weight loss of the finished product every year. Quality loss through spoilage and insect attack on dried fish has been estimated to 10-35% in the coastal areas [7]. To protect the products from the infestation of insects, the processors, wholesalers and retailers often use various harmful insecticides and fungicides indiscriminately. Use of insecticides like DDT, Nogos, Rubral etc. to avoid insect infestation was reported during a market survey conducted by BFRI [5]. Sun dried fish contaminated with insecticides like DDT can act as a potential carcinogenic agent and could create a wide spectrum of health hazard.

In an attempt to reduce post-catch losses and to overcome the limitations of outdoor sun drying, solar dryer may be used as an alternative to sun drying to produce quality dried products. The available information on solar drying suggests that it is effective in controlling blow fly larvae infestation and other contaminants with higher drying rate over the traditional sun drying for producing high quality product with longer shelf life. Solar dryer consumes no fuel for operation; requires less maintenance and there is no pilferage by animals and birds and it is non-polluting [12]. A Hohenheim type solar tunnel dryer constructed with locally available materials was found very suitable for drying of Silver Jew fish at temperature of 35° to 52°C for 5 days without showing any infestation, oxidative rancidity, spoilage and contamination [3,4] . Solar dryer may be considered as one of the best scientific tools within the reach of poor fishermen living in remote fishing villages for drying their daily catch. But the solar drying technology has some limitations also. Such as solar drying is not effective in bad/cloudy weather conditions particularly during the rainy season which results in spoilage of fishes. It needs to operate the solar dryer very early in the morning to get the fish dried by the evening. Failure to operate it in the early morning results in the elongation of the drying

*Corresponding author E-mail: jakiulbau@yahoo.com

process. From this point of view this study aimed to investigate selection of an effective drying device to produce dried mola and also to choose the best cooking methods for mola fish comparing the nutritive values of various processed mola products.

## MATERIALS AND METHODS

### Materials

Fresh mola fish samples were collected from a local market adjacent to Sylhet Agricultural University (SAU) Campus, Sylhet and were transported to the Faculty of Fisheries, SAU, Sylhet using an insulated ice box. The samples were divided into two groups; one group of about 500 gm of fresh samples of mola were used for drying in solar tunnel and rotary dryer and another group of sample was used for cooking to evaluate the quality change by determining organoleptic and biochemical aspects. Traditionally dried mola samples were also collected from the same market. Whole samples obtained from both dried and cooked fish were ground in an electric blender to produce a homogenous mixture before being sampled for analysis.

### *Methods*

#### *Production of dried fish in solar tunnel and rotary dryer*

The raw materials were washed with tap water to remove dirt and other undesirable substances attached with the fish body. After gutting, the entire viscera were removed using knives and washed again with tap water to remove blood, slime and other undesirable substances. The fishes were then dried in rotary dryer and solar tunnel dryer. In case of rotary dryer, drying time was in the range of 12-24 hours while it was about 10-12 hours in case of solar tunnel dryer. After drying, the different processed products were packed in polyethylene bag using sealer to prevent moisture absorption.

#### *Organoleptic quality assessment*

A large number of schemes have been proposed for sensory evaluation for various types of fish and fishery products. The evaluation methods used in this study were based on the one that is currently used in various institution of the world. Representative whole sample of dried products were taken on a tray to assess the characteristics such as colour, odour, texture, broken pieces and insect infestation by panel of experts of four (4) members constituted in the department of Fisheries Technology and Resource Utilization, Faculty of Fisheries, SAU.

#### *Proximate composition analysis*

Whole samples obtained from both dried and cooked fish were ground in an electric blender to produce a homogenous mixture before being sampled for biochemical analysis. Proximate composition analysis of moisture, crude protein, lipid and ash were performed according to the methods given in AOAC [1] with certain modifications.

#### *Statistical analysis*

Statistical analysis was performed by using MS-STATC programme. The mean values were compared by following the DMRT (Duncan Multiple Range Test) at 5% level of probability for interpretation of results [9].

#### *Determination of Total Volatile Base Nitrogen (TVB-N)*

Total volatile base nitrogen (TVB-N) was determined according to the standard method described by EC [8] with some modifications.

#### *Processing technique of mola fish curry with vegetables and spices*

At first, fresh mola fishes were simply gutted by using knives and the entire viscera were removed. After gutting, the raw materials were washed again with tap water to remove blood, slime and other undesirable substances. Fishes were then washed with salt water and again washed with plain water. Some vegetables like potato, bean, brinjal, coriander leaf etc and spice like turmeric powder, red chili powder, coriander powder, salt and oil were added and cooked for about half an hour.

## RESULTS AND DISCUSSION

### Organoleptic and Nutritional Quality Analysis

#### *Organoleptic quality assessment of traditional, solar and rotary dried mola products*

The organoleptic parameters such as colour, odour, texture, insect infestation, presence of broken pieces and overall quality of traditional, rotary and solar tunnel dried mola products were examined and recorded (Table 1). Organoleptically, the colour of traditional dried mola products were slight brownish with emission of slight off odour and the texture found somewhat soft.

The overall quality of the product obtained from traditionally dried was not up to the mark of acceptable limit. The colour of dried mola fish produced in rotary dryer showed characteristic shiny colour. Texture was firm and flexible with characteristic fresh fish like odour. No insect infestation or broken pieces were found around the products and the overall quality of rotary dried mola fish products was found excellent.

On the other hand, the colour of solar tunnel dried mola was whitish to slight brownish. Texture was firm and flexible with characteristic odour. Any insect infestation and broken pieces around the products was not observed. The overall quality of solar tunnel dried mola fish products was also excellent. From the above observation, it can be said

that during the production of traditional sun dried products, proper care was not taken in various processing steps.

Specially, improper washing and long time exposure in the open air for drying leads to loss of color. Storage in abused condition probably caused the oxidation of lipid in the muscle and leads to development of sour rancid odour. Improper storage also allows the infestation which results in loss of texture and breaking the dried fish muscle.

***Proximate composition of dried mola fish products***

Proximate composition such as moisture, crude protein, lipid and ash contents of traditional, rotary and solar tunnel dried products were studied and are presented in Table 2. A significant difference ($p<0.05$) was found among different dried mola products. The moisture content of dried mola products was in the range of 12.80 to 26.60 % with the lowest value obtained from solar tunnel dried mola and the highest value from traditional dried mola. The moisture content of dried mola products produced in rotary dryer under room condition was 16.23%, whereas the moisture content was 18.13% in those products produced in rotary dryer under direct sun light. These values are much lower than that of traditional dried products which contains 26.60% moisture. Moisture content of traditional dried mola products was high because in most cases traditional dried products were stored without any packaging materials. As a result, moisture uptake from the environment takes place giving rise to the chance of the growth of microorganisms, loss of nutrients and

Table 1. Organoleptic characteristics of traditional, rotary and solar tunnel dried mola fish products

| Dryer Used | Colour | Odour | Texture | Insect infestation | Broken piece | Overall Quality |
|---|---|---|---|---|---|---|
| Traditional | Slight brownish in colour | Slight off odour | Texture somewhat soft | Infested by insect | Present | Poor |
| Rotary dryer | Whitish colour like as fresh fish | Characteristic odour like as fresh fish | Firm and flexible texture | No infestation | Absent | Excellent |
| Solar tunnel dryer | Whitish and slightly brownish | Good fishy odour | Firm and flexible texture | No infestation | Absent | Excellent |

Table 2. Proximate composition of traditional, rotary and solar tunnel dried mola products

| Composition | Sun dried (Traditional) | Solar dryer with white polythene | Solar dryer with black polythene | Rotary dryer in room | Rotary dryer in direct sunlight | LS | LSD |
|---|---|---|---|---|---|---|---|
| Moisture | 26.60± 0.37a | 12.80±0.15e | 15.87±0.13d | 16.23±0.18c | 18.13±0.39b | 0.01 | 1.12 |
| Protein<br>*(Dry) | 50.03±0.52d<br>*(67.09±0.42c) | 62.53±0.74a<br>*(71.27±0.73b) | 61.19±0.88b<br>*(73.06±0.63a) | 60.43±0.83b<br>*(72.13±0.75ab) | 57.60±0.46c<br>*(71.58±0.52b) | 0.01<br>*(0.05) | 1.01<br>(0.98) |
| Lipid<br>*(Dry) | 12.16±0.11c<br>*(16.90±0.26d) | 18.36±0.21a<br>*(21.03±0.23a) | 16.12±0.24b<br>*(19.16±0.33b) | 16.38±0.13b<br>*(19.55±0.10b) | 16.45±0.34b<br>*(18.89±0.21c) | 0.01<br>*(0.05) | 0.57<br>(0.55) |
| Ash<br>*(Dry) | 12.19±0.12a<br>*(15.11±0.10a) | 7.52±0.01b<br>*(8.71±0.01c) | 5.93±0.03d<br>*(8.08±0.03d) | 6.96±0.04c<br>*(8.32±0.03d) | 7.78±0.03b<br>*(9.50±0.05b) | 0.01<br>*(0.01) | 0.32<br>(0.24) |

*Values within parenthesis are on dry matter basis

short shelf life of the product. Generally bacteria, yeast and mold do not grow with moisture content below 18, 20 and 16% respectively [13]. So, for a better shelf life of the product a moisture content of less than 16% is considered ideal for dried fish [12, 13].

Protein content varied from 50.03 to 62.5% with highest value in dried fish produced in solar dryer with white polythene and lower value obtained from traditional dried product. Protein content in both rotary and solar dried fish produced under different conditions was more or less similar. There were a significant ($p<0.05$) difference found among sun dried (Traditional), solar dried and rotary dryer dried mola fish except products from rotary dryer in room and solar dryer with black polythene. Protein content varied from 67.09 to 73.06 % with highest value obtained from solar dried mola with black polythene and lowest value obtained from traditional sun dried product on dry weight basis. There were no significant ($p<0.05$) differences among the protein content of the products obtained from solar dryer and rotary dryer in room.

Lipid values were found significant among dried products from different drying methods. Lipid content also varied considerably with highest value of 18.36% obtained from dried mola fish produced in solar dried with white polythene and lowest value of 12.16% obtained from traditional dried mola products. There was no significant ($p<0.05$) difference between the lipid contents of the products obtained from solar and rotary dryers under different conditions. On dry weight basis, highest lipid content of 21.03% was obtained from the product produced in solar dryer with white polythene and lowest value of 16.90% obtained from traditional dried mola products. No significant ($p<0.05$) difference between the products obtained from solar dryer with black polythene and rotary dryer in room.

Ash content varied from 5.93 to 12.19 % with highest value obtained from traditional sun dried products and lowest value from the solar dried product with black polythene. No significant ($p<0.05$) difference between the products obtained from solar dried with black polythene and rotary dryer in direct sunlight. There was also little difference between the ash content of mola products obtained from both solar and rotary dryer under various conditions.

Table 3. Proximate composition of mola fish at various steps of processing and cooking

| Sample | Moisture% | Protein% *(Dry ) | Lipid% *(Dry ) | Ash% *(Dry ) |
|---|---|---|---|---|
| Fresh muscle of mola | 82.87±1.09a | 13.83±0.34b *(72.39±0.85a) | 3.85±0.03c *(19.69±0.44d) | 1.43±0.005bc *(7.94±0.12b) |
| Whole mola | 75.79±0.88e | 15.40±0.24a *(69.50±0.88c) | 5.48±0.02d *(25.36±0.34c) | 1.60±0.006a *(7.25±0.13c) |
| After salt wash muscle | 81.03±0.87ab | 10.98±0.22d *(71.66±1.02ab) | 3.49±0.03d *(19.95±0.45d) | 1.52±0.007ab *(8.38±0.11a) |
| Fried mola | 76.55±0.76d | 13.54±0.33b *(59.49±0.56d) | 8.22±0.04a *(36.11±0.34b) | 1.00±0.005d *(4.39±0.03e) |
| Boiled mola | 80.18±0.85b | 11.89±0.31c *(70.52±0.64bc) | 3.56±0.01d *(21.11±0.45d) | 1.41±0.007c *(8.36±0.05a) |
| Mola Cooked with vegetables | 77.77±0.66c | 13.23±0.12b *(59.22±0.88d) | 8.05±0.04b *(36.03±0.34b) | 1.06±0.005d *(4.74±0.03d) |
| Gut content | 79.23±0.98bc | 12.30±0.19c *(52.25±0.45e) | 8.19±0.04a *(42.85±0.54a) | 1.08±0.005d *(4.56±0.04de) |
| LS | 0.01 | 0.01 *(0.01) | 0.01 *(0.01) | *(0.05±) *(0.01) |
| LSD(0.05) | 1.437 | 0.54 *(1.115) | 0.124 *(0.343) | 0.094 *(0.183) |

*Values within parenthesis are on dry matter basis

The lowest protein content of the traditional sun dried product was due to some loss of water soluble protein and lipid during different stages of processing and subsequent storage. On the other hand the highest ash content of traditional sun dried mola products was due to contamination of sand, filth and dust during different processing stages and subsequent storage.

The most significant ($p<0.05$) variation in chemical composition of mola fish products were the higher moisture content in traditional dried mola compared to those of rotary and solar tunnel dried mola. It was evident from the study that there was an inverse relationship between fat content and protein content of dried mola fish products. However, result of the present study is in agreement with [2] who reported that the solar dried fishes contain high percentage of protein and fat over the traditional sun dried products.

**Food Quality Analysis**

Food quality of traditional, rotary and solar tunnel dried products was analyzed by determining Total Volatile Base Nitrogen (TVB-N). TVB-N values of dried products prepared under different conditions are presented in Fig. 1 and Table 4.

TVB-N values varied from 10.64 to 20.36 mg/100g with highest value obtained from traditional sun dried and lowest value from the products obtained in rotary dryer in room conditions. TVB-N values of the dried products prepared using solar or rotary dryer were more or less similar ranged from 10.64 to 15.68 mg/100g. The highest TVB-N values of traditional dried products are probably associated with some bacterial actions during processing and subsequent storage. However, TVB-N values of all the samples were found lower than the recommended value of 100-200 mg/100g for variety of salted and dried products [6]. It is likely to expect low TVB-N values in dried products because most of the volatile bases are lost due to heat during drying.

Proximate composition of mola during various processing and cooking steps is shown in Table 3. The analysed moisture contents of different mola products ranges between 75.79 % to 82.87% whereas it was 82.87%, 75.79%, 81.03%, 76.55%, 80.18%, 77.77% and 79.23% in fresh muscle of whole mola, whole mola, after salt wash muscle, fried mola, boiled mola, cooked mola with vegetables and gut content respectively . In case of moisture content there were no significant ($p<0.05$) difference between fresh muscle of whole mola and after salt wash muscle; boiled mola and after salt wash muscle, cooked mola with vegetables and gut content.

The analysed protein contents of fresh muscle of whole mola, whole mola, after salt wash muscle, fried mola, boiled mola, cooked mola with vegetables and gut content was 13.83%, 15.40%, 10.98%, 13.54%, 11.89%, 13.23%, 12.30% respectively. The highest crude protein content (15.40%) was found in whole mola and the lowest (10.98%) was found in after salt wash muscle. No significant differences were found among the fresh muscle of whole mola, fried mola and cooked mola with vegetables. To get more precise results dry matter basis analysis were also conducted. In case of dry matter analysis highest value of protein content was found in fresh muscle of mola (72.39%) and lowest amount of protein content were found in gut content (52.25%). No significant difference was found except cooked vegetables and gut content. The result from after salt wash muscle indicates loss of protein from muscle. This was due to washout of sarcoplasmic and salt soluble protein.

Table 4. TVB-N value of Traditional, Rotary and Solar Tunnel Dried mola Products

| Dried Sample Name | | TVB-N value (mg/100g) |
|---|---|---|
| Mola | *RR | 10.64 |
| | *RS | 13.80 |
| | *SD | 15.68 |
| | *SD(B) | 14.82 |
| | *TD | 20.36 |

***** RR-Rotary Dryer in Room condition; *RS-Rotary Dryer under Sunlight; *SD- Solar Tunnel Dryer; *SDB-Solar Tunnel Dryer using Black polyethylene; *TD- Traditional dried.

The analysed lipid contents of different fish feeds varied considerably among the different processed mola fish under different conditions. The value of crude lipid was recorded as 3.85% in fresh muscle of whole mola, 5.48% in whole mola, and 3.49% in after salt wash muscle, 8.22% in fried mola, 3.56% in boiled mola, 8.05% in cooked mola with vegetables and 8.19% in gut content (Table 3). The values obtained from whole mola, after salt wash muscle and boiled mola show no significant difeerences. Whereas fresh muscle of mola and fried mola show a statistically significant different values. The highest lipid value was found in fried mola (8.22%) and lowest value in after salt wash muscles (3.49%). Dry matter basis results show that insignificant relation were found among fresh muscle of mola, after salt wash muscle and boiled mola. Values from whole mola, fried & cooked mola with vegetables and gut content showed significant ($p<0.05$) results.

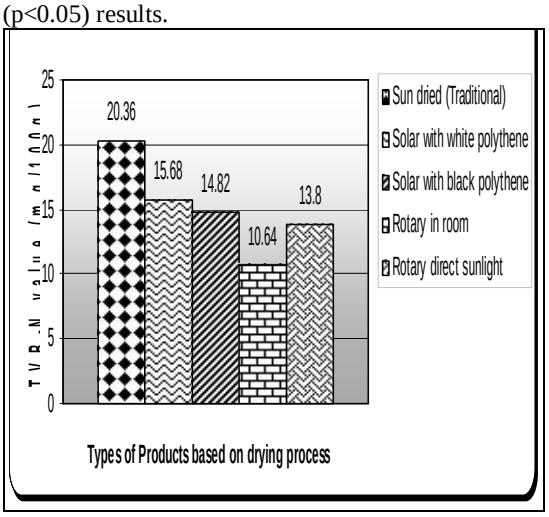


Figure 1. TVB-N values of different dried mola fish products

The analysed ash contents were found as fresh muscle of whole mola(1.43%), whole mola(1.60%), after salt wash muscle, fried mola (1.52%),fried mola (1.00%), boiled mola(1.41%), cooked mola with vegetables (1.06%) and gut content (1.08). A significant difference for ash content were found in whole mola, boiled mola and cooked with vegetables (Table 3).

The highest ash value was found in whole mola (1.60%) and lowest value in fried mola (1.00%). Analytical results from dry matter indicated significant difference among fresh muscle of mola, whole mola and after salt treatment where values obtained from fried mola and gut content; boiled mola and after salt treatment showed no significant differences. The whole mola contained much amount of ash and show a little loss and fried mola with huge loss of minerals content.

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