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Quality aspect and heavy metal content of fresh and dry salted Hilsa (*Tenualosa ilisha*) of Bangladesh

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Abstract

This study was conducted to assess the food quality and heavy metal content of Bangladeshi fresh and salted Hilsa (Tenualosa ilisha) products from three major stocks (Chandpur, Chittagong and Barisal). Moisture content of fresh and salted Hilsa of Chandpur, Chittagong and Barisal origin were 56.816%, 49.293%, 55.902%, 47.236%, 44.910% and 48.108%, respectively while their protein contents were 18.709%, 19.275%, 18.826%, 24.232%, 22.633% and 23.202%, respectively. On the other hand, Lipid contents were significantly higher as Hilsa is regarded as a fatty fish and the values were 18.932%, 21.552%, 19.847%, 17.264%, 17.956% and 16.803%, respectively and ash contents were 1.266%, 1.238%, 1.318%, 15.795%, 18.878% and 18.006%, respectively. TVB-N content of fresh and salted T. ilisha products collected from Chandpur, Chittagong and Barisal region were within the acceptable limit while their salt content ranged from 17.05 to 19.036%. Heavy metal concentrations in fresh and salted T. ilisha from Chandpur region, Cadmium were 0.235µg/g and 0.328µg/g, Copper 0.688µg/g and 0.732µg/g, and for Lead 0.443µg/g and 0.433µg/g, respectively; whereas the concentration of heavy metal in fresh and salted T. ilisha from Chittagong region Cadmium were 0.729µg/g and 0.233µg/g, for Copper as 0.713µg/g and 0.750µg/g and for Lead as 0.961µg/g and 0.676µg/g respectively, and heavy metal concentrations in fresh and salted T. ilisha from Barisal region Cadmium were 0.246µg/g and 0.326µg/g, Copper 0.375 µg/g and 0.465µg/g, and for Lead 0.465µg/g and 0.689µg/g, respectively; which were within the satisfactory level for human consumption.

Keywords: Proximate composition, TVB-N, Heavy metal, *Tenualosa ilisha*.

Introduction

Quality is the degree of excellence of any commodity or product. Fish quality is all those attributes which fish eater or buyer consciously or unconsciously consider or expect to be present in fish in terms of nutritional benefit, dietary satisfaction and that it does not contain any harmful bacteria or pathogen and that it is caught from unpolluted water[1]. A heavy metal is a metallic element which is toxic and has a high density, specific gravity or atomic weight. Less commonly, any metal with a potential negative health effect or environmental impact may be termed a heavy metal. Fisheries play quite an important role in terms of protein supply, generation of employment and earning of foreign currency in Bangladesh society. Fisheries have made up 5-6% of the country's GDP for the past several years[2]. The country's most important aquatic resource is the Ilish, or the Hilsa shad. It is the largest and single most important fishery in Bangladesh. In the year 2011-12, about 11% of the country's total fish production came from Hilsa. Average Hilsa production is about 3, 46,512 MT which is valued at about 300 million taka. Hilsa contributes 1.0% to the GDP[2]. Hilsa contributes the largest single species fishery in Bangladesh in almost all the river system, estuaries and the sea. Among them the major stocks are Chandpur, Chittagong and Barisal. These three stocks are renowned for Hilsa production and Hilsa supply in every year. The BFRI, riverine station studies identified the lower stretches and estuarine of the Meghna River as the major spawning grounds of Hilsa[3,4]. Fish preservation has been practiced in Bangladesh for a long time; the simplest methods employed are drying, salting, freezing and semi-fermentation. Drying is not suitable for Hilsa, because Hilsa contains high amount of fat, which causes more oxidation and rancidity. Considering the suitability and acceptability, salting is the most suitable method of Hilsa preservation in Bangladesh. Salting is the oldest and effective method of fish preservation which provides a simple and low cost fish preservation technique; keeps the fish edible for a long time compared to other preservation methods; salt is easily available and salting can be done throughout the year; salted fish can be easily stored, transported and marketed. In Bangladesh, Hilsa fish is the only species used for salting. The quality of the traditional salted products is poor due to low quality raw fish and salt used unhygienic condition during salting, handling and storage. High quality salt contains 99.9% NaCl, low quality salt may contain only 80% NaCl[5]. Trace elements can be accumulated by fish, both through the food chain and water. Fish living in the

polluted water may accumulate toxic trace metals via their food chains[6]. High levels of arsenic, lead, copper and iron have been reported to cause rapid physiological changes in fish[7]. Arsenic is one of the toxic environmental pollutants which have recently received attention because of its chronic and epidemic effects on human health trough widespread water and crop contamination due to the natural release of these toxic elements from aquifer rocks in Bangladesh[8]. Therefore, the objectives of this study were to investigate the proximate composition, Total Volatile Base Nitrogen (TVBN), content of heavy metals, and the quality and safety aspects of the market samples of *T. ilisha* and its salted products of different stocks of Bangladesh (Chandpur, Chittagong and Barisal).

Materials and methods

Collection and preparation of sample: The fresh Hilsa *(Tenualosa ilisha*) fish were collected from Local Fish Market of Chandpur, Chittagong and Barisal Town, Bangladesh. The collected Hilsa were transported to the laboratory of Fisheries Technology, Bangladesh Agricultural University, Mymensingh in insulated box with fish ice ratio of 1:2. Upon arrival in the laboratory, fishes were washed with tap water to remove the dirt. Then some fishes were gutted and viscera were removed using knives, and washed again with tap water to remove blood, slime and other undesirable substances. The fish were cut transversely from the dorsal to the ventral by a sharp knife or 'Boti' in such a way that the chunks remain attached at the ventral region. The thickness of the piece ranges from 0.75-1.0 cm. Then, one part solar salt was added to the four part fish in sufficient amount, in its gills and mouths, in eyes and abdomen and in between each chunk with a small amount of turmeric powder. Salted fish were arranged one after another in crescentic fashion in a bamboo basket kept 12 days in the Laboratory in cool and dry place for adequate maturation. The Hilsa and its salted products are divided into two portions which were packed individually and put into a deep freeze at around -20^{o}C for studying the quality changes in Hilsa during frozen storage.

Sampling procedure: Frozen stored Hilsa (*T.ilisha*) and its salted product were used for the study. The frequency of monitoring was once a week up to 8 weeks. Frozen Hilsa and its salted product were thawed and then water on fish skin (i.e. surface) was soaked with tissue paper with proper care. Only fish muscle was collected for the further examination. Then the muscle was chopped and finally ground with a blender for homogenous mixture.

Bio-chemical analysis: Proximate composition (Moisture, protein, lipid and ash) of the *T. ilisha* was determined in accordance with AOAC method[9]. All the determinations were made in triplicate.

Total Volatile Base-Nitrogen (TVB-N): Total volatile basic nitrogen (TVB-N) was estimated according to the Antonacopoulos and Vyncke method[10].

Determination of NaCl: An amount of 25g of accurately weighed homogenized sample was blended with 225 ml of distilled water. This was filtrated through Whatman No. 1 filter paper. An aliquot of 1 ml of the homogenate was titrated against 0.1 N $AgNO_3$ solution using potassium dichromate (5% solutions in water) as indicator.

NaCl content was calculated from the following relationship:
1 ml 0.1$AgNO_3$=0.005845g NaCl
% of NaCl in fish = S×90
Where: S is the NaCl content in 10 ml aliquot.

For fish sample containing more than 7% NaCl in the filtered homogenate was diluted 4 times with distilled water and titration was performed in the same manner. For calculation the dilution factor 4 was used to find out the % of NaCl in the original fish sample (fish). Since 10.00 ml aliquot (diluted) was taken for titration.

The calculation was as follows:
% of NaCl in fish = (S×90) × 4

Detection of unwanted chemicals (heavy metals): Collected fish tissues were weighed by electronic balance and 5 ml of di acid mixture (5 ml conc. HNO_3**:** 3 ml 60% $HClO_4$) were added to each sample. The content mixed for overnight. Samples were then digested, initially at 80^{o}C temperature and later on 150^{o}C for 2 hours. The completion of digestion was indicated by almost colorless material. The brown fumes also cease to exist at completion of digestion. The samples were separately filtered by using an ash less filter paper and volume made up to 25 ml with 0.5% HNO_3 which prepared for the determination of arsenic, cadmium and chromium[11]. The samples were subjected to analysis by Atomic Absorption Spectrophotometer (HG-AAS, PG-990, PG Instrument Ltd. UK) at Chemical Analyst MD. Tarikul Alam, Bangladesh Institute of Nuclear Agriculture (BINA), BAU, Mymensingh, following the method of Clesceri *et al.*[12]. The concentration of Cd, Cu and Pb in fish samples were calculated by the following formula:

$$\text{Metal concentration} = \frac{\text{ppm conc.Observed} \times \text{final volume of sample in ml}}{\text{Weight of tissues taken in gm}}$$

Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS) 16.0 for windows (SPSS, SAS Institute Inc. Cary, USA).

Results and discussion

Proximate composition of fresh Hilsa: Proximate composition of fresh Hilsa of three different stocks (Chandpur, Chittagong, Barisal) were shown in Table-1. Moisture content of fresh Hilsa of Chandpur, Chittagong and Barisal were 56.816%, 49.293 % and 55.902% respectively, crude protein content were 18.709 %, 19.275%, and 18.826% respectively. On the other hand, lipid and ash content of Chandpur, Chittagong, and Barisal samples were 18.932%, 21.552%, 19.847% and 1.266%, 1.238% and

1.318% respectively. This variation has been attributed to sex, age, climate condition and nutritional status. It has been reported that proximate composition of raw hilsa of dorsal and ventral part was 56.49% and 55.45% moisture, 23.62% and 22.99% protein, 18.01% and 18.96% fat and 1.71% and 2.26% ash, respectively[13]. Our findings are also similar to Begum *et al.*[14] and Chakrabarty *et al.*[15].

Table-1: Proximate composition of fresh Hilsa.

Region	Moisture (%)	Crude protein (%)	Crude lipid (%)	Ash (%)
Chandpur	56.816 ± 0.431	18.709 ± 0.380	18.932 ± 0.096	1.266 ± 0.237
Chittagong	49.293 ± 0.720	19.275 ± 0.262	21.552 ± 0.445	1.238 ± 0.317
Barisal	55.902 ± 0.498	18.826 ± 0.225	19.847 ± 0.087	1.318 ± 0.082

*Values are mean ± Standard deviation (SD).

Proximate composition of salted Hilsa: Proximate composition of salted Hilsa of three different stocks (Chandpur, Chittagong, Barisal) were presented in Table-2. Moisture content of salted Hilsa of Chandpur, Chittagong and Barisal were 47.236%, 44.910% and 48.108% respectively, crude protein content are 24.232%, 22.633%, and 23.202% respectively. On the other hand, lipid and ash content of Chandpur, Chittagong, and Barisal samples were 17.264%, 17.956%, 16.803% and 15.795%, 18.878% and 18.006% respectively. Salt content of Chandpur, Chittagong, and Barisal salted samples were 18.57%, 19.04%, 17.05% respectively. It was found that the seasonal variation of moisture content of different salted fishes found high moisture ranged between 48.2 to 58.6% in monsoon that is similar to our study[16]. Besides, the proximate composition of different portion of hilsa collected from two regions of the Bay of Bengal and found the highest protein content (21.89%) in ventral where lowest (20.50%) in caudal region[17]. Our results from this study is more or less alike to Rohomania *et al.*[13] and Rahman *et al.*[18].

TVBN value of fresh and salted Hilsa: TVBN value of fresh Hilsa of Chandpur, Chittagong and Barisal region were 2.26 mg/100g, 2.49 mg/100g and 2.96 mg/100g respectively and TVBN value of salted Hilsa of those region were 4.89 mg/100g, 5.19 mg/100g and 5.03 mg/100g respectively (Figure-1). It has been reported that the TVBN of Hilsa from six various coastal regions of Bangladesh ranged from 2.01-3.5 mg N/100g[14]. It has been reported that the TVBN value of dry salted Tengra (*Mystus tengra*) was 3.90mg/100gm of fish[19]. It has been investigated that Total Volatile Base Nitrogen (TVB-N) content of traditional dried Ribbon fish, Bombay duck, Big-eye tuna, Silver Jew fish and Chinese pomfret ranged from 16.56-44.83 mg/100g[20]. It has been observed that the Total Volatile Base Nitrogen (TVB-N) content were 3.5 to 25.2, 1.9 to 8.9, 2.5 to 15.2, 3.6 to 15.6 and 5.3 to 19.0 mg/100 g for silver jewfish, Bombay duck, big-eye tuna, Chinese pomfret and ribbon fish respectively [21]. Some researchers found their results which are more or less similar to present study[22,23].

Detection of heavy metal concentrations in fresh and salted Hilsa: The maximum limits Mn, Cu, Zn, Pb and Cd for fish are 1µg/g, 30µg/g, 100µg/g, 2µg/g, 1µg/g[24]. Copper concentration of fresh Hilsa in Chandpur, Chittagong and Barisal stocks were 0.688 µg/g, 0.713 µg/g, 0.375 µg/g and in case of salted Hilsa for those regions were 0.732 µg/g, 0.750 µg/g, 0.465 µg/g respectively which was within the acceptable level for human consumption. Cadmium concentration of fresh Hilsa in Chandpur, Chittagong and Barisal stocks were 0.235 µg/g, 0.729 µg/g, 0.246 µg/g and in case of salted Hilsa for those regions were 0.328 µg/g, 0.233 µg/g and 0.326 µg/g respectively which was within the acceptable level for human consumption. Lead concentration of fresh Hilsa in Chandpur, Chittagong and Barisal stocks were 0.443 µg/g, 0.961 µg/g, 0.465 µg/g and in case of salted Hilsa for those regions were 0.433 µg/g, 0.676 µg/g, 0.689 µg/g respectively which was within the acceptable level for human consumption (Figure-2). These non-essential metals have no biological function or requirement and their concentrations in coastal fishes are generally low[25,26].

The variation of copper, cadmium and lead content of fresh and salted Hilsa among three different stocks are believed to be due to water pollution with different ways like fertilizer industry's wastes, pharmaceuticals industry's wastes, battery industry's wastes etc. Simillar results also reported by Dural *et al.*[27] and Nchumbeni Humtsoe[28] and Chakraborty *et al.*[29].

Table-2: Proximate composition and salt content of salted Hilsa.

Region	Moisture (%)	Crude protein (%)	Crude lipid (%)	Ash (%)	Salt content (%)
Chandpur	47.236 ± 0.762	24.232 ± 0.876	17.264 ± 0.403	15.795 ± 0.738	18.57 ± 0.282
Chittagong	44.910 ± 0.920	22.633 ± 0.489	17.956 ± 0.605	18.878 ± 0.316	19.04 ± 0.151
Barisal	48.108 ± 0.206	23.202 ± 0.415	16.803 ± 0.522	18.006 ± 0.710	17.05 ± 0.863

*Values are mean ± Standard deviation (SD).

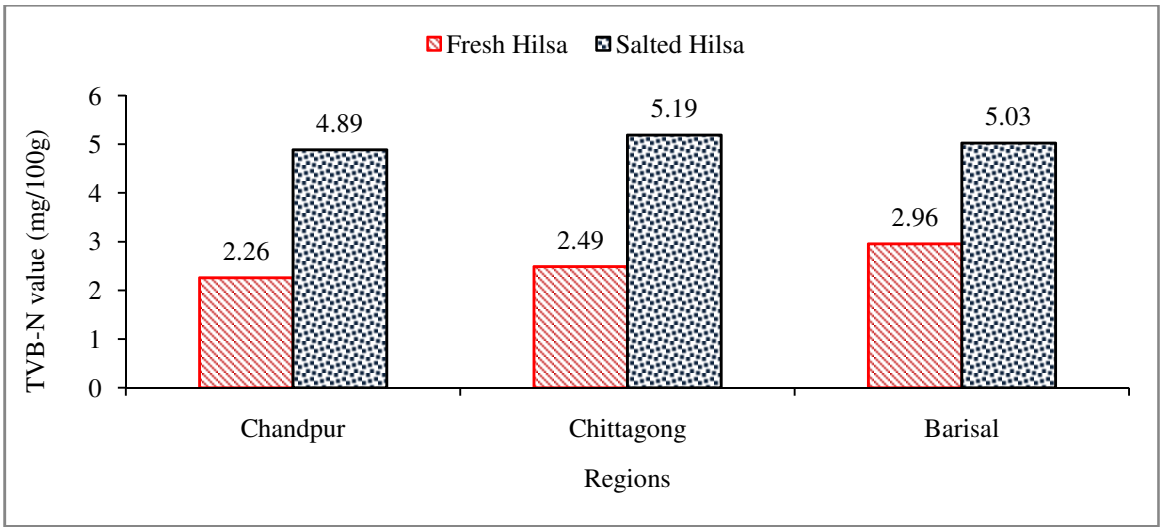

Figure-1: TVB-N content of fresh and salted Hilsa fish of Chandpur, Chittagong and Barisal region.

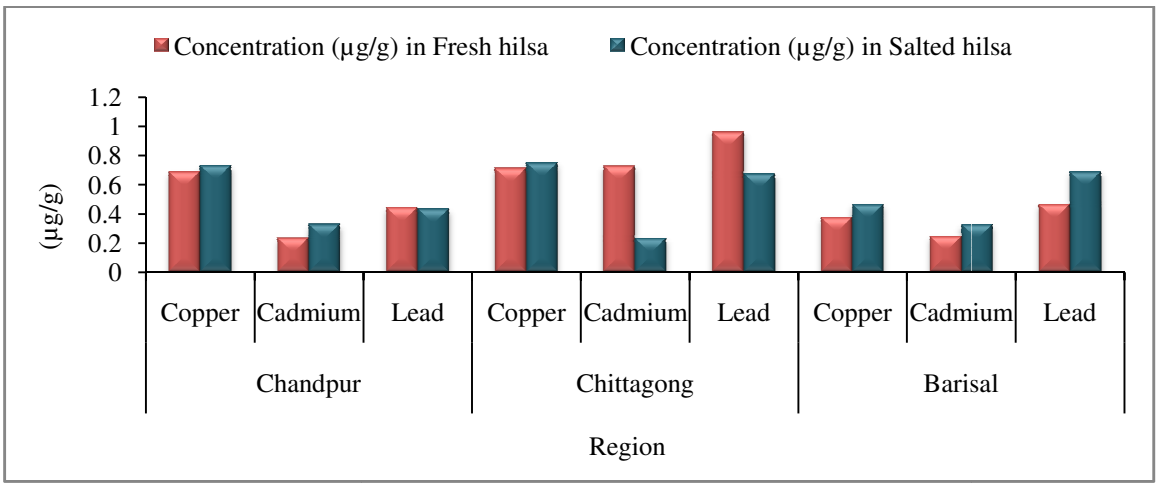

Figure-2: Heavy metal content of fresh and salted Hilsa fish of Chandpur, Chittagong and Barisal region.

Conclusion

In the present investigation, the quality aspects of the popular pelagic fish *Tenualosa ilisha* and its salted product from three different socks of Bangladesh were evaluated. The protein content of fresh Hilsa was lower than that of salted Hilsa, but moisture and lipid content was higher in fresh Hilsa, The ash content of these products were within the limit. Total volatile base-nitrogen (TVB-N) of fresh and salted Hilsa collected from various local markets from Chandpur, Chittagong and Barisal region was within the level acceptable for human consumption. As far as heavy metal concentration is concerned all of the samples contained some heavy metals (cadmium, copper and lead) but the ranges were within the acceptable limit recommended by WHO[30]. Among the three stocks of Hilsa the Chittagong stock contained slightly higher quantity of heavy metal. It may be due to aquatic pollution by industrial effluent discharge and large quantity waste dump in that area. The recommended value arsenic, cadmium and chromium are 0.050 ppm, 0.1 ppm and 0.1 ppm respectively[30].

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