

## Studies on the quality attributes and safety aspect of semi-fermented fish product

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Semi-fermented fish product was organoleptically of satisfactory quality and it was organoleptically acceptable for a long time. Proximate composition of the semi-fermented fish product was comparable with other processed fish and fishery products. Proximate composition data were moisture 36.63%, protein 33.74%, lipid 18.54% and ash 11.83%. Total Volatile Base Nitrogen (TVB-N) of this semi-fermented product was 3.08 mg/100 g. Bacterial load of semi-fermented fish product was  $1.18 \times 10^6$  CFU/g. To confirm the safety aspect of the semi-fermented fish product of this research study the exact quality of metal and elements particularly the heavy metal quantity was determined. Result of heavy metal concentrations in semi-fermented fish product "Sheedal Shutki or Chapa Shutki" was Arsenic 0.019 µg/g, Cadmium 0.075 µg/g which were within the acceptable level for human consumption.

[ **Keywords** : Fermented fish, Contamination, Proteolysis, Fermentation, Organoleptic ]

### Introduction

It is important to know the composition, quality and safety of the fermented fish. Some studies were done on the composition of fermented fish "Sheedal Shutki" or "Chapa Shutki"<sup>1</sup>. In spite of such studies the present research study was undertaken with special importance on the quality and safety aspect. Contamination of fish by heavy metal from polluted water cause some chronic disease in human body. Arsenic is also contaminated to fish which is harmful for health.

A number of research studies were done by the scientists and researchers. Among these studies some are worthwhile to mention here. Stated that seafood fermentation was a very ancient and traditional technology responding to the perishability of fish and shell-fish in Europe. Worked on the protein and lipid hydrolysis of Philippine fish sauce "patis" prepared from irradiated and non-irradiated anchovies<sup>2</sup>. They reported an increase in total volatile base (TVB) from 0 to 140<sup>th</sup> day, with higher values obtained from the control samples than the 0.5 Mrad-treated samples on the 70<sup>th</sup> and 140<sup>th</sup> day. They also observed that the

initial pH of the "patis" samples was slightly acidic (5.88 to 6.6) and the pH generally decreased from 0 to 140<sup>th</sup> day. They also noted an increase in the amino nitrogen of samples upto 70<sup>th</sup> day and leveling off on the 140<sup>th</sup> day of fermentation.

NRCT<sup>3</sup> reported that out of 280 samples of "pla-ra" from various parts of Thailand found that the pH and titratable acid of the product (expressed as lactic acid) range between 4.7-6.2 and 0.37-3.15% respectively. Salt content was 7.8-17.9% and bacterial count which included the genera *Pedococcus*, *Staphylococcus*, *Micrococcus* and *Bacillus* were between  $2.2 \times 10^6$  and  $8.9 \times 10^7$  cfu/g.

The fish sauce Nuoc-mam and similar products are fish hydrolysates; the fish proteins have undergone varying degrees of digestion. Proteolysis results from a combination of autolytic action of the natural fish enzymes and the effects of microbial fermentation, brought about by the intentional introduction of bacteria, moulds and yeasts. Products are characterized by distinctive aromas and flavours prized by the people of the region. Quality products have high protein content and are rich in essential amino acids. In most cases indigenous fermented fish

products are native to a country or culture, and they are developed before recorded history. Considering the importance of fish to relieve the protein shortage in Bangladesh the present study was undertaken to evaluate the nutritional and food quality of the semi-fermented fish product “Sheedal Shutki” or “Chapa Shutki” as well as to assess the percentage of arsenic, chromium, cadmium contamination.

Materials and Methods

The experimental materials i.e. the semi-fermented fishery products or “Sheedal Shutki” or “Chapa Shutki” were collected from the Fish Market of Mymensingh town in Bangladesh. The semi-

fermented fishery product was taken into the polyethylene packets and brought to the Laboratory of the Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh.

Physical characteristics such as colour, odour and texture of the semi-fermented fishery product were studied by organoleptic test. Sensory method were used to assess the degree of freshness based on organoleptic/physical characteristics such as colour, odour, general appearance, texture, consistency of flesh etc. These characteristics were judged by ten-persons as panelist. Quality of the semi-fermented fishery product at retailer level was assessed on the basis of organoleptic characteristics. Organoleptic

test was conducted by the method which was adopted from the method described by<sup>4</sup>.

Table 1–Determination of defect point

| Characteristics      | Defect characteristics                  | Defect points | Quality    |
|----------------------|-----------------------------------------|---------------|------------|
| General appearance   | a. Bright, shining blackish             | 1             | Excellent  |
|                      | b. Slight dullness                      | 3             | Acceptable |
|                      | c. Dullness                             | 4             | Fare       |
|                      | d. Definite dullness, loss of weight    | 5             | Reject     |
| Colour               | a. Shining blackish or yellowish colour | 1             | Excellent  |
|                      | b. Gray yellowish colour                | 2             | Acceptable |
|                      | c. Brown or gray colour                 | 3             | Acceptable |
|                      | d. Colour become fad                    | 4             | Poor       |
|                      | e. Strong whitish colour                | 5             | Reject     |
| Odour                | a. Good odour                           | 1             | Excellent  |
|                      | b. Slight off sour odour                | 3             | Acceptable |
|                      | c. Faint sour odour                     | 4             | Poor       |
|                      | d. Strong sour odour                    | 5             | Reject     |
| Texture              | a. Firm elastic                         | 1             | Excellent  |
|                      | b. Soft abdomen                         | 2             | Acceptable |
|                      | c. Some loss of elasticity              | 3             | Acceptable |
|                      | d. Limp and floppy                      | 4             | Poor       |
|                      | e. Melting abdomen, easily bruise       | 5             | Reject     |
| Consistency of flesh | a. Soft                                 | 1             | Excellent  |
|                      | b. Flesh some what hard                 | 2             | Acceptable |
|                      | c. Flesh become very soft               | 3             | Acceptable |
|                      | d. Loss of water absorption             | 4             | Poor       |
|                      | e. Melting abdomen                      | 5             | Reject     |

$$SDP = \frac{\sum DP}{n}$$

Where SDP = Score of Defect Point

DP = Defect Point

n = number of characteristics studied

**Table 2**–Grading of semi-fermented fishery products

| Grade    | Defect point | Degree of freshness/<br>Quality |
|----------|--------------|---------------------------------|
| <b>A</b> | <2           | Excellent                       |
| <b>B</b> | 2 to <4      | Acceptable                      |
| <b>C</b> | 4<5          | Poor                            |
| <b>D</b> | 5            | Rejected                        |

Biochemical analysis of the semi-fermented fishery products were done according to the methods given in<sup>5</sup>. In this analyses the protein, lipid, ash and moisture contents of the semi-fermented fishery products were determined. All determinations were done at least in triplicate and the mean value has been reported.

Total Volatile Base Nitrogen (TVB-N) content of the semi-fermented fishery products was determined according to the methods given in<sup>5</sup>. TVB-N content of fish and fishery products is an indicator of quality and shelf-life. All determinations of this test was done in triplicate and the mean value was reported.

The media used to determine microbial load were as follows

**Plate Count Agar:** Plate count agar was a commercial preparation (Hi media, India) that was used for enumeration of viable bacteria count in experimental samples i.e. semi-fermented fishery products. Accurately weighed 23.5 g of media was taken into 1000 ml distilled water and suspended, which was then boiled to dissolve the ingredients completely. The media was then sterilized at 121° C for 15 min under 15 lb/inch<sup>2</sup> pressure in an autoclave.

Peptone diluents (0.2%) were used as diluents in determining APC.

The microbial load of the semi-fermented fishery products was calculated by following formula:

$$\text{Colony Forming Unit (CFU/g)} = \frac{\text{No. of Colony} \times 10^n \times 10 \times \text{Vol. of Soln.}}{\text{Weight of Sample}}$$

Quantitative Bacteriological Analysis were carried out. Aerobic plate count (APC) was done by consecutive decimal dilution technique. Sample for the APC was accurately weighed and added with required amount of water and liquefied in a sterilized blender jar and consecutive ten fold dilution were prepared in the test tubes. From all the dilutions spread plate cultures were made in duplicate and incubated at 35° C for 24 to 48 hours. Colonies developed on the plates having 30 to 300 colonies were selected for APC. According to<sup>6</sup>, APC was calculated by the following formula:

$$APC/g = C \times D \times 10/S \text{ CFU/g}$$

where, C = Number of colonies found

D = Dilution factor

S = Weight of sample in grams

CFU = Colony forming unit

Detection of heavy metal particularly Arsenic, Chromium, Cadmium was done at “Professor Mohammad Hossain Central Laboratory” of Bangladesh Agricultural University, Mymensingh. The method of<sup>7</sup> was followed in this research study.

**Apparatus:**

- (1) Hybrid generation
- (2) Atomic Absorption Spectrophotometer
- (3) Test tube (reaction vessel)
- (4) Fume hood

**Reagent:**

- (1) Hydrochloric acid (2M HCl)
- (2) Hydrochloric acid (5M HCl)
- (3) Potassium borohydride (KBH<sub>4</sub>)
- (4) Sodium hydroxide (NaOH)
- (5) Nitric Acid (5 ml conc. HNO<sub>3</sub>)
- (6) Hypochlorate (3 ml 60% HClO<sub>4</sub>)

## Procedure:

Accurately weighed muscle/tissue of semi-fermented fishery product was taken in a test tube and 5 mL of diacid mixture (5 mL conc.  $\text{HNO}_3$  : 3 mL 60%  $\text{HClO}_4$ ) were added to each sample<sup>8</sup>. The content mixed for over night. Samples were then digested, initially at 80°C temperature and later on 150°C for 2 hours. The completion of digestion was indicated by almost colourless condition of the material. The brown fumes also cease to exist at completion of digestion. The samples were separately filtered by using an ashless filter paper and volume made up to 25 mL with 0.5%  $\text{HNO}_3$  prepared for the determination of arsenic, cadmium and chromium<sup>9</sup>. The samples were subjected to analysis by Atomic Absorption Spectrophotometer (HG-AAS, PG-990, PG Instruments, UK). The wave length of arsenic (As), chromium (Cr) and cadmium (Cd) in semi-fermented fishery product was calculated by the following formula:

$$\text{Metal concentration} = \frac{\text{ppm conc. observed} \times \text{final vol. of sample in ml}}{\text{Weight of tissue taken in g}}$$

## Results and Discussion

Organoleptic characteristics of semi-fermented fishery products of three different origin e.g. from producers, wholesalers and retailers were evaluated are presented in Table 3. Organoleptic characteristics included general appearance, colour, odour, texture, consistency of flesh. The product which was obtained from the producers was of excellent quality. On the other hand, the overall quality of the product obtained from wholesaler of local market was in acceptable condition for consumption. Semi-fermented product obtained from retailers had dull appearance with faded whitish colour, faint sour odour and limp and floppy texture. The abdomen of the product obtained from retailer was very soft and lost water absorption capacity. This product was considered as poor in quality. In this study the organoleptic characteristics of the majority of semi-fermented fishery products were found to be of satisfactory quality.

Results of proximate composition analysis of semi-fermented fishery products are presented in Table 4. Semi-fermented fishery product contained 36.63% moisture. The protein content, which is most important from nutritional point of view, of semi-fermented fishery product was 33.74% in wet weight

basis. For better evaluation data were recalculated on dry weight basis. On dry weight basis 61.32% protein was determined in the semi-fermented fishery product. Lipid content in the semi-fermented fishery product was 18.54%, on wet weight basis. For better comparison the lipid content was recalculated on moisture free basis. On moisture free basis lipid content was 29.25%. There was an inverse relationship between protein and fat content of the semi-fermented fishery product. Ash content of the semi-fermented fishery product was 11.83%. Ash content of a product is very important because it indicates total mineral content of a product.

Total Volatile Base Nitrogen (TVB-N) of the semi-fermented fishery product was determined to evaluate the food quality of this product. TVB-N in this product was 3.08 mg/100 g (Table 4). The TVB-N content of the semi-fermented fishery product was within the acceptable limit. On the basis of this result it can be assumed that the food quality of this product is of satisfactory quality.

Total bacterial count of the semi-fermented fishery product was noted as  $1.18 \times 10^6$  cfu/g. A correlation was found between bacterial count and total volatile base nitrogen. The sample with high total volatile base nitrogen showed maximum bacterial count. Comparatively samples with low total volatile base nitrogen had minimum bacterial count. On the other hand, high moisture content promoted the growth of microorganisms and accelerated the formation of total volatile base nitrogen irrespective of the samples analyzed.

Presence of heavy metal in the semi-fermented fishery product was tested by detecting arsenic, cadmium, chromium concentration. Arsenic concentration was 0.019 µg/g, cadmium concentration was 0.075 µg/g, and chromium concentration was 0.039 µg/g. Arsenic, cadmium, chromium are harmful for health. Such type of heavy metal cause many chronic diseases. Result of the heavy metal detection of the present study are presented in Table 5. Result of this test indicate that the arsenic, chromium, cadmium concentration in semi-fermented fishery product is within the acceptable limit. Heavy metal detection in semi-fermented fishery product will help to create awareness among the consumers.

Table 3—Organoleptic characteristics of traditional semi-fermented fishery product

| General appearance       | Colour                               | Odour                    | Texture                         | Consistency of flesh                                      | Grade | Overall Quality          |
|--------------------------|--------------------------------------|--------------------------|---------------------------------|-----------------------------------------------------------|-------|--------------------------|
| Bright, Shining blackish | Shining blackish or yellowish        | Characteristic odour     | Firm and flexible texture       | Soft and spongy                                           | A     | Excellent <sup>*1</sup>  |
| Slight dullness          | Gray Y<br>ellowish<br>Colour         | Slight off<br>sour odour | Firm and<br>flexible<br>texture | Flesh is hard                                             | B     | Acceptable <sup>*2</sup> |
| Dull ness                | Colour faded<br>on Slightly<br>white | Faint sour<br>odour      | Limp and<br>flappy              | Malting flesh,<br>loss of water<br>absorption<br>capacity | C     | Poor <sup>*3</sup>       |

<sup>\*1</sup> Sample from the producers<sup>\*2</sup> Sample from the wholesalers<sup>\*3</sup> Sample from the retailers

Table 4—Proximate composition, TVB-N, bacterial count of the semi-fermented fishery product

| Parameter | Result                   |
|-----------|--------------------------|
| Moisture  | 36.63%                   |
| Protein   | 33.74%                   |
| Lipid     | 18.54%                   |
| Ash       | 11.83%                   |
| TVB-N     | 3.08 µg/100g             |
| APC       | $1.18 \times 10^6$ cfu/g |

Table 5 Detection of arsenic, cadmium, chromium in the semi-fermented fishery product

| Heavy metal   | Quantity (ig/g)   |
|---------------|-------------------|
| Arsenic (As)  | $0.019 \pm 0.001$ |
| Cadmium (Cd)  | $0.075 \pm 0.003$ |
| Chromium (Cr) | $0.039 \pm 0.002$ |

## Conclusion

Present study infers that the semi-fermented fishery product is rich in protein, lipid and mineral content. It has food quality and bacterial count as well as heavy metal concentration is within the acceptable limit. It can be concluded that the semi-fermented

fishery product is a food with nutritional quality and it is safe to eat.

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