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**Ismot Ara**
Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

**Mirza Mohiuddin Ayubi**
Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

**Roksana Huque**
Food Technology Division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh

**Mst. Afifa Khatun**
Food Technology Division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh

**Mahfuza Islam**
Food Technology Division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh

**Md. Afzal Hossain**
Food Technology Division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment, Ganakbari, Savar, Dhaka, Bangladesh

**Corresponding Author:**
**Ismot Ara**
Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

# Morphometric, meristic and proximate composition between freshwater and marine hilsa fish

**Ismot Ara, Mirza Mohiuddin Ayubi, Roksana Huque, Mst. Afifa Khatun, Mahfuza Islam and Md. Afzal Hossain**

**Abstract**
Hilsa is the only fish that has secured recognition as the geographical indication product of Bangladesh. The present study was carried out to compare the morphometric, meristic and proximate composition of freshwater and marine hilsa fish. A number of freshwater hilsa were collected from Sandhya river and marine hilsa were collected from Chittagong Port. Morphometric characteristics showed higher value in marine hilsa than freshwater. Among them, total length (TL), standard length (SL) and head length (HL) of both varieties showed difference. Body proportions of both hilsa fish, were different. Number of pectorals, pelvic, anal fin rays showed different. Proximate data showed that, freshwater hilsa contained higher moisture content (70 ± 0.34 %) than marine hilsa. Protein (20.06 ± 0.94 %), lipid (13.8 ± 2 %) and ash contents (1.26 ± 0.15 %) were relatively higher in marine hilsa. Freshwater hilsa showed large amount of calcium (182.4 ± 3.48 mg/100 g) and phosphorus (133 ± 4.52 mg/ 100g) but iron content (3.30 mg /100 g) was higher in marine hilsa. The present result revealed that both marine and freshwater hilsa are nutritionally enriched. Hilsa of freshwater origin is tastier than those of the sea. That is why fresh water hilsa is more popular in Bangladesh.

**Keywords:** Hilsa fish, meristic, morphometric, proximate composition, *Tenualosa ilisha*

## Introduction
*Tenualosa ilisha*, known as hilsa belongs to the family clupeidae. It is a migratory and the national fish of Bangladesh [1]. Bangladesh harvests about 60% of world hilsa catch, it contributed 12.9 % of the country's total fish production in 2017-2018 with an estimated annual production of 517,198 tons, which was 1.0% to the GDP to support livelihoods of 1.2 million hilsa fishers of Bangladesh [2]. The upstream migration during the main breeding season depends largely on the commencement of the south- west monsoon and consequent flooding of the major rivers of Bangladesh, Burma and India. Hilsa is a valuable source of macro and micronutrients and play an important role to provide essential nutrients for the people of Bangladesh [3].

Morphometric measurements and meristic counts are considered as authentic method for the identification of a species which is termed as morphological systematics [4]. Morphometric characteristics are measurable characteristics of a species whereas meristic counts are countable characteristics such as, number of fin rays, spines, brancheostegal rays, scales on lateral line etc. Morphometric and meristic characteristics have been commonly used in fishery biology as powerful tools for measuring discreteness and relationship among various taxonomic categories [5, 6].

Biochemical composition of fish flesh is a good indicator for the fish quality, physiological condition and habitat of any fish [7, 8, 9]. Fish of various species don't provide the same nutrient profile to their consumers and the nutritive value of a fish varies with habitat, stage of life cycle, sex and seasons [10]. Moisture, ash, protein, lipid, vitamins and minerals are the most important components that act as sources of nutritive value of fish meat [11]. Quantifying proximate composition is important in ensuring the requirements of food regulations and commercial specifications [12]. Moisture content of flesh is a good indicator of its relative content of energy, protein and lipid [7]. Fish meat contains significantly low lipids and higher water than beef or chicken and is favoured over other white or red meats [13].

The total lipid and ash content of fish vary with the increasing weight or length of the fish; it may also vary with the season and varied habitats [12]. Among the proximate composition, protein in fish is the excellent source, because of the amino acid composition and degree of digestibility [14]. There is lack of information about the morphometric and meristic characteristics. Proximate composition of fish varied widely from species to species and even within the same species from one individual to another. Several literatures were available on proximate, mineral and fatty acid composition of hilsa fish [3, 15, 16]. Therefore, the aim of the present study was to compare morphometric, meristic and proximate composition between freshwater and marine hilsa fish.

## Materials and Methods

### Sample collection

Specimens of both freshwater and marine hilsa were collected from Sandhya river, Barishal and Chittagong Port respectively. At least 25 specimens from both varieties were collected and brought to the Limnology and fisheries Laboratory, Department of Zoology, Jahangirnagar University. Specimens were analyzed in fresh condition without using any preservatives for morphometric and meristic comparison. Then, all specimens were carried to the Institute of Food and Radiation Biology (IFRB), Atomic Energy Research Establishment (AERE), Savar, Dhaka to conduct research on proximate composition comparison of both freshwater and marine hilsa.

### Morphometric data measurements

Different measurements of the specimens were considered in this study following the method described by Lagler *et al.* [17].

### Meristic data measurements

Various countable characteristics such as number of rays in different fins, number of scales above and below lateral line, number of scales on lateral line were recorded. The lateral line of both freshwater and marine hilsa is consist of 45-47 scales on median lateral series, 17- 19 in transverse series [18]. In this study, the lateral line was recorded separately as no. of scales on medial lateral line (L1) and lateral line transverse (Ltr).

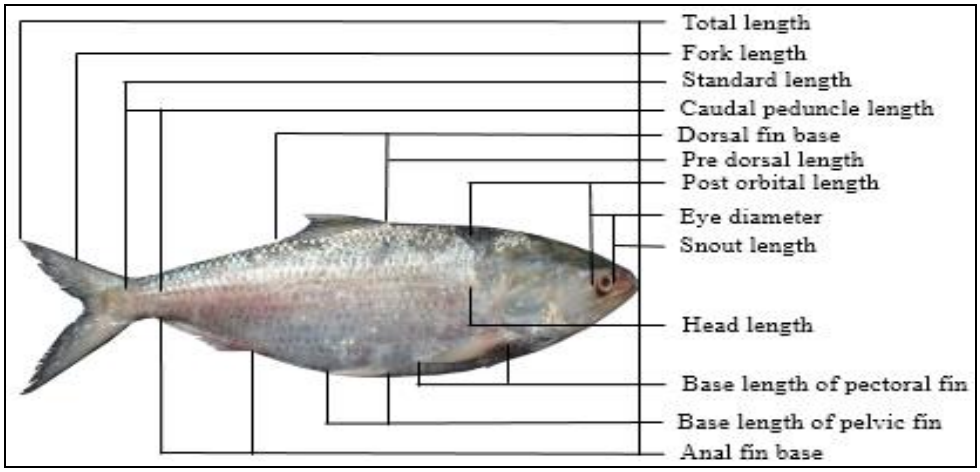


**Fig 1:** Different morphometric measurements of *Tenualosa ilisha*

### Taxonomic formula

The taxonomic formula of freshwater (Fig. 2) and marine hilsa (Fig. 3) *Tenualosa ilisha* are as follows [18, 19]:

Freshwater hilsa: Br. VI; D. 17-20; $P_1$. 14-16; $P_2$. 8-9; A. 18-23; C. 19; Ll. 45-49; Ltr. 17-20; Scute (16-18) + (12-15)

Marine hilsa: Br. VI; D. 17-19; $P_1$. 15; $P_2$. 8; A. 20-23; C. 19-20; Ll. 46-48; Ltr. 15-19; Scute (17-18) + (13-15)

**Fig 2:** Freshwater hilsa fish, *Tenualosa ilisha*

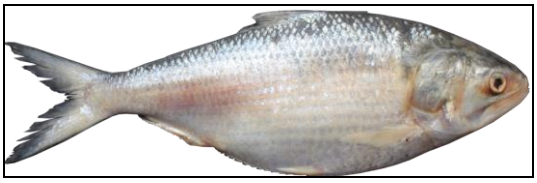

**Fig 3:** Marine hilsa fish, *Tenualosa ilisha*

### Proximate analysis

Fresh muscles were collected from both freshwater and marine hilsa for comparative proximate such as moisture, protein, lipid ash and mineral contents following standard [11, 12, 20].

## Results and Discussion

### Morphometric and meristic analysis

Morphometric and meristic characteristics of freshwater and marine hilsa, *Tenualosa ilisha* are listed in Table 1, 2 and 3. The present study showed that the mean Total length (TL) of marine hilsa fish were 36.25 cm which is higher than freshwater hilsa fish (34.36 cm). The standard length was 28.7 cm in marine and 27.04 cm in freshwater hilsa. The fork length and caudal peduncle length shows higher value in marine hilsa fish than that of freshwater variety. In case of head length, eye diameter, snout length, post orbital length, pre dorsal length values were higher in marine variety than freshwater variety. Abdominal region length, dorsal fin base length, height of ventral fin, upper jaw length shows higher value in marine hilsa. But anal fin base length and Anal fin base length did not vary greatly in both varieties (Table 1).

**Table 1:** Morphometric characteristics of freshwater and marine hilsa, *Tenualosa ilisha* (n=25)

| Characteristics | Mean ± SD (cm) | |
|---|---|---|
| | Freshwater Hilsa | Marine Hilsa |
| Total length (TL) | 34.36 ± 0.75 | 36.25 ± 2.09 |
| Fork length (FL) | 29.98 ± 0.27 | 31.74 ± 2.28 |
| Standard length (SL) | 27.04 ± 0.12 | 28.7 ± 1.78 |
| Caudal peduncle length (CpL) | 2.15 ± 0.12 | 2.28 ± 0.25 |
| Head length (HL) | 8.25 ± 0.13 | 8.76 ± 0.13 |
| Eye diameter | 1.35 ± 0.03 | 1.45 ± 0.06 |
| Snout length (SnL) | 1.9 ± 0.25 | 2.21 ± 0.06 |
| Post orbital length | 5.2 ± 0.19 | 5.9 ± 0.12 |
| Pre dorsal length | 13.58 ± 0.15 | 13.61 ± 0.88 |
| Abdominal region length | 13.52 ± 0.12 | 15.36 ± 0.82 |
| Dorsal fin base length | 4.75 ± 0.06 | 4.88 ± 0.44 |
| Anal fin base length | 4.88 ± 0.06 | 4.88 ± 0.44 |
| Height of pectoral fin | 5.14 ± 0.06 | 5.14 ± 0.19 |
| Height of ventral fin | 3.17 ± 0.13 | 3.33 ± 0.05 |
| Upper jaw length | 2.21 ± 0.06 | 2.41 ± 0.13 |

As the morphometric characteristics may vary on according to age, growth, food and physiological conditions of fish. So, there is a need to justify the meristic and body proportions of fish to find the accuracy of taxonomic identity of the species [4]. According to the present study, there is a difference between the body proportions of freshwater and marine hilsa fish. The TL and CpL, SL and CpL of hilsa fish was found different in both varieties, but TL and SL, TL and FL and SL and FL of both varieties shows little difference. SnL, eye diameter, post orbital length shows higher proportions in freshwater hilsa fish in proportion with HL, but the proportions of HL and dorsal fin base shows the opposite (Table 2).

**Table 2:** Body proportions of freshwater and marine hilsa, *Tenualosa ilisha* (n=25)

| Characteristics | Mean ± SD (cm) | |
|---|---|---|
| | Freshwater Hilsa | Marine Hilsa |
| TL: SL | 1.27 ± 0.003 | 1.26 ± 0.005 |
| TL: FL | 1.14 ± 0.008 | 1.14 ± 0.01 |
| SL: FL | 0.9 ± 0.004 | 0.9 ± 0.009 |
| TL: CpL | 15.99 ± 0.89 | 15.93 ± 0.86 |
| SL: CpL | 12.58 ± 0.67 | 12.6 ± 0.63 |
| HL: SnL | 4.39 ± 0.65 | 3.95 ± 0.57 |
| HL: Post orbital | 1.58 ± 0.06 | 1.48 ± 0.01 |
| HL: Dorsal fin base | 1.73 ± 0.05 | 1.8 ± 0.13 |
| HL: Eye diameter | 6.1 ± 0.25 | 6.02 ± 0.18 |

Different meristic characteristics such as, number of rays in dorsal fin, pectoral fin, pelvic fin, anal fin and caudal fin, lateral line scales, branchiostegal and scutes were studied. Present study showed that, both types of hilsa fish had the similar number of dorsal fin rays, pelvic fin rays, caudal fin rays, branchiostegals and pre pelvic scutes. Anal fin rays and post pelvic scutes are maximum in number in marine hilsa fish. Lateral line scales and lateral line transverse shows higher in freshwater hilsa (Table 3).

**Table 3:** Various meristic characteristics of freshwater and marine hilsa, *Tenualosa ilisha* (n=25)

| Characters | Freshwater Hilsa | Marine Hilsa |
|---|---|---|
| Dorsal fin rays (D) | 17-20 (19) | 17-19 (19) |
| Pectoral fin rays (P1) | 14-16 (14) | 15 |
| Pelvic fin rays (P2) | 8-9 (8) | 8 (8) |
| Anal fin rays (A) | 18-23 (19) | 20-23 (20) |
| Caudal fin rays (C) | 19 | 19-20 (19) |
| Lateral line scales (L.l) | 45-49 (48) | 46-48 (47) |
| Lateral line transverse (L.tr) | 17-20 (20) | 15-19 (17) |
| Branchiostegals (Br) | Vi | Vi |
| Scutes | (16-18) + (12-15) | (17-18) + (13-15) |
| Prepelvic scutes | 16-18 (17) | 17-18 (17) |
| Postpelvic scutes | 12-15 (13) | 13-15 (14) |

So, considering the results, it may be concluded that the taxonomic keys of both hilsa would be as follows:

Freshwater hilsa: Br. VI; D. 17-20; $P_1$. 14-16; $P_2$. 8-9; A. 18-23; C. 19; L.l. 45-49; L.tr. 17-20; Scute (16-18) + (12-15).

Marine hilsa: Br. VI; D. 17-19; $P_1$. 15; $P_2$. 8; A. 20-23; C. 19-20; L.l. 46-48; L.tr. 15-19; Scute (17-18) + (13-15).

**Proximate analysis**

Moisture contents in many fish and shell fish varies between 60 and 80 per cent. The present results showed that moisture content was highest (70 %) in fresh water fish then the marine fish 64.7 % (Fig 4). Debnath *et al.* [15] reported similarly that riverine hilsa contained relatively more moisture (61.01%) than marine fishes (58.91%). Begum *et al.* [16] also found that moisture contents of hilsa fish were ranged from 66.94 to 72.04 %.

Protein is the most important constituent of fish from the nutritional point of view. It varies from 18 to 25 % even though in exceptional cases the values (9%) are encountered in the Bombay duck. In the present study, the protein contents of freshwater and marine hilsa were 18.07 % and 20.06 % respectively (Fig 4), whereas Debnath *et al.* [15] found differences in protein content in freshwater (17.37%) and marine hilsa (16.17%).

Lipid content of fish muscle shows wide variation from 0.2% to 60-65%. Hilsa fish regards as fatty fish because of high contents of lipid. In the present study, the lipid contents (13.8%) marine hilsa and (13.5%) freshwater hilsa were not significantly different (Fig 4). But Debnath *et al.* [15] found significantly higher lipid content (18.27%) in marine hilsa than freshwater hilsa.

The minerals present in the fish and varies between 0.4 to 2%. In the present study, the ash contents in marine (1.26%) and freshwater hilsa (1.23%) were not significantly different (Fig 4). Debnath *et al.* [15] stated that ash content in freshwater hilsa (2.04%) was higher than marine hilsa (1.69%). This variation noticed could have been due to variations in age, sex, and environment.

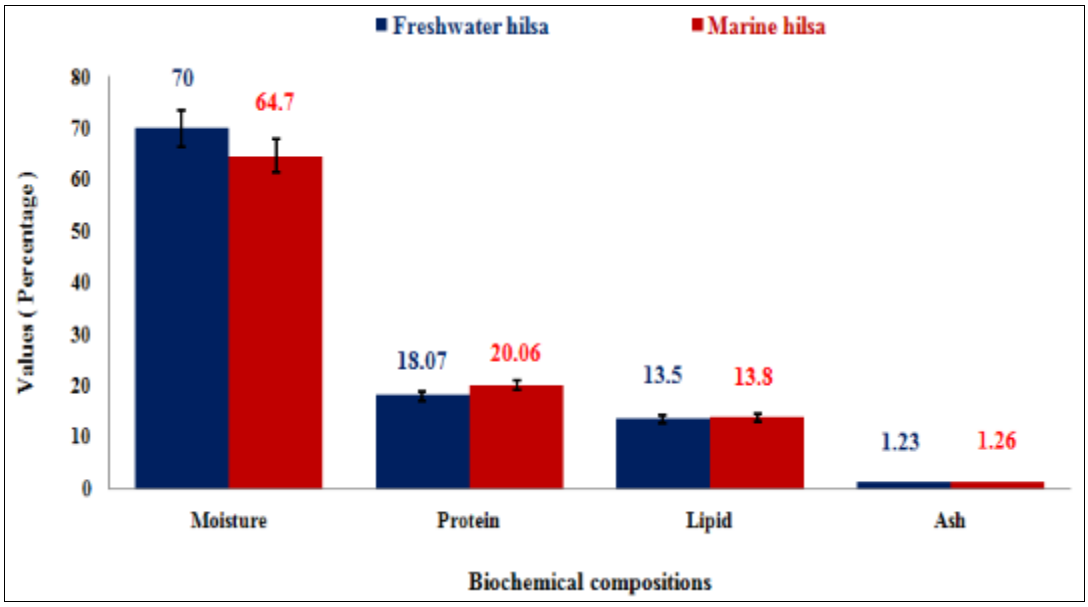


**Fig 4:** Biochemical compositions of fresh water and marine hilsa, *Tenualosa ilisha*

Calcium and phosphorus are the most important minerals content for growth and major constituent of the structural components of skeletal tissues. In the present experiment, calcium contents of freshwater fish were significantly higher (182.4 mg/100) than those of marine fishes (Fig 5). Debnath *et al.* [15] found higher calcium content (394.14 mg/100g) in marine hilsa than freshwater fishes. Begum *et al.* [16] recorded calcium content in hilsa fish ranged considerably from 144.21 to 372.67 mg/100 g. In the present study, phosphorus contents were 133 mg/100g 85.1 mg/100g in fresh water and marine hilsa, respectively (Fig 5). Debnath *et al.* [15] stated that the phosphorus content was higher in the freshwater hilsa (113.44mg/100g) than the marine hilsa (82.47mg/100g). Begum *et al.* [16] found phosphorus content in hilsa fishes collected from six regions of Bangladesh ranged from 118.17 to 204.06 mg/100 gm. Marine fish also showed large amount of iron (3.30 mg/100 gm) compare to fresh water fish (2.13 mg/100gm).

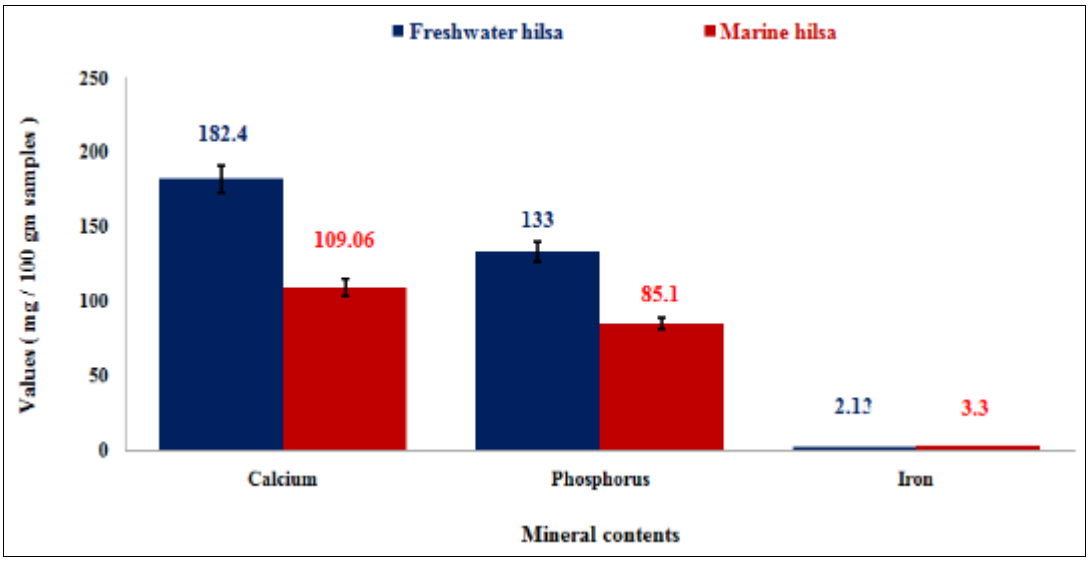


**Fig 5:** Minerals composition of freshwater and marine hilsa, *Tenualosa ilisha*

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